Fundamentals of Yarn and Fabric Forming   **X233204**

Program Name   :   Diploma in Textile Chemistry

Program Code   :   TC

Semester   :   Second

Course Title   :   Fundamentals of Yarn and Fabric Forming

Course code   :   X233204

I   RATIONAL

Diploma engineers (also called technologists) must deal with various textile materials and machines in industries. The study of basic concepts of yarn and fabric manufacturing like blow room, carding, combing, speed frame, ring frame, looms, warp, weft, etc. will help them understand the textile manufacturing processes where emphasis is laid on the applications of textile material. This course is developed in a way by which fundamental information will help diploma engineers apply the basic principles of yarn and fabric manufacturing in textile processing to solve broad-based problems.

II   INDUSTRY / EMPLOYER EXPECTED OUTCOME
Apply principles of yarn and fabric manufacturing process to produce fabric.

III   COURSE LEVEL LEARNING OUTCOMES (COS)
Students will be able to achieve & demonstrate the following COs on completion of course based learning
CO1 - Use pre-opening principles to deliver quality material for subsequent
CO2 - Apply the principles of spinning to produce the yarn.
CO3 - Select the relevant preparatory process to produce fabric.
CO4 - Apply the principle of interlacement of threads to produce plain woven fabric.
CO5 – Use the principle of design to reproduce the textile material.
CO6 – Apply the principle of interloping of threads to produce knitted fabric.

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Course Category	Actual Contact Hrs/ week			SLH	NLH	Credits	Paper Duration (hrs)	Theory				Based on LL and TL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
X233204	Fundamentals of Yarn and Fabric Forming	GE	2	0	3	1	6	3	3	30	70	100	40	25	10	25	10	25	10	175

Total IKS hours for semester: 2 Hrs.
Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
 FA-TH represents average of two class tests of 30 marks each conducted during the semester.
1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V   **THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
		SECTION I	
1	TLO 1.1 Explain cultivation process for the given textile fiber. TLO 1.2 Describe the objectives of pre-opening for the given fiber. TLO 1.3 Classify the given textile fibers. TLO 1.4 Sketch the process flow chart for the specified type of yarn.	**Unit - I Pre-opening** 1.1 Textile fiber: definition, Essential properties and classification. 1.2 Traditional Cotton cultivation and hand picking. (IKS) 1.3 Pre cleaning: objects of pre ginning and ginning. 1.4 Flow chart for carded, combed and double yarn.	Chalk-Board Video Demonstrations Cooperative Learning Site/Industry Visit
2.	TLO 2.1 Explain the objectives of the blow room, carding, draw frame, sliver lap and ribbon lap, comber, speed frame, and ring frame. TLO 2.2 Describe the procedure to apply the principles of spinning to produce the given type of yarn. TLO 2.3 Distinguish the features of the given types of yarns.	**Unit - II Yarn Spinning** 2.1 Objectives and working of blow room, carding, draw frame, sliver lap and ribbon lap, comber, speed frame, ring frame. 2.2 Yarn manufacturing process, ring frame machine elements. 2.3 Classification of Yarn: single yarn, double yarn, staple yarn, hosiery yarn, 2.2 open end yarn, ring yarn.	Chalk-Board Video Demonstrations Cooperative Learning Site/Industry Visit
3.	TLO 3.1 Describe the specified objectives of the weaving process. TLO 3.2 Differentiate between the given types of process flow charts. TLO 3.3 Classify types of looms based on the given parameters. TLO 3.4 Select the relevant method to produce the given type of fabric.	**Unit - IV Preparatory Elements of Weaving** 3.1 Fabric Components: warp, weft. Objects: of Winding, warping, sizing, drawing-In, pirn winding, weaving. 3.2 Process flow charts: a) Grey fabric b) Mono color fabric (dyed warp and gray weft), c) Warp or weft stripes d) pattern. 3.3 Classification of looms. 3.4 Methods to produce fabric: weaving, knitting, braiding, non-woven.	Chalk-Board Video Demonstrations Cooperative Learning Site/Industry Visit

		SECTION II	
4.	TLO 4.1 Identify cone specifications for the given cone dyeing situation. TLO 6.1 Describe the design process for the given fabric. TLO 4.2 Predict the effect of creel capacity on warping in the specified machine. TLO 4.3 Identify the quality requirement of warping beam for the specified process. TLO 4.4 Explain the function of the specified objects of drawing-In process. TLO 4.5 Explain passage of warp through weaving machine.	**Unit - V Principles of Weaving** 4.1 Types of winding, winding package; cone, cheese, its specification. 4.2 Objects and passage of warp through Warping, Sizing, Drawing-In process. 4.3 Weaving: Primary motion, Secondary motion and Auxiliary motions. 4.4 Fabric inspection and fabric defects.	Chalk-Board Video Demonstrations Cooperative Learning Site/Industry Visit
5.	TLO 5.1 Describe the design process for the given fabric. TLO 5.2 Estimate draft plan for the given fabric design. TLO 5.3 Estimate lifting plan for the given fabric design. TLO 5.4 Describe the designing process to produce fabric from the given fabric sample.	**Unit - VI Fabric Structure** 5.1 Method to represent on paper design, draft and peg plan. 5.2 Interlacement Diagram 5.3 Design, draft and peg plan for Plain, Twill, Sateen and Satin. 5.4 Concept of crimp and cover factor.	Chalk-Board Video Demonstrations Cooperative Learning Site/Industry Visit
6.	TLO 6.1 Explain how knitting is classified TLO 6.2 Describe different Latch, Bearded and compound needle used in knitting TLO 6.3 Explain Knitting cycle of Latch, Bearded and compound needle TLO 6.4 State properties of Single jersey, interlock, rib and purl fabrics TLO 6.5 State properties of tricot and raschel fabrics TLO 6.6 Compare woven and knitted fabrics TLO 6.7 Compare Warp and Weft knitted fabrics TLO 6.8 Describe design process for given weft knitted fabric TLO 6.9 Estimate graphical representation, cam arrangement and needle arrangement of given weft knitted fabric	**Unit - VI Principles of Knitting** 6.1 Classification of Knitting, Types of Needles and Knitting Cycle 6.2 Weft Knitted fabric and their properties – Single Jersey, Interlock, Rib and Purl 6.3 Warp Knitted fabrics and their properties – Tricot and Raschel 6.4 Compression of woven and Knitted fabric, weft knitted and warp knitted fabric 6.5 Weft knitted structure and application.	Chalk-Board Video Demonstrations Cooperative Learning Site/Industry Visit

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Observe and note passage of cotton through blow room line. LLO 1.2 Trace the passage of cotton through the blow room line on a sheet of paper.	1	** Use blow room machines for opening and cleaning of cotton.	3	CO1
LLO 2.1 Trace passage of material through carding machine. LLO 2.2 Observe and enlist various settings affecting quality and productivity. LLO 2.3 Trace passage of material through carding machine. LLO 2.4 Observe and enlist carding machine setting affecting quality and productivity of machine. LLO 2.5 Trace passage of cotton through carding machine. LLO 2.6 observe and enlist various setting affecting quality and productivity	2	* Use carding machine to perform individualization and paralysation of cotton to prepare sliver.	3	CO2
LLO 3.1 Trace passage of material through draw frame machine. LLO 3.2 Enlist various settings affecting the quality and productivity of the draw frame.	3	* Use draw frame machine for drafting and attenuation of cotton sliver	3	CO2
LLO 4.1 Trace passage of material through Fly frame machine. LLO 4.2 Enlist fly frame settings affecting Roving quality.	4	. Use fly frame machine for drafting, twisting and winding process to prepare rove.	3	CO2
LLO 5.1 Trace passage of material through Ring frame machine.	5	* Use Ring frame machine for drafting, twisting and winding to prepare given count of yarn.	3	CO2
LLO 6.1 Trace passage of yarn through Drum winding machine. LLO 6.2 Perform Knotter/ Splicer settings to join the yarn.	6	* Use winding machine to convert smaller package to bigger package.	3	CO3
LLO 7.1 Trace passage of material through Beam Warping / Sectional machine. LLO 7.2 Enlist and sketch the important components of warping machine.	7	Use warping machine to prepare warpers beam.	3	CO3
LLO 8.1 Trace passage of yarn through Pirn winding machine.	8	Use Pirn winding machine to prepare pirn for weaving process	3	CO3
LLO 9.1 Observe and enlist various types of weaving machines used. LLO 9.2 Enlist various types of fabric produced on the given type of weaving machine.	9	*Use weaving machines to produce given type of fabric.	3	CO4
LLO 10.1 Trace the passage of warp sheet	10	* Use power looms to correlate the	3	CO4

through power loom. LLO 10.2 trace the thread interlacement diagram.		principles of fabric manufacturing process.		
LLO 11.1 Trace Primary, secondary and auxiliary motion used on loom.	11	* Use power looms to trace various types of motion used on loom.	3	CO4
LLO 12.1 Use the given fabric sample to draw the design, draft, and peg plan.	12	* Use woven fabric samples to identify warp, weft and interlacement pattern	3	CO5
LLO 13.1 Calculate EPI, PPI, crimp, cover factor and GSM of given fabric sample.	13	*Use woven fabric samples to estimate crimp, cover factor GSM and GLM.	3	CO5
LLO 14.1 Use the given fabric sample to draw the design, draft, and peg plan.	14	* Use woven fabric samples to identify warp, weft and interlacement pattern	3	CO5
LLO 15.1 Observe and enlist various types of Knitting machines used. LLO 15.2 Enlist various types of fabric produced on the given type of Knitting machine.	15	*Use Knitting machines to produce given type of fabric	3	CO6
LLO 16.1 Use the given fabric sample to draw the line diagram, graphical representation, cam arrangement and needle arrangement.	16	* Use weft knitted fabric samples to identify wale, course and interloping pattern	3	CO6
LLO 17.1 Use the given fabric sample to draw the line diagram, graphical representation, cam arrangement and needle arrangement.	17	* Use weft knitted fabric samples to identify wale, course and interloping pattern	3	CO6
Note: Out of above suggestive LLOs - • '*' Marked Practical (LLOs) Are mandatory. • Minimum 80% of above list of lab experiment are to be performed. • Judicial mix of LLOs is to be performed to achieve desired outcomes.				

VII - SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

Self-Learning

Following are some suggestive self-learning topics:
• Collect information on recent developments in weaving machinery along with their specifications. Collect woven samples with various weaves and write the information on the same.
• Collect information on recent developments in spinning machinery along with their specifications.
• Collect photographs of the yarn manufacturing machines and prepare a presentation by listing the objectives of each process.
• Collect Photographs of various Shedding devices and prepare a presentation.

Micro project
• Prepare flow chart diagrams for various fabric-producing processes and write objectives of various loom motions. (Group of 4-5 students)

- Yarn spinning: Collect different types of yarn samples and prepare a booklet providing information related to the collected samples. (Group of 4-5 students)
- Weaving: Collect different types of woven fabric samples and prepare a booklet providing information related to the collected samples. (Group of 4-5 students)
- Knitting: Collect different types of Knitted samples and prepare a booklet providing information related to the collected samples. (Group of 4-5 students)

VIII – LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
1	Laxmi Machine Works Blow Room	LLO1
2	Laxmi Machine Works Carding	LLO2
3	Laxmi Machine Works Draw Frame	LLO3
4	Laxmi Machine Works Speed Frame	LLO4
5	Laxmi Machine Works Ring Frame	LLO5
6	Cone Wing machine	LLO6
7	Beam Warping machine	LLO7
8	Pirn Winding machine	LLO8
9	Power loom	LLO9,10,11
10	Pick glass, needle, graph paper	LLO12,13,14
11	Well Knit single jersey weft knitting machine	LLO15
12	Pick glass, needle, graph paper	LLO16,17

IX SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R- Level	U- Level	A– Level	Total Marks
1	I	Pre-Opening	CO1	2	2	2	6	10
2	II	Yarn Spinning	CO2	6	4	2	6	12
3	III	Preparatory Elements of Weaving	CO3	4	4	2	6	12
4	IV	Principles of Weaving	CO4	6	4	2	6	12
5	V	Fabric Structure	CO5	6	4	2	6	12
6	VI	Principles of Knitting	CO6	6	4	2	6	12
				30	0	0	0	70

X ASSESSMENT METHODOLOGY /TOOLS

Formative assessment (Assessment for Learning)

Mid Term Test,
Micro Projects and
assignments Rubrics
Each practical will be assessed considering 60% weightage to process and 40% weightage to product.

Summative Assessment (Assessment of Learning)

End Term Examination
Laboratory Performance

XI SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Lifelong learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	2	-	-	2	3	-	1
CO2	3	1	1	2	-	-	2	3	1	2
CO3	3	1	1	2	-	-	2	3	1	2
CO4	3	2	2	-	-	-	2	3	2	-
CO5	3	2	2	-	-	-	1	3	2	-
CO6	3	2	2	2	-	-	2	1	2	2
Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping										
PROGRAM SPECIFIC OUTCOMES (PSO's) (What s/he will continue to do in the textile technology specific industry soon after diploma programme)										
PSO 1: Perform preparatory, colouration and finishing of Textiles using various relevant technologies.										
PSO 2: Perform Quality evaluation of textiles, Fibers, Yarns, Fabrics, Dyes and Chemicals using various standard test methods .										
PSO 3: Maintain various textile machines to produce various types of quality textiles at optimum and sustainable cost.										

XII SUGGESTED LEARNING RESOURCES / BOOKS

Sr. No.	Author	Title	Publisher
1	Klein Werner	The Technology of short staple spinning	The Textile Institute ISBN : 1 87081298 8
2	Salotra K.R	Spinning of Manmade and Blends on cotton spinning	The Textile Association Of India, ISBN :81 89328 00 X
3	Eric Oxberg	Spun Yarn Technology	Butterworths (Publishers) Limited, 1983, ISBN :0-408014644
4	Lord P.R	Weaving Conversion of Yarns to Fabric	Woodhead Publication ISBN :1 855734834
5	Marks & Robbinson	Principle Of Weaving	The Textile Institute, ISBN :0-900739797
6	Ambumani N	Knitting Fundamentals, Machines, Structures and Developments	New Age International Private Ltd. ISBN 978-8-12241-954-2.

XIII LEARNING WEBSITES AND PORTALS

Sr. No.	Links / Portals	Description
1	http://www.textileschool.com/articles/109/blow-room-functions	Blow Room Function
2	www.textileword.com	animated videos of various textile machines
3	https://en.wikipedia.org/wiki/Cotton_gin	Cotton Ginning Process
4	http://nptel.ac.in/courses/116102005/48	Over all textile manufacturing process
5	http://nptel.ac.in/courses/116102005/49	Over all textile manufacturing process
6	http://gluedideas.com/Encyclopedia-Britannica-Volume-6- Part-2-Colebrooke-Damascius/Cotton-Ginning	Cotton ginning methods
7	http://www.rieter.com/cz/rikipedia/articles/rotor-spinning/a pplications-engineering/preparation-of-r	cotton spinning system
8	http://www.rieter.com/cz/rikipedia/articles/rotor-spinning/a pplications-engineering/preparation-of-r	cotton spinning system
9	https://textilelearner.blogspot.com/2011/05/knitting-cycle-of-single-jersey-latch_1244.html	Knitting
10	https://nptel.ac.in/courses/116102005/1	Knitting

XIV   COURSE CURRICULUM DEVELOPMENT COMMITTEE
   Faculty Members from Polytechnics

Sr. No	Name & Designation	Institute	Contact No.	Email ID
1.	Mr. S.S. Joglekar Sr. Lecturer (Selection Grade)	Sasmira's Institute of Man-made Textiles, Worli, Mumbai – 30.	9833909871	shirishjoglekar@sasmira.edu.in

Fundamentals of ICT   C235207

Program Name	:	**Diploma in Textile Technology / Diploma in Textile Chemistry / Diploma in Knitting Technology**

Program Code	:	**TT / TC /KT**

Semester	:	**Second**

Course Title	:	**Fundamentals of ICT**

Course code	:	**C235207**

I   RATIONAL

In any typical business setup in order to carry out routine tasks related to create business documents, perform data analysis and its graphical representations and making electronic slide show presentations, the student need to learn various software as office automation tools like word processing applications, spreadsheets and presentation tools. They also need to use these tools for making their project reports and presentations. The objective of this course isto develop the basic competency in students for using these office automation tools to accomplish the job. Thiscourse also presents an overview of emerging technologies so that students of different discipline can appraise the applications of these technologies in their respective domain.

II   INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcome through various teaching learning experiences: 1) Use computers for Internet services, Electronics Documentation, Data Analysisand Slide Presentation. 2) Appraise Application of ICT based Emerging Technologies.in different domain.

III   COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 - Use computer system and its peripherals for given purpose

CO2 - Prepare Business document using Word Processing Tool

CO3 - Analyze Data and represent it graphically using Spreadsheet

CO4 - Prepare professional Slide Show presentations

CO5 - Use different types of Web Browsers and Apps

CO6 - Explain concept and applications of Emerging Technologies

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Course Category	Learning Scheme					Credits	Assessment Scheme												Total Marks
			Actual Contact Hrs/ week			SLH	NLH		Paper Duration (hrs)	Theory				Based on LL and TSL				Based on SL		
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
C235207	Fundamentals of ICT	SEC	0	0	3	1	3	1.5	0	0	0	0	0	0	0	25	10	0	0	25

Total IKS hours for semester: 0 Hrs.

Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

 FA-TH represents average of two class tests of 30 marks each conducted during the semester.

1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V   THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
SECTION I			
1	TLO 1.1 Explain the functions of components inthe block diagram of computer system. TLO 1.2 Classify the giventype of software TLO 1.3 Explain characteristics of the given type of network TLO 1.4 Describe application of the given typeof network connecting device TLO 1.5 Describe procedure to manage a file /folder in the given way.	**Unit - I Introduction to Computer System** 1.1 Basics of Computer System: Overview of Hardware and Software: block diagram of Computer System, Input/Output unit CPU, Control Unit, Arithmetic logic Unit (ALU), Memory Unit 1.2 Internal components: processor, motherboards, random access memory (RAM), read-only memory (ROM), video cards, sound cards and internal hard disk drives) 1.3 External Devices: Types of input/output devices, types of monitors, keyboards, mouse, printers: Dot matrix, Inkjet and LaserJet, plotter and scanner, external storage devices CD/DVD, Hard disk and pen drive 1.4 Application Software: word processing, spreadsheet, database management systems, control software, measuring software, photo-editing software, video-editing software, graphics manipulation software System Software compilers, linkers, device	Hands-on Demonstration Presentations

		drivers, oper 1.5 Network environments: network interface cards, hubs, switches, routers and modems, concept of LAN, MAN, WAN, WLAN, Wi-Fi and Bluetooth 1.6 Working with Operating Systems: Create and manage file and folders, Copy a file, renaming and deleting of files and folders, Searching files and folders, application installation, creating shortcut of application on the desktop.	
2.	TLO 2.1 Write steps to create the given text document. TLO 2.2 Explain the given feature for document editing. TLO 2.3 Explain the given page setup features of a document. TLO 2.4 Write the given table formatting feature. TLO 2.5 Write the steps to set the given type of document layout	**Unit - II Word Processing** 2.1 Word Processing: Overview of Word processor Basics of Font type, size, colour, Effects like Bold, italic, underline, Subscript and superscript, Case changing options, previewing a document, Saving a document, Closing a document and exiting application. 2.2 Editing a Document: Navigate through a document, scroll through text, Insert and delete text, Select text, Undo and redo commands, Use drag and drop to move text, Copy, cut and paste, Use the clipboard, Clear formatting, Format and align text, Formatting 2.3 Changing the Layout of a Document: Adjust page margins, change page orientation, create headers and footers, Set and change indentations, Insert and clear tabs 2.4 Inserting Elements to Word Documents: Insert and delete a page break, insert page numbers, Insert the date and time, insert special characters (symbols), Insert a picture from a file, Resize and reposition a picture 2.5 Working with Tables: Insert a table, convert a table to text, Navigate and select text in a table, Resize table cells, Align text in a table, Format a table, Insert and delete columns and rows, Borders and shading, Repeat table headings on subsequent page	Hands-on Demonstration Presentations

		2.6 Working with Columned Layouts and Section Breaks: a Columns, Section breaks, Creating columns, Newsletter style columns, Changing part of a document layout or formatting, Remove section break, Add columns to remainder of a document, Column widths, Adjust	
3.	TLO 3.1 Write steps tocreate the given spreadsheet. TLO 3.2 Explain the givenformatting feature of a worksheet. TLO 3.3 Write steps to insert formula and functionsin the given worksheet. TLO 3.4 Write steps to create charts for the givendata set. TLO 3.5 Explain steps to perform data filter, sort andvalidation operations on thegiven data set. TLO 3.6 Write steps tosetup and print a spreadsheet.	**Unit - III Spreadsheets** 3.1 Working with Spreadsheets: Overview of workbook and worksheet, Create Worksheet Entering sample data, Save, Copy Worksheet, Delete Worksheet, Close and openWorkbook. 3.2 Editing Worksheet: Insert and select data, adjust row height and column width, delete, move data, insert rows and columns, Copy and Paste, Find and Replace, Spell Check, Zoom In-Out, Special Symbols, Insert Comments, Add Text Box, Undo Changes, - Freeze 3.3 Formatting Cells and sheet: Setting Cell Type, SettingFonts, Text options, Rotate Cells, Setting Colors, Text Alignments, Merge and Wrap, apply Borders and Shades, Sheet Options, Adjust Margins, Page Orientation, Header and Footer, Insert Page Breaks, S 3.4 Working with Formula: Creating Formulas, Copying Formulas, Common spreadsheet Functions such as sum, average, min, max, date, In, And, or, mathematical functions such as sqrt, power, applying conditions usingIF. 3.5 Working with Charts: Introduction to charts, overview of different types of charts, Bar, Pie, Line charts, creating and editing charts. Using chart options: chart title, axis title, legend, data labels, Axes, grid lines, moving chart in a separate sheet. 3.6 Advanced Operations: Conditional Formatting, Data Filtering, Data Sorting, Using Ranges, Data Validation, Adding Graphics, Printing Worksheets, print area, margins, header, footer and other page setup	Hands-on Demonstration Presentations

		options.	
		SECTION II	
	TLO 4.1 Write the steps tocreate the given slide presentation. TLO 4.2 Write the steps to insert multiple media in thegiven presentation. TLO 4.3 Explain the method of including animation, transition effectsin slide show. TLO 4.4 Write steps to apply table features in thegiven presentation TLO 4.5 Write steps to manage charts in the given presentation	**Unit - IV Presentation Tool** 4.1 Creating a Presentation: Outline of an effective presentation, Identify the elements of the User Interface, Starting a New Presentation Files, Creating a Basic Presentation, Working with textboxes, Apply Character Formats, Format Paragraphs, View a Prese 4.2 Inserting Media elements: Adding and Modifying Graphical Objects to a Presentation - Insert Images into a Presentation, insert audio clips, video/animation, Add Shapes, Add Visual Styles to Text in a Presentation, Edit Graphical Objects on a Slide, Format 4.3 Working with Tables: Insert a Table in a Slide, Format Tables, and Import Tables from Other Office Applications. 4.4 Working with Charts: Insert Charts in a Slide, Modifya Chart, Import Charts from Other Office Applications.	Hands-on Demonstration Presentations
	TLO 5.1 Explain use of thegiven setting option in browsers. TLO 5.2 Explain the given option used for effective searching in search engine TLO TLO5.3 Explain features ofthe given web service. TLO 5.4 Explain conceptsand applications of emerging technologies TLO 5.5 Use various elementary cloud-based tools.	**Unit - V Basics of Internet and Emerging Technologies** 5.1 World Wide Web: Introduction, Internet, Intranet, Cloud, Web Sites, web pages, URL, web servers, basic settings of web browsers- history, extension, default page,default search engine, creating and retrieving bookmarks, use search engines effectively for 5.2 Web Services: e-Mail, Chat, Video Conferencing, e-learning, e-shopping, e-Reservation, e-Groups, Social Networking 5.3 Emerging Technologies: IOT, AI and ML, Drone Technologies,3D Printing. 5.4 Tools: Docs, Drive, forms, quiz, Translate and otherApps	Hands-on Demonstration Presentations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Identify various Input/output devices, connections and peripherals of computer system LLO 1.2 Work with Computer System, Input/output devices, and peripherals for manages files and folders for data storage.	1	* a) Work with Computer System, Input/output devices, and peripherals. b)Work with files and folders	2	CO1
LLO 2.1 Create and manage word document. LLO 2.2 Apply formatting features on text at line, paragraph and page level.	2	*Work with document files: a) Create, edit and save document in Word Processing. b) Text, lines and paragraphlevel formatting	2	CO2
LLO 3.1 Insert and edit images, shapes in a document file	3	Work with Images and Shapes in Word Processing.	2	CO2
LLO 4.1 Insert table and apply various tableformatting features on it.	4	*Work with tables in Word Processing.	2	CO2
LLO 5.1 Apply page layout features in wordprocessing. LLO 5.2 Print a document by applying various print options LLO 5.3 Use mail merge in word processing	5	*Working with layout and printing a) Document page layout, Themes, and printing. b) Use of mail merge with options.	2	CO2
LLO 6.1 Enter and format data in a worksheet. LLO 6.2 Insert and delete cells, rows and columns LLO 6.3 Apply alignment feature on cell	6	*Create, open and edit Worksheet.	2	CO3
LLO 7.1 Create formula and "If" condition on cell data LLO 7.2 Apply various functions and named ranges in worksheet.	7	*Formulas and functions in Worksheet.	2	CO3
LLO 8.1 Implement data Sorting, Filtering and Data validation features in a worksheet.	8	*Sort, Filter and validate data in Spreadsheet.	2	CO3
LLO 9.1 Create charts using various chart options in spreadsheet.	9	*Charts for Visual Presentation in Spreadsheet.	2	CO3
LLO 10.1 Print the worksheet by applying various print options for worksheet	10	Worksheet Printing.	2	CO3
LLO 11.1 Apply design themes to the givenpresentation LLO 11.2 Insert pictures text/images/shapesin slide LLO 11.3 Use pictures text/images/shapes editing options.	11	*Make Slide Show Presentation.	2	CO4
LLO 12.1 Add tables and charts in the slides.				

LLO 12.2 Run slide presentation in differentmodes LLO 12.3 Print slide presentation as handouts/notes	12	*Use Tables and Charts in Slide	2	CO4
LLO 13.1 Apply animation effects to the text and slides LLO 13.2 Add/set audio and video files in the presentation.	13	*a) Insert Animation effects to Text and Slides. b) Insert Audio and Video files inpresentation	2	CO4
LLO 14.1 Configure internet connection ona computer system LLO 14.2 Use different web services on internet	14	a) Internet connection configuration b)Use Internet and Web Services.	1	CO5
LLO 15.1 Configure different browser settings LLO 15.2 Use browsers for the given purpose	15	Working with Browsers.	1	CO5
LLO 16.1 Create web forms for survey using different options.	16	*Prepare Web Forms for Survey.	1	CO5
LLO 17.1 Create web forms for Quiz using different options	17	*Prepare Web Forms for Quiz	1	CO5

Note : Out of above suggestive LLOs -
- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII - SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

Self-Learning

Following are some suggestive self-learning topics: 1) Use ChatGPT/any other AI tool to explore information. 2) Use Calendar to Schedule and edit activities. 3) Use Translate app to translate the given content from one language toanother. 4) Use cloud based storage drive to store and share your files.

Micro project

The microproject has to be industry application based, internet-based, workshop-based, laboratory-based or field- based as suggested by Teacher. 1) Perform a survey on various input and output devices available in market and make its report. 2) Prepare Time Table, Prepare Notes on Technical Topics, Reports, Biodata with covering letter (Subject teacher shall assign a document to be prepared by each students) 3) Prepare slides with all Presentation features such as: classroom presentation, presentation about department, presentation of Technical Topics. (Subject teacher shall assign a presentation to be prepared by each student). 4) Student Marksheet, Prepare Pay bills, tax statement, student's assessment record using spreadsheet. (Teacher shall assign a spreadsheet to be prepared by each student). 5) Carry-out Survey on different web browsers. 6) Generate resume for different job profile, survey report of any industry using ChatGPT/any other AI tool.

VIII – LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
1	a) Computer System with all necessary Peripherals and Internet connectivity. b) Any Office Software c) Any Browser (Any General Purpose Computer available in the Institute)	All

IX SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R- Level	U- Level	A– Level	Total Marks
1	I	Introduction to Computer System	CO1	2	0	0	0	0
2	II	Word Processing	CO2	3	0	0	0	0
3	III	Spreadsheets	CO3	3	0	0	0	0
4	IV	Presentation Tool	CO4	4	0	0	0	0
5	V	Basics of Internet and EmergingTechnologies	CO5	3	0	0	0	0
				15	0	0	0	0

X ASSESSMENT METHODOLOGY /TOOLS
   Summative Assessment (Assessment for learning)

- Lab. Performance (Term work)

XI SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life long learning	PSO-1	PSO-2	PSO-3
CO1	1	-	-	-	-	-	1	-	-	-
CO2	-	-	-	3	-	-	-	1	1	-
CO3	-	2	1	3	-	-	1	1	1	-
CO4	-	-	-	3	-	-	1	1	1	1
CO5	1	-	-	3	-	-	1	1	1	1

Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping

PROGRAM SPECIFIC OUTCOMES (PSO's)

(What s/he will continue to do in the textile technology specific industry soon after diploma programme)

PSO 1: Perform spinning, weaving, Knitting and garmenting processes using various relevant technologies.

PSO 2: Execute designing and development of various textile products using various relevant technologies.

PSO 3: Maintain various textile machines to produce various types of quality textiles at optimum cost.

XII SUGGESTED LEARNING RESOURCES / BOOKS

Sr. No.	Author	Title	Publisher
1	Goel, Anita	Computer Fundamentals	Pearson Education, New Delhi, 2014, ISBN-13: 978-8131733097
2	Miller, Michael	Computer Basics Absolute Beginner's Guide, Windows 10	QUE Publishing; 8th edition August 2015, ISBN: 978-0789754516
3	Alvaro, Felix	Linux: Easy Linux for Beginners	CreatevSpace Independent Publishing

			Platform- 2016, ISBN-13: 978-1533683731
4	Johnson, Steve	Microsoft Office 2010: On Demand	Pearson Education, New Delhi India, 2010. ISBN :9788131770641
5	Schwartz, Steve	Microsoft Office 2010 for Windows: Visual Quick Start	Pearson Education, New Delhi India, 2012, ISBN : 9788131766613
6	Leete, Gurdy, FinkelsteinEllen, Mary Leete	OpenOffice.org for Dummies	Wiley Publishing, New Delhi, 2003 ISBN : 978-0764542220

XIII LEARNING WEBSITES AND PORTALS

Sr. No.	Links / Portals	Description
1	https://www.microsoft.com/en-in/learning/office-training.asp x	Office
2	http://www.tutorialsforopenoffice.org/	Open Office
3	https://s3-ap-southeast-1.amazonaws.com/r4ltue295xy0d/ Special_Edition_Using_StarOffice_6_0.pdf	Open Office
4	https://ashishmodi.weebly.com/uploads/1/8/9/7/18970467/compu ter_fundamental.pdf	Computer Fundamental
5	http://www.tutorialsforopenoffice.org/	Open Office
6	https://www.tutorialspoint.com/computer_fundamentals/index.h tm	Computer Fundamental
7	https://www.tutorialspoint.com/word/	Word Processing
8	https://www.javatpoint.com/ms-word-tutorial	Word Processing
9	https://support.microsoft.com/en-au/office/word-for-windows- training-7bcd85e6-2c3d-4c3c-a2a5-5ed8847	Word Processing
10	https://www.javatpoint.com/excel-tutorial	Spreadsheet
11	https://support.microsoft.com/en-au/office/excel-video-train ing-9bc05390-e94c-46af-a5b3-d7c22f6990bb	Spreadsheet
12	https://www.javatpoint.com/powerpoint-tutorial	Powerpoint Presentation
13	https://support.microsoft.com/en-au/office/powerpoint-for-wi ndows-training-40e8c930-cb0b-40d8-82c4-b	Powerpoint Presentation
14	https://www.geeksforgeeks.org/ms-dos-operating-system/	Operating System
15	https://www.javatpoint.com/windows	Windows Operating System
16	https://www.javatpoint.com/what-is-linux	Linux Operating System
17	https://www.techtarget.com/iotagenda/definition/Internet-of- Things-IoT	IoT
18	https://www.geeksforgeeks.org/introduction-to-internet-of-th ings-iot-set-1/	IoT
19	https://www.javatpoint.com/machine-learning	AI & Machine Learning
20	https://www.skillrary.com/blogs/read/introduction-to-drone-t echnology	Drone Technology
21	https://www.cnet.com/tech/computing/what-is-3d-printing/	3D Printing
22	https://support.google.com/a/users/answer/9389764?hl=en	Apps

XIV COURSE CURRICULUM DEVELOPMENT COMMITTEE
   Faculty Members from Polytechnics

Sr. No	Name & Designation	Institute	Contact No.	Email ID
1.	Mr. S.S. Joglekar Sr. Lecturer (Selection Grade)	Sasmira's Institute of Man-made Textiles, Worli, Mumbai – 30.	9833909871	shirishjoglekar@sasmira.edu.in

Programme Name : Diploma in Textile Chemistry

Programme Code : DTC

Semester : Second

Course: Pretreatment Technology

Course Code : X231201

I   RATIONALE

In textile industry, pre-treatment is a processes applied on textile material (viz. fibres, yarn, fabrics) to prepare the material for dyeing, printing or finishing. In textiles, Pretreatment plays a crucial role in achieving consistent and high-quality results in textile processing. To get effective results of dyeing, printing, and finishing processes, the fabric should be free from any of the impurities such as size, oil, fat, wax and pigments, as their presence affect the quality of further textile processing. This course is developed in such a way that the fundamental information will help the diploma engineer to apply the concepts of textile pretreatment technologies to solve broad based problems in the textile industry.

II   INDUSTRY / EMPLOYER EXPECTED OUTCOMES

The aim of this course is to help the student to **"Use different types of textile pre-treatment machines and processes"** and attain the same industry identified competency through various teaching learning experiences**.**

III   COURSE LEVEL LEARNING OUTCOME (CO'S)

The Theory, practical experiments and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented CO's associated with the above mentioned competency:

CO1 - Select relevant pre-treatment process and machines for obtaining ready for dyeing quality textiles.
CO2 - Use relevant mechanical process to remove the impurities from textiles.
CO3 - Use relevant desizing process to remove size from textile.
CO4 - Use relevant scouring process to improve absorbency of textile.
CO5 - Use relevant bleaching process to improve whiteness of textile.
CO6 - Use relevant mercerization process to improve luster of cotton.

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category	Learning Scheme					Credits	Paper Duration (hrs)	Assessment Scheme											Total Marks
				Actual Contact Hrs/ week			SLH	NLH			Theory				Based on LL & TL				Based on SL			
															Practical							
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
X231201	Pretreatment Technology	PT	DSC	3	0	3	1	7	3.5	3	30	70	100	40	25	10	25	10	25	10	175

Total IKS hours for semester : 1 Hrs.

Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

 FA-TH represents average of two class tests of 30 marks each conducted during the semester.

1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
		SECTION I	
1	TLO 1.1 Describe with sketches the sizing process for the given textile and its importance. TLO 1.2 Describe the use of relevant ingredient for sizing the given textile. TLO 1.3 Compare properties of the relevant adhesives used in sizing TLO 1.4 Select relevant starch to improve strength of the given textile with justification. TLO 1.5 Formulate the relevant sizing recipe for the given textile.	**Unit I – Sizing** 1.1 Sizing: Process, Purpose, 1.2 Ingredients: Types, functions 1.3 Adhesives: Classification, Starches- Types, Properties 1.4 Softeners: Types, properties 1.5 General Size paste formulation: Cotton, P/C, P/V blended yarn	Lectures, Presentations, Assignments, Practical, You-tube simulation.
2.	TLO 2.1 Describe with sketches the pretreatment process of the given fabric. TLO 2.2 Describe with sketches the procedure to identify problems in the given fabric. TLO 2.3 Describe with sketches the process of inspection of the given fabric. TLO 2.4 Describe type of machine used for inspection of the given fabric.	**Unit II - Mechanical preparatory processes** 2.1 Mechanical Pretreatments: Importance, application, types 2.2 Pretreatment sequences: cotton, polyester, polyester / cotton, wool and silk. 2.3 Grey fabric inspection: Purpose, Faults in grey fabric. 2.4 Shearing and cropping machine: Singeing: Importance, Construction and working	Lectures, Presentations, Assignments, Practical, You-tube simulation.

	TLO 2.5 Explain with sketches the shearing and cropping process for the given fabric. TLO 2.6 Explain with sketches the construction and working principle of shearing and cropping machine used for the given fabric. TLO 2.7 Describe with sketches the procedure of using singeing machine for singeing of the given fabric.	principle of gas singeing machines for fabric.	
3.	TLO 3.1 Identify the size present on the given fabric. TLO 3.2 Explain with sketches the mechanism of desizing for the given fabric. TLO 3.3 Describe with sketches the relevant desizing method for the given sized fabric. TLO 3.4 Describe with sketches the relevant method to evaluate efficiency of desizing of the given fabric.	**Unit III – Desizing** 3.1 Size on grey fabric: Identification 3.2 Desizing process: Classification - Purpose, Methods- Hydrolytic & Oxidative, Factors affecting process. 3.3 Desizing machines: Batch wise and continuous. 3.4 Desizing efficiency: Evaluation methods.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
SECTION II
	TLO 4.1 Describe with sketches the relevant scouring method to remove hydrophobic impurities from the given cotton fabric/ PET and its blends TLO 4.2 Describe with sketches the relevant pretreatment process for the given wool/silk. TLO 4.3 Describe with sketches the use of relevant machine for scouring of the given fabric. TLO 4.4 Describe the relevant method to evaluate efficiency of the given scouring process.	**Unit IV – Scouring** 4.1 Scouring: Importance, Mechanism and Reactions 4.2 Methods: Alkaline scouring, solvent scouring, bio-scouring. 4.3 Scouring process: cotton, polyester (PET) and their blends, knit goods. 4.4 Scouring machine: Batch-wise, semi continuous and continuous 4.5 Wool: purpose & Scouring methods. 4.6 Degumming of silk: Purpose, Methods - Soap, alkali, and enzyme. Traditional method of degumming of silk. 4.7 Evaluation of scouring process efficiency.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
	TLO 5.1 Explain with sketches the mechanism of the given type of the bleaching process. TLO 5.2 Explain the factors affecting the given type of bleaching process. TLO 5.3 Describe with sketches the	**Unit V – Bleaching** 5.1 Sodium hypochlorite bleaching: Purpose, mechanism, Procedure for cotton, 5.2 Hydrogen peroxide bleaching: Purpose, mechanism, factors affecting, Role of stabilizer,	Lectures, Presentations, Assignments, Practical, You-tube simulation.

	relevant bleaching process for the given textile/polyester and its blend.	activator, Process for cotton, Polyester and their blends Comparison between H_2O_2 and NaOCl bleaching.	
	TLO 5.4 Describe relevant method to evaluate efficiency of the given bleaching process.	5.3 Sodium chlorite bleaching: Mechanism, Procedure for polyester.	
	TLO 5.5 Explain with sketches the mechanism of optical whitening for the given fabric.	5.4 Wool, silk, knits and colored woven goods: Precautions, procedure.	
		5.5 Machines: Batch wise, semi continuous and continuous methods of bleaching.	
		5.6 Efficiency of bleaching: Evaluation methods.	
		Optical Whitening: Objectives, Classification, Selection criteria, Methods of application.	
	TLO 6.1 Explain the effects of mercerization on properties of the given type of fabric.	**Unit VI – Mercerization**	
	TLO 6.2 Explain the structural changes in cellulose during mercerization of the given cotton.	6.1 Mercerization: Importance, changes occurred in fibre.	
		6.2 Causticization: Purpose, process.	
		6.3 Factors affecting the mercerization process.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
	TLO 6.3 Describe the relevant factors affecting mercerization process of the given cotton.	6.4 Machines: Yarn mercerization, pad-chain, padless-chainless, hot mercerization, liquid ammonia mercerization.	
	TLO 6.4 Select relevant machine for mercerization of the given textile with justification.	6.5 Efficiency: Evaluation by different methods.	
	TLO 6.5 Describe the relevant method to evaluate efficiency of mercerization of the given fabric.		

VI LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Identify various apparatus and glassware used for practical. LLO 1.2 Select suitable apparatus and glassware for the practical execution. LLO 1.3 Use relevant apparatus and glassware for the practical execution and chemicals to identify the size on textile material.	1	Use relevant chemicals to identify the size on textile material and relevant qualitative method for testing the given starch	3	CO1

LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and chemicals to identify the size on textile material.	2	Use relevant chemicals to identify the size on textile material and relevant qualitative method for testing the given starch	3	CO2
LLO 3.1 Identify various apparatus and glassware used for practical. LLO 3.2 Select suitable apparatus and glassware for the practical execution. LLO 3.3 Use relevant apparatus and glassware for the practical execution and understand the use of acid desizing method to remove size on the given textile	3	Use acid desizing and enzyme desizing method to remove size on the given textile	3	CO3
LLO 4.1 Identify various apparatus and glassware used for practical. LLO 4.2 Select suitable apparatus and glassware for the practical execution. LLO 4.3 Use relevant apparatus and glassware for the practical execution and understand the use of acid enzyme desizing method to remove size on the given textile.	4	Use acid desizing and enzyme desizing method to remove size on the given textile	3	CO3
LLO 5.1 Identify various apparatus and glassware used for practical. LLO 5.2 Select suitable apparatus and glassware for the practical execution. LLO 5.3 Use relevant apparatus and glassware for the practical execution and understand the open bath scouring method to improve the absorbency of the given cotton fabric.	5	Use open bath scouring method to improve the absorbency of the given cotton fabric-	3	CO4
LLO 6.1 Identify various apparatus and glassware used for practical. LLO 6.2 Select suitable apparatus and glassware for the practical execution. LLO 6.3 Use relevant apparatus and glassware for the practical execution and understand the open bath scouring method to improve the absorbency of the given cotton fabric	6	Use open bath scouring method to improve the absorbency of the given cotton fabric-	3	CO4
LLO 7.1 Identify various apparatus and glassware used for practical. LLO 7.2 Select suitable apparatus and glassware for the practical execution. LLO 7.3 Use relevant apparatus and glassware for the practical execution	7	Use pressure boil scouring method to improve the absorbency of the given cotton fabric	3	CO4

and understand the pressure boil scouring method to improve the absorbency of the given cotton fabric				
LLO 8.1 Identify various apparatus and glassware used for practical. LLO 8.2 Select suitable apparatus and glassware for the practical execution. LLO 8.3 Use relevant apparatus and glassware for the practical execution and understand the scouring method to remove hydrophobic impurity from the given polyester and its blend.	8	Use relevant scouring method to remove hydrophobic impurity from the given polyester and its blend	3	CO4
LLO 9.1 Identify various apparatus and glassware used for practical. LLO 9.2 Select suitable apparatus and glassware for the practical execution. LLO 9.3 Use relevant apparatus and glassware for the practical execution and understand the degumming method to remove Sericin from the given silk fabric.	9	Use relevant degumming method to remove Sericin from the given silk fabric	3	CO4
LLO 10.1 Identify various apparatus and glassware used for practical. LLO 10.2 Select suitable apparatus and glassware for the practical execution. LLO 10.3 Use relevant apparatus and glassware for the practical execution and understand the hypochlorite bleaching method to improve whiteness of the given cotton fabric	10	Use hypochlorite bleaching method to improve whiteness of the given cotton fabric	3	CO5
LLO 11.1 Identify various apparatus and glassware used for practical. LLO 11.2 Select suitable apparatus and glassware for the practical execution. LLO 11.3 Use relevant apparatus and glassware for the practical execution and understand the hydrogen peroxide bleaching method to improve whiteness of the given cotton fabric.	11	Use hydrogen peroxide bleaching method to improve whiteness of the given cotton fabric	3	CO5
LLO 12.1 Identify various apparatus and glassware used for practical. LLO 12.2 Select suitable apparatus and glassware for the practical execution. LLO 12.3 Use relevant apparatus and	12	Use combined scouring and bleaching method to improve absorbency and whiteness of the given cotton fabric	3	CO5

glassware for the practical execution and understand the combined scouring and bleaching method to improve absorbency and whiteness of the given cotton fabric.				
LLO 13.1 Identify various apparatus and glassware used for practical. LLO 13.2 Select suitable apparatus and glassware for the practical execution. LLO 13.3 Use relevant apparatus and glassware for the practical execution and understand the bleaching method for polyester and its blends.	13	Use relevant bleaching method for the given polyester and its blends	3	CO5
LLO 14.1 Identify various apparatus and glassware used for practical. LLO 14.2 Select suitable apparatus and glassware for the practical execution. LLO 14.3 Use relevant apparatus and glassware for the practical execution and understand the effect of open bath bleaching method for the given wool fabric	14	Use open bath bleaching method for the given wool fabric	3	CO5
LLO 15.1 Identify various apparatus and glassware used for practical. LLO 15.2 Select suitable apparatus and glassware for the practical execution. LLO 15.3 Use relevant apparatus and glassware for the practical execution and understand the effect of Use of open bath bleaching method for the given silk fabric	15	Use open bath bleaching method for the given silk fabric	3	CO5
LLO 16.1 Identify various apparatus and glassware used for practical. LLO 16.2 Select suitable apparatus and glassware for the practical execution. LLO 16.3 Use relevant apparatus and glassware for the practical execution and understand the hank mercerization method for the given cotton hank to Determine Barium Activity Number (BAN) of cotton.	16	Use hank mercerization method for the given cotton hank to Determine Barium Activity Number (BAN) of the given mercerized goods	3	CO6

VII   SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

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:

- Visit textile process house and collect recipes used for pretreatments in textile process house.
- Collect fabric samples at various stages in pretreatment and check their absorbency and whiteness.
- Collect information of various pretreatment auxiliaries used in textile process house.
- Visit textile process house and collect information of parameters used in mercerization for different sorts of fabric.

ASSIGNMENTS –

A suggestive list is given here. Similar ASSIGNMENTS could be added by the concerned faculty:
   a. **Strength of chemicals:** Collect chemicals used in textile preparatory processes and determine their strength. Present the results.
   b. **Auxiliaries:** Collect auxiliaries used in preparatory processes and prepare presentation including commercial/ industrial names.
   c. **Role of oxidizing and reducing agent in wet processing:** Visit textile industry, collect information and photographs. Prepare presentation incorporating different oxidizing, reducing agents used in preparatory processes.
   d. **Collection of sized samples:** Visit textile industry, collect sized samples of different GSM, count and construction. Prepare presentation.
   e. **Collection of pretreated samples:** Collect pretreated samples at various stages for any four qualities of fabric, prepare presentation incorporating description of the collected samples.
   f. **Comparison:** Compare the absorbency of cotton sample collected from textile industry, scoured by different methods for any four qualities of fabric. Prepare presentation.
   g. **Performance Study:** Study, relation between various bleaching parameters on the whiteness and strength of any four qualities of fabric. Present the results.
   h. **Performance Study:** Study relation between various mercerizing parameters on the absorbency, dyeability, Lustre and strength on different varieties. Present the results.

VIII   LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
1	Laboratory Glass Ware (Round bottom flask, condenser, pipettes, burettes, thermometer, and other related glassware) heating mantle	1, 2,3, 4, 5, 6
2	Fabric inspection machine (1 meter x 2 meter purging machine with top and bottom light source)	7,8,9, 10,11,12, 13,14,15
3	ICI pilling tester	All
4	Water bath (6 or 12 dye-pot holding capacity made of stainless steel which can be either gas heated or electrically heated with microprocessor control)	All
5	Dye-pots (made of stainless steel each of 250 or 500 ml capacity, which fits perfectly in water bath)	All
6	Steamer (which has the capacity to generate a pressure of 30 psi and can have a batch size of 02 to 05 kg.)	All
7	Hank mercerization machine (which has a capacity to mercerize hank and lea)	

IX SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R- Level	U-Level	A–Level	Total Marks
1	I	Sizing	CO1	06	4	2	2	08
2	II	Mechanical Preparatory Processes	CO2	08	4	3	3	10
3	III	Desizing	CO3	10	7	6	4	17
4	IV	Scouring	CO4	10	7	6	4	17
5	V	Bleaching & Optical Whitening	CO5	08	4	3	3	10
6	VI	Mercerization	CO6	06	4	2	2	08
				48	30	22	18	70

X ASSESSMENT METHODOLOGY /TOOLS

Formative Assessment (Assessment for learning)
- Lab. Performance (Term work)

Summative Assessment (Assessment of Learning)
- End of Term examination – Practical Exam and Viva-voce

XI SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life long learning	PSO-1	PSO-2	PSO-3
CO1	2	2	3	1	1	1	2	2	3	3
CO2	2	2	3	1	1	1	2	2	3	3
CO3	2	2	3	1	1	1	2	2	3	3
CO4	2	2	3	1	1	1	2	2	3	3
CO5	2	2	3	1	1	1	2	2	3	3
CO6	2	2	3	1	1	1	2	2	3	3

Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping

PROGRAM SPECIFIC OUTCOMES (PSO's)

(What s/he will continue to do in the textile and related industry soon after diploma programme)

PSO 1: **Perform preparatory, Colouuration and Finishing of Textiles using various relevant technologies.**

PSO 2: **Perform Quality evaluation of textiles, Fibres, Yarns, Fabrics, Dyes and Chemicals using various standard test methods.**

PSO 3: **Maintain various textile machines to produce various types of quality textiles at optimum and sustainable cost.**

XII   SUGGESTED LEARNING RESOURCES / BOOKS

S. No.	Title of Book	Author	Publication
1	Textile Preparation and Dyeing	Choudhary, A. K. R.	Science Publishers, Enfield, NH, USA, 2006, ISBN: 9781578084043
2	Textile Sizing	Goswami, B. C.; Anandjiwala, R. D.; Hall, D.	CRC Press, 2004, ISBN: 9780203913543
3	Chemical Processing of Polyester/ Cellulosic Blends	Mittal, R.M.; Trivedi, S. S.	ATIRA, Ahmedabad, 1983
4	Chemical Processing of Synthetic Fibres and Blends	Datye, K. V.; Vaidya, A. A.	Wiley-Blackwell, New York, 1984, ISBN: 9780471876540
5	Technology of Bleaching and Mercerizing	Shenai, V. A.	Sevak Publication, Mumbai, 2003
6	Chemical Technology in the Pretreatment Processes of Textile	Karmakar, S. R.	Elsevier Science Publication, Netherlands, 1999, ISBN: 9780444500601
7	Textile Scouring & Bleaching	E.R.Trotman	B.I.Publications, New Delhi.
8	Textile Preparation and Dyeing	A K R Choudhury, 2006	Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
9	Technology of Textiles- Spinning and Weaving, Dyeing, Drying, Printing and Bleaching	EIRI Board	Engineers India Research Institute, ISBN: 9788186732489
10	The Complete Technology Book on Textile Processing With Effluents Treatment	NIIR Board	NIIR Board, 2004 ISBN: 8178330504
11	TECHNIQUE OF COTTON TEXTILE IN ANCIENT INDIA (UPTO 6 TH CENTURY A.D.)	Suniti Pandey	The Indian History Congress

XIII   LEARNING WEBSITES AND PORTALS

a. www.nptel.ac.in/courses/116102005/20
b. www.textilelearner.blogspot.in/2011/03/cotton-desizing-process_255.html
c. www.handprintingguiderajasthan.in/science-behind-preparatory-processes-for-hand printing/pre-treatment-of-cotton-fabric/
d. www.shodhganga.inflibnet.ac.in/bitstream/10603/24222/9/09_chapter4.pdf
e. www.textilelearner.blogspot.in/2011/03/scouring-treatments-of-cotton-silk-wool_4142.html
f. www.cdn.intechopen.com/pdfs-wm/25013.pdf
g. www.textilelearner.blogspot.in/2012/12/bleaching-of-cotton-fiberfabric-with.html
h. www.nptel.ac.in/courses/116102016/19
i. www.nptel.ac.in/courses/116102016/16
j. www.textilelearner.blogspot.in/2013/06/mercerization-process-of-cotton-fabric.html
k. www.thesmarttime.com/pretreatment/mercerization.html
l. www.nptel.ac.in/courses/116102016/20
m. www.linkedin.com/pulse/facebook-unveils-plan-tackle-fake-news-problem-google-lorraine-k-lee
n. www.textilelearner.blogspot.in/2013/07/pretreatment-process-of-silk.html
o. www.handprintingguiderajasthan.in/science-behind-preparatory-processes-for-hand-printing/pre-treatment-of-silk-fabric/
p. www.thesmarttime.com/pretreatment/scouring-of-wool.html

XIV   COURSE CURRICULUM DEVELOPMENT COMMITTEE

S. No.	Name	Institute	Contact No.	Email
1	Shri. Rajan R.Kori Lecturer in Textile Chemistry	Sasmira, Mumbai	9004940950	rajankori@sasmira.edu.in

Program Name : **Diploma in Textile Technology / Diploma in Textile Chemistry**

Program Code : **DTT / DTC / DKT**

Semester : **Second**

Course Title : **GENERAL ENGINEERING**

Course code : **C233204**

I   RATIONALE

Textile industry is totally depends upon electrical as well thermal energy for functioning of its various utilities like boilers, condensers, generators, motors, transformers etc. This subject will impart the basic knowledge about the economical generation and efficient industrial utilization of electrical and thermal energy associated with textile machineries.

II   INDUSTRY / EMPLOYER EXPECTED OUTCOME

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

   "Apply concepts of electrical, mechanical and thermal engineering in textile machineries, operations and process".

III   COURSE LEVEL LEARNING 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 the thermodynamics principle, to generate steam in textile industry.
(b) Compare various boilers along with condenser used in textile processes.
(c) Explain the air conditioning refrigeration processes & I. C engines   as applicable to textile industries.
(d) Use electro-magnetic induction along with necessaries laws & measuring instrument   for calculating voltage, current and power.
(e) Compare of alternating current (A.C.) & direct current (D.C.) theory along with A.C. / D.C. motors / generators & associated   single/ three phase circuits relevant to machineries in textile industries.
(f) Analyze the requirement of single & three phase induction motors & transformers & its applications to textile industries.

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & T L				Based on SL	Total Marks
				CL	TL	LL											Practical				
											FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA	
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
C233204	**GENERAL ENGINEERING**	GE	GE	2	-	-	-	2	1	1.5	15	35*#	50	20	-	-	-	-	-	-	50

Total IKS hours for semester: 0 Hrs.

Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment
Legends: @InternalAssessment, #ExternalAssessment, *#OnLineExamination,@$Internal Online Examination

Note:
FA-TH represents average of two class tests of30marks each conducted during the semester.
1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.*15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. *Self-learning hours shall not be reflected in the Time Table.
6. *Self-learning includes micro project /assignment / other activities.

V   THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
		SECTION I	
1	TLO1.1 Describe the concept of give physical Explain first and second law of thermodynamics. TLO1.2 Apply Claussius's and Kelvin Plank's statements laws of thermodynamics. TLO1.3 Explain heating characteristics of various materials. TLO1.4 Explain relationship of pressure volume & temperature in thermodynamic processes, open, closed & natural processes and elaborate P-V diagram TLO1.5 Comparison of various types of steam and Explain Dryness fraction. TLO1.6 Use steam table for process data with respect to pressure volume &	**Basic Laws Of Thermodynamics & Properties of Steam** 1.1 Law of conservation of energy. First and second law of thermodynamics. 1.2 Claussius's and Kelvin Plank's statements. 1.3 Specific heats, their relationships and ratio. 1.4 Simple thermodynamic process such as constant volume, constant pressure, isothermal and adiabatic, hyperbolic, polytropic and throttling. (only introduction and P-V diagram) 1.5 Important terms such as wet steam, dry steam, superheated steam, dryness fraction, sensible heat, enthalpy and specific volume of steam. 1.6 Steam table and its use. Advantages of superheated steam.	Improved Lecture, tutorial, Assignments, Demonstration, Simulation.

	temperature. Use application of superheated steam in textile processes.		
2.	TLO 2.1 Compare of types of boiler viz water tube & fire tube boiler with respective application in textile industries. TLO 2.2 Identify of all boiler mounting and their functioning. TLO 2.3 Explain on Advantages of condensers in steam power plant. TLO 2.4 Explain Requirements of a steam condensing plant. TLO 2.5 Explain on various types of condensers and its uses	**Unit– II** **Steam Boilers & Condensers** 2.1 Steam Boiler**:** Classification, selection, important terms and essentials of a good steam boiler. Fire tube and water tube boiler such as Cochran, Lancashire, Cornish, Babcock and Wilcox boiler. 2.2 Boiler mounting such as water level indicator, pressure gauge, blow-off cock, safety valve, fusible plug and accessories such as feed pump, super heater, and economizer. (Only simple idea and functions; no construction details. Only diagram). 2.3 Introduction. Advantages of condensers in steam power plant. 2.4 Requirements of a steam condensing plant. 2.5 Classification of condensers and their comparison.	Improved Lecture, tutorial, Assignments, Demonstration, Simulation.
3.	TLO3.1 Explain refrigeration process. TLO3.2 Explain complete refrigeration process & components. TLO3.3 Explain air-conditioning, system for human comfort. TLO3.4 Identify Equipment's used in air conditioning cycle. & components of the system. TLO3.5 Awareness of Air conditioning systems and types. TLO3.6 Explain internal combustion engines. TLO3.7 Explain Main components of I.C.	**Unit– III** **Refrigeration Aircondioning & I.C. Engines** 3.1 Introduction to air and vapour compression refrigeration. 3.2 Mechanism of refrigeration. 3.3 Introduction to air-conditioning. Factors of human comfort. 3.4 Equipment used in air conditioning cycle. 3.5 Air conditioning systems and types. 3.6 Introduction to internal combustion engines. 3.7 Main components of I.C. Engines. Sequence of operation. 3.8 Two stroke cycle engine. Four stroke cycle engine. Advantages of two and four stroke	Improved Lecture, tutorial, Assignments, Demonstration, Simulation.

	Engines. Sequence of operation. TLO3.8 Compare Two stroke cycle engine with Four stroke cycle engine. Write Advantages of two and four stroke cycle engine.	cycle engines	
		SECTION II	
	TLO4.1 Define electromagnetism & associated rules & laws. TLO4.2 Classify basic measuring instruments into various categories. TLO4.3 Compare instruments used for measuring electromagnetic inductions.	**Unit –IV** **Electromagnetic Induction & Measuring Instruments** 4.1 Electromagnetism. Electromagnetic induction. Faraday's laws, Lenz's law, right hand rule and left hand rule. Right hand thumb rule. 4.2 Types of secondary instruments. Essentials of indicating instrument. 4.3 Moving iron instruments. Attractive type and repulsive type moving iron instruments. Moving coil instruments such as permanent magnet moving coil instruments.	
5	TLO5.1 Explain Simple single phase A.C. circuits containing resistance R, inductance L and capacitance C in series. & Combination of R-L-C. TLO5.2 Calculate three phase circuits. Star and delta connections for voltage, current. TLO5.3 Calculate power in single and three phase circuits. TLO5.4 Explain principle of D. C. Generator. & Working of D. C. Generator. TLO5.5 Explain parts and description & Types	**Unit –V** **Alternating Current &Direct Current Cycles Component Circuits With Power** 5.1 Alternating current. Frequency, amplitude, cycle, time period, Root Mean Square value (RMS value), average value, and vector representation of A.C. 5.2 Simple single phase A.C. circuits containing resistance, inductance and capacitance in series. Combination of R-L-C. Simple numerical examples. 5.3 Introduction to three phase circuits. Star and delta connections. 5.4 Measurement of power in single and three phase circuits, simple numerical examples. 5.5 Basic principle of D. C. Generator. Rectification. Working of D. C.	

	of D. C. Generator. TLO5.6 Explain principle, construction and working of D. C. Motor. TLO5.7 Explain characteristic of D. C. Motors need of starter. TLO5.8 Classify D. C. Motors into various categories.	Generator. 5.6 Practical D. C. Generator – parts and description. Types of D. C. Generator. Simple numerical examples.	
6	TLO6.1 Explain principle and working of Induction Motor. TLO6.2 Explain functions of various components of induction motor. TLO6.3 Explain principle and working of Transformer. TLO6.4 Solve Transformer Emf Equation and problems.	**Unit-VI** **Induction motor & Transformer** 6.1 Construction of induction motor. Working principle of induction motor. Motor starter. Squirrel cage and phase wound rotor. Frequency of rotor current. $f' = s \cdot f$ simple numerical examples 6.2 Transformer: Single phase ideal transformer. Construction of transformer. 6.3 Emf equation of transformer. Emf equation of transformer Voltage regulation in transformer. Transformer tests. Losses in transformer. Efficiency of transformer. Transformer on load and on no load. Simple numerical examples on single phase transformer	

VI   LABORATORY LEARNING OUTCOMES AND ALIGNED PRACTICALS : NIL

VII   SUGGESTED MICRO PROJECTS / ASSIGNMENTS/ACTIVITIES FOR SPECIFIC LEARNING/ SKIL DEVELOPMENT / SELF LEARNING -

SUGGESTED STUDENT ACTIVITIES

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

(a) Visit Textile Composite Mill and visit the Engineering department. Study various utilities like Boilers, Condensers, Air conditioning units, Refrigeration units, compressors,

(b) Visit Textile Composite Mill and visit and study various motors being used, repaired.

(c) Visit Textile Mills and study the Generators and transformers being used

(d) Visit textile process house and study boilers and condensers.

(e) Solving the question banks from the text books.

SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

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

(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 Sessional examination.

(h) Assign unit wise assignments to group of 4 to 5 students for solving unit wise questions.

(i) Use of video, animation films to explain concepts, facts and applications related to textile pretreatment.

SUGGESTED ASSIGNMENT

Only one assignment is planned to be undertaken by a student that needs to be assigned to him/hir in the beginning of the semester. In the first four semesters, the assignments are group-based, However, in the fifth and sixth semesters, in 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 application based, internet – based, workshop-base, laboratory-based or field-based. Each assignment 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 assignments 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) Write a detail note on application of zeroth law, first law of thermodynamics with example of each.

(b) Explain with neat sketches P-V diagram for IC Engine (Petrol and diesel)
(c) (Otto cycle and Diesel cycle)
(d) Explain with sketch Boiler Mounting and Boiler Accessories
(e) (list and use of boiler mountings and accessories)
(f) Describe construction and working of Babcock and Wilcox Boiler with the help of neat labeled sketches on a full imperial size card board.
(g) List and Explain Factor affecting human comfort.
(h) Explain vapour compression refrigeration cycle.
(i) Draw and explain type's auto diesel and duel cycle.
(j) Explain statically induced emf and dynamically induced emf.
(k) Explain different types of torques in measuring instruments.
(l) Explain with neat sketch single phase elementary generator.
(m) Explain the constructional details of D.C. machine and state the function of each part.
(n) Draw equivalent circuit diagram of single phase transformer.
(o) Draw and explain the power flow diagram of induction motor.

VIII   LABORATORY MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED – NIL

IX   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. NO	Unit No.	Unit Title	Aligned Cos	LEARNING Hours	R Level	U Level	A Level	Total Marks
					Distribution of Theory Marks			
SECTION I								
1	I	Basic laws of thermodynamics and properties of steam	CO1	4	1	2	2	5
2	II	Steam boilers & Condensers	CO2	6	1	2	2	5
3	III	Refrigeration / air-conditioning & I. C. Engines.	CO3	6	2	2	3	7
		Total		16	4	6	7	17
SECTION II								
4	IV	Electromagnetic Induction and measuring instruments	CO4	3	1	1	2	4
5	V	A. C. /D.C motors / Generators & single phase & three phase circuits	CO5	10	2	3	5	10
6	VI	Induction motors & Transformers	CO6	3	1	1	2	4
		Total		16	**4**	**5**	**9**	**18**

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

<u>*Note*</u>*: 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*.

X   ASSESSMENT METHODOLOGIES TOOLS

Formative Assessment (Assessment for learning)

- Two-unit test of 15 marks Tests
- Self-learning
- Seminar / Presentation

Summative Assessment (Assessment of Learning)

- End term assessment of 35 marks through online MCQ examination.

XI   SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life long learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	1	1	1	2	1	2
CO2	3	2	2	2	1	1	1	2	1	2
CO3	3	2	2	2	1	1	1	2	1	2
CO4	3	2	2	2	1	1	1	2	1	2
CO5	3	2	2	2	1	1	1	2	1	2
CO6	3	2	2	2	1	1	1	2	1	2
Legends :- High : 03, Medium : 02, Low : 01 , 0 : No mapping										
PSO 1:Perform preparatory, colouration and finishing of textiles using various relevant technologies.										
PSO 2:Perform Quality evalution of textiles, fibres, yarns, Fabrics, Dyes and chemicals using various standerd Test										
PSO 3: Maintain Various Textile machines to produce various types of quality textiles at optimum and sustainable cost										

XII SUGGESTED LEARNING RESOURCES

Sr. No.	Name of Book	Author	Publication
1	Mechanical Technology (Thermal Engineering)	R. S. Khurmi	S. Chand & Company Pvt. Ltd.
2	Applied Thermodynamics	Sarao & Rai	Satya Prakashan
3	Fundamentals of Electrical Engineering and Electronics	B. L. Theraja	S. Chand & Company Pvt. Ltd.
4	Elements of Electrical Engineering	B. R. Sharma	Acharya Book Depot
5	Worked Examples in Electrical Technology	B. L. Theraja	S. Chand & Company Pvt. Ltd.

XIII SUGGESTED SOFTWARE/ LEARNING WEBSITES

- https://courses.lumenlearning.com/introchem/chapter/the-three-laws-of-thermodynamics/
- https://en.wikipedia.org/wiki/Laws_of_thermodynamics
- http://engineering.myindialist.com/2015/steam/#.Xfl3mpMza1s
- https://www.slideshare.net/Arjun_Dedaniya/properties-of-steam-62226458
- https://en.wikipedia.org/wiki/Boiler
- https://www.youtube.com/watch?v=02p5AKP6W0Q
- https://en.wikipedia.org/wiki/Condenser_(heat_transfer)
- https://www.slideshare.net/saxenaankit2010/condenser-and-its-types
- https://nptel.ac.in/courses/112105129/
- https://en.wikipedia.org/wiki/Air_conditioning
- https://en.wikipedia.org/wiki/Refrigeration
- https://www.slideshare.net/8695/icengine-ppt
- https://en.wikipedia.org/wiki/Internal_combustion_engine
- https://www.youtube.com/watch?v=vIJ50aUiBgM
- https://en.wikipedia.org/wiki/Electromagnetic_induction
- https://www.electronics-tutorials.ws/electromagnetism/electromagnetic-induction.html
- http://www.emfs.info/what/measuring/
- https://www.toppr.com/guides/physics/magnetic-effects-of-electric-current/electromagnetic-induction-and-its-applications/
- https://en.wikipedia.org/wiki/AC_motor
- https://www.watelectrical.com/ac-motor-construction-working-types-applications/
- https://en.wikipedia.org/wiki/DC_motor
- https://www.youtube.com/watch?v=LAtPHANEfQo
- https://en.wikipedia.org/wiki/Electric_generator
- https://economictimes.indiatimes.com/small-biz/productline/power-generation/electric-generator-an-basic-introduction-to-how-generators-work-their-features-and-applications/articleshow/69343338.cms?from=mdr
- https://www.elprocus.com/induction-motor-types-advantages/
- https://www.youtube.com/watch?v=AQqyGNOP_3o

- https://en.wikipedia.org/wiki/Transformer.
- https://www.youtube.com/watch?v=vh_aCAHThTQ

XIV   COURSE CURRICULUM DEVELOPMENT COMMITTEE

S. No.	Name and Designation	Institute	Contact No.	E-mail
1	H. V. Ramteke	Sasmira's Institute of Man-made Textiles, Mumbai	9766306847	hoddmtt@sasmira.edu.in

Programme Name: Diploma in Textile Chemistry

Programme Code: DTC

Semester : Second

Course: Technology of Dyeing Natural Fibres

Course Code: X231202

I   RATIONALE

In textile industry, quality textile is manufactured through various processes such as dyeing, printing, and finishing. These major processes improve the aesthetic as well as the market value of the textile. Dyeing is an important process of colouring natural textile substrate such as cotton, wool, and silk throughout their length and width. The knowledge and skills related to dyeing of natural fibres is essential for the diploma engineer to create quality textile. This course is developed in such a way that basic concepts and principles of dyeing of natural fibres and their application methods will help the diploma engineer to get quality dyed yarn and fabrics and to solve broad based problems in the textile colouration processes. To educate the students regarding the principles of Evaluation of Fastness properties

II   INDUSTRY / EMPLOYER EXPECTED OUTCOMES

The aim of this course is to help the student to **"Use relevant dyes, chemicals, dyeing equipment for natural fibres & fabrics" and** attain the same industry identified competency through various teaching learning experiences**.**

III   COURSE LEVEL LEARNING OUTCOME (CO'S)

The Theory, practical experiments associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented CO's associated with the above mentioned competency:

CO1 - Select relevant pre-treatment process and machines for quality dyeing of natural fibres.
CO2 - Use relevant method to dye cellulosic material with direct and reactive dyes.
CO3 - Use relevant method to dye cellulosic material with vat and sulphur dyes.
CO4 - Use relevant method to dye cellulosic material with solubilised vat dyes and pigments.
CO5 - Use relevant method to dye natural fibres with acid and basic dyes.
CO6 - Use relevant method to dye natural fibres with natural dyes.

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Course Category	Learning Scheme					Credits	Paper Duration (hrs)	Assessment Scheme										Total Marks
			Actual Contact Hrs/ week			SLH	NLH			Theory				Based on LL and TSL				Based on SL		
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
C231202	Technology of Dyeing Natural Fibres	DSC	3	0	3	1	7	3.5	3	70	30	100	40	25	10	25	10	25	10	175

Total IKS hours for semester: 3 Hrs.

Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note :

FA-TH represents average of two class tests of 30 marks each conducted during the semester.

1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V   THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
		SECTION I	
1	TLO 1.1 Describe dye properties with flow chart and their effects on the dyeing of the given fabric. TLO 1.2 Describe the process to analyse the quality parameters of the given textile material for dyeing. TLO 1.3 Calculate various dyeing parameters for the given fabric. TLO 1.4 Explain the significance of various sequence of the events for given dyeing and dyes. TLO 1.5 Describe the classification of colouring matter for textile fibre types based on application	**Unit I – General terms & theory of dyeing** 1.1 Dye properties: Substantivity, affinity, exhaustion, even dyeing, rate of dyeing, Equilibrium dyeing, saturation dyeing. 1.2 Dyeing parameters: exhaustion, expression, percent shade, material to liquor ratio. 1.3 Dyeing Assistants: leveling agents, retarding agents, exhausting agents, % expression, pick up, add on, etc Calculations related to above terms i.e. selections dilution of solutions, preparation of treatment bath with reagents on weight and volume basis. 1.4 Sequence of events in dyeing, Various dye fibre interactions, affinity of dyes etc. 1.5 Classification of colouring matter based on application	Lectures, Presentations, Assignments, Practical, You-tube simulation.
2.	TLO 2.1 - Describe properties and classification of direct dye which govern the dyeing quality of the given fabric. TLO 2.2 - Describe application of direct	**Unit II - Dyeing with Direct Dyes** 2.1 Direct Dyes: Properties, types, parameters affecting dyeing quality.	Lectures, Presentations, Assignments, Practical, You-

	dye with parameters affecting the dyeing quality of the given fabric. TLO 2.3 - Describe the relevant direct dyeing method with time temperature profile for the given cotton fabric. TLO 2.4. - Describe the relevant after treatment method with time temperature profile for the given cotton fabric. TLO 2.5 - Rectify dyeing deects in the given direct dyed fabric with relevant solutions.	2.2 Different methods of classification of direct dyes 2.3 Application methods: Batch wise, semi continuous and continuous dyeing. 2.4 After treatments: Procedure, effect on hue and fastness properties. 2.5 Problems in direct dyed fabric and their remedies/ solutions	tube simulation.
3.	TLO 3.1 – Describe application of reactive dye with parameters affecting the dyeing quality of the given fabric. TLO 3.2 – Describe properties and classification of reactive dye which govern the dyeing quality of the given fabric. TLO 3.3 – Describe the relevant reactive dyeing method with time temperature profile for the given cotton fabric. TLO 3.4 - Describe the different reactive dyeing methods with time temperature profile for the given cotton fabric and compare. TLO 3.5 - Rectify dyeing defects in the given reactive dyed fabric with relevant solutions.	**Unit III – Dyeing with Reactive Dyes** 3.1 Reactive Dyes: Properties, types, reactive systems, classification 3.2 Parameters affecting dyeing quality. 3.3 After treatments: Procedure, effect on hue and fastness, 3.4 Dyeing methods: Batch wise, semi continuous and continuous dyeing. 3.5 After treatments: Washing, soaping, stripping, fastness properties.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
	SECTION II		
	TLO 4.1 – Differentiate between the given types of vat dyes based on their properties. TLO 4.2 – Select relevant vat dyeing method for the given cotton fabric with justification. TLO 4.3 – Rectify faults in the given vat dyed material with relevant solutions. TLO – 4.4 Differentiate between the given types of sulphur dyes based on their properties. TLO – 4.5 Describe sulphur dyeing method with time temperature profile for the given cotton fabric. TLO 4.6 - Rectify faults in the given sulphur dyed material with relevant solutions.	**Unit IV – Dyeing with Vat and Sulphur Dyes** 4.1 Vat dyes: Properties, classification, auxiliaries used in dyeing, vatting. 4.2 Application methods: Leuco vat, vat acid and pigmentation, batch wise, semi continuous and continuous dyeing. 4.3 Faults and remedies in vat dyeing of cellulosic. 4.4 Sulphur dyes: Classification, auxiliaries 4.5 Application methods: Batch and continuous dyeing methods. 4.6 Problems and remedies in dyeing with different dyes on cotton.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
	TLO 5.1 – Classify types of acid, MCD & Basic dyes. TLO5.2 – Describe application procedure	**Unit V – Dyeing with Acid, Metal complex and Basic Dyes**	Lectures, Presentations, Assignments,

	of acid dyes with flow chart for the given wool or silk material. TLO 5.3 – Describe application procedure of MCD dyes with flow chart for the given wool material. TLO5.4 – Describe application procedure of basic dyes with flow chart for the given wool or silk material. TLO 5.5 – Rectify faults occurred in given acid and basic dyed goods with relevant solutions.	5.1 Acid dyes: Classification – Good, moderate and poor levelling acid dyes, 5.2 Application: Factors affecting, principles, dyeing of wool and silk. 5.3 Metal complex dyes(MCD): Classification of MCD 5.4 Application: Factors affecting, principles, dyeing of wool with MCD. 5.5 Basic dyes: Auxiliary, dyeing of cellulose, wool and silk. 5.6 Stripping, problems and their remedies.	Practical, You-tube simulation.
	TLO 6.1 Classify types of solubilised vat dyes. TLO 6.2 Describe the application procedure of solubilised vat dyes with flow chart for the given textile material TLO 6.3 Rectify faults occurred in given dyed goods with relevant solutions. TLO – 6.4 Describe relevant dyeing method with flow chart of natural dyes on the given textile fabric. TLO 6.5 - Describe relevant principle of determining the fastness properties of dye on the given textile fabric. TLO – 6.6 Describe relevant method of determining the fastness properties of dye on the given textile fabric.	**Unit VI – Dyeing with Solubilised vat, Natural Dyes and Fastness properties in general** 6.1 Solubilised dyes: Classification, Application: Factors affecting, principles, dyeing of different substrates, advantages and limitations 6.2 Stripping, problems and their remedies. 6.3 Natural dyes: Classification-vegetable, animal dyes, Sources. 6.4 Application methods: Pre-mordanting, post-mordanting and simultaneous mordanting. 6.5 Fastness of dyes and their assessment: Principle involved, Grey scales for staining and change in colour. 6.6 Principles and standard methods for assessment of fastness to washing, rubbing, perspiration,, light, gas, bleaching, ironing, dry cleaning etc. Various dyes and their typical fastness properties.	Lectures, Presentations, Assignments, Practical, You-tube simulation.

VI LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Identify various apparatus and glassware used for practical. LLO 1.2 Select suitable apparatus and glassware for the practical execution.	1	Use Open Bath Beaker Dyeing (OBBD) machine to dye the given cotton fabric with direct dye for different shades	3	CO1

LLO 1.3 Use relevant apparatus and glassware for the practical execution and understand the effect of change in shades on dyeing of cotton.				
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of after treatments on dyed of cotton.	2	Use Open Bath Beaker Dyeing (OBBD) machine to apply relevant after treatments on the given direct dyed cellulosic fabric.	3	CO2
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different concentrations of exhausting agents on dyeings of cotton.	3	Use Open Bath Beaker Dyeing (OBBD) machine to dye the given cotton fabric with H-brand reactive dyes for different concentrations of exhausting agent	3	CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different MLR on dyeing of cotton.	4	Use Open Bath Beaker Dyeing (OBBD) machine to dye the given cotton fabric with H-brand reactive dyes for different material to liquor ratios (MLR)	3	CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different concentration of fixing agents on dyeing of cotton.	5	Use exhaust method to dye the given cellulosic fabric with H-brand reactive dyes for different concentrations of fixing agents (alkali).	3	CO1 / CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	6	Use Open Bath Beaker Dyeing (OBBD) machine to dye the given cellulosic fabric with cold brand reactive dyes.	3	CO3
	7	Use Open Bath Beaker Dyeing (OBBD) machine to dye the given cellulosic fabric with vinyl sulphone reactive dyes.	3	CO3

LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	8	Use exhaust method to dye the given cellulosic fabric with HE brand reactive dyes.	3	CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	9	Use exhaust method to dye the given cellulosic fabric with ME brand reactive dyes.	3	CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	10	Use leuco vat method to dye the given cotton fabric with I_k class of vat dye.	3	CO4
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	11	Use leuco vat method to dye the given cotton fabric with I_W and I_N class of vat dye.	3	CO4
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	12	Use dyeing method to dye the given cotton fabric with solubilised vat dye.	3	CO4
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	13	Use acid dye to dye the given wool and silk fabric by exhaust dyeing method.	3	CO5
LLO 2.1 Identify various apparatus and glassware used for practical.	14	Use basic dye to dye the given wool and silk fabric by exhaust dyeing	3	CO5

LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.		method.		
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	15	Use natural dye to dye the given fabric by pre-mordanting dyeing method.	3	CO6
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	16	Use different assessment methods for checking the fastness of dyed material.	3	CO6

VII   SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

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:

- o Market survey of different dyes and pigments: compare their properties, applications, and prices.
- o Library survey regarding new developments in dyes, pigments and their application methods.
- o Prepare shade card using combination of primary colours.
- o Prepare question bank referring earlier MSBTE question papers.
- o Give seminar on relevant topic.
- o Collect information from internet about different tools and gauges used in textile industry.

ASSIGNMENTS –

A suggestive list is given here. Similar ASSIGNMENTS could be added by the concerned faculty:
  a. **Dyeing Fault Rectification:** Visit industries and collect at least 10 faulty dyed samples and identify the fault in each sample and rectify. Present your report.
  b. **Lab to bulk dyeing:** Collect any two cotton dyed samples from the industry with their recipe and produce same results in laboratory on OBBD machine by changing appropriate recipe. Correlate the results and present.
  c. **Dye and chemical cost:** Visit industry and collect at least five dyeing recipe, price of dyes and chemicals of any two dyeing methods and calculate dyeing cost. Present report.

d. **Water consumption of Dyeing Process:** Visit any textile dye house. Collect information of any two dyeing machines for their water consumption per day. Calculate the quantity of water consumption per kg of fabric for the complete dyeing process. Present your report.

e. **Shade matching:** Collect any one dyed sample from dye house. Using any class of dye match the shade in the laboratory. Present your matched samples with recipe.

f. **Fastness properties:** Collect any one dyed sample from dye house and evaluate its fastness to washing, rubbing and perspiration in the laboratory. Present your ratings.

g. **Effect of dyeing parameters:** Select any one dye class and the relevant method. Change the dyeing parameters such as Material to Liquor Ratio, temperature, time, chemical concentration and dye the samples in the laboratory. Present the results with your observations.

VIII   LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
1	OBBD machine, 12 pots each with 250 / 500 ml. capacity.	1, 2,3, 4, 5, 6
2	Water bath with steel dye pots with 250 / 500 ml. capacity.	7,8,9, 10,11,12, 13,14,15
3	Drying, Curing & Setting Chamber (Oven), Max. Temperature -200°C	All
4	Electronic balance with 0.001gm accuracy, capacity 300 gm.	All
5	Glassware – Watch glass, Beaker, Glass rod, Pipette etc.	All
6	Relative dyes and chemicals	All

IX   SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE
   (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R- Level	U-Level	A– Level	Total Marks
1	I	General terms & theory of dyeing	CO1	08	4	3	3	10
2	II	Dyeing with Direct Dyes	CO2	06	4	2	2	08
3	III	Dyeing with Reactive Dyes	CO3	10	7	6	4	17
4	IV	Dyeing with Vat and Sulphur Dyes	CO4	10	7	6	4	17
5	V	Dyeing with Acid, Metal complex and Basic Dyes	CO5	08	4	3	3	10
6	VI	Dyeing with Solubilised vat, Natural Dyes and Fastness properties in general.	CO6	06	4	2	2	08
				48	30	22	18	70

X   ASSESSMENT METHODOLOGY /TOOLS
   Formative Assessment (Assessment for learning)

- Lab. Performance (Term work)

   Summative Assessment (Assessment of Learning)
- End of Term examination – Practical Exam and Viva-voce

XI   SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life long learning	PSO-1	PSO-2	PSO-3
CO1	2	2	3	1	1	1	2	2	3	3
CO2	2	2	3	1	1	1	2	2	3	3
CO3	2	2	3	1	1	1	2	2	3	3
CO4	2	2	3	1	1	1	2	2	3	3
CO5	2	2	3	1	1	1	2	2	3	3
CO6	2	2	3	1	1	1	2	2	3	3

Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping

PROGRAM SPECIFIC OUTCOMES (PSO's)

(What s/he will continue to do in the textile and related industry soon after diploma programme)

PSO 1: **Perform preparatory, Colouuration and Finishing of Textiles using various relevant technologies.**

PSO 2: **Perform Quality evaluation of textiles, Fibres, Yarns, Fabrics, Dyes and Chemicals using various standard test methods.**

PSO 3: **Maintain various textile machines to produce various types of quality textiles at optimum and sustainable cost.**

XII   SUGGESTED LEARNING RESOURCES / BOOKS

Sr. No.	Author	Title	Publisher
1	Chemical Processing of Textiles	Koushik, C. V.; Josico, A. I.	NCUTE, 8th Floor, Main Building, IIT, Hauz Khas, New Delhi year 2003
2	Textile processing & properties	Vigo, T. L.	Elsevier Science B.V. Amsterdam year 1994, ISBN: 9780444882240
3	The dyeing of cellulose fibres	Clifford Preston	Dyers co. Publication Trust. England. year 1986, ISBN: 901956430
4	Dyeing and chemical Technology of Textile Fibres	Trotman, E. R.	John Wiley & Sons Inc, year 1985 ISBN: 9780471809104
5	Silk dyeing printing & finishing	Gulrajani, M. L.	Dept. of Textile Technology, Indian Institute of Technology, New Delhi
6	Technology of Dyeing	Shenai, V. A.	Sevak Publications Mumbai - 400031

7	Handbook of Textile and Industrial Dyeing	Clarke, M.	Woodhead Publishing, Year 2011 ISBN: 9781845696962
8	Chemistry of Dyes and Principles of Dyeing	Shenai, V. A.	Sevak Publications Mumbai - 400031
9	Cellulosic Dyeing	Shore John	Society of Dyers and Colourists, England
10	Dyeing of Silk	Shenai, V. A.	Sevak Publications Mumbai - 400031
11	Textile Laboratory Manual	Garner W.,	Volume 4, Dyestuff, American Elsevier Publication, New York.
12	The theory and practice of Wool Dyeing	Bird C.L.	The Society of Dyers and Colourist, England

XIII   LEARNING WEBSITES AND PORTALS

Sr. No.	Links / Portals	Description
1	www.en.wikipedia.org/wiki/Dyeing	Introduction
2	www.teonline.com/knowledge-centre/dyeing-fiber-to-apparel.html	
3	www.teonline.com/knowledge-centre/dyeing.html	
4	www.textilelearner.blogspot.in/2011/12/methods-of-dyeing-different-dyeing.html	
5	www.study.com/academy/lesson/what-is-dyeing-in-textiles.html	
6	www.fibre2fashion.com/industry-article/3871/dyeing?page=1	
7	www.dyes-pigments.standardcon.com/batch-dyeing-process.html	
8	www.dyes-pigments.standardcon.com/continuous-dyeing-process.html	
9	www.dyes-pigments.standardcon.com/semi-continuous-process.html	
10	www.dyes-pigments.standardcon.com/pigment-dyeing.html	

XIV   COURSE CURRICULUM DEVELOPMENT COMMITTEE

S. No.	Name	Institute	Contact No.	Email
1	Shri. Anand P. Modgekar HOD in Textile Chemistry	Sasmira, Mumbai	9869210958	apmodgekar13@rediffmail.com

Program Name :   **Diploma in Textile Technology / Diploma in Textile Chemistry / Diploma in Knitting Technology**

Program Code :   **TT / TC / KT**

Semester :   **Second**

Course Title :   **Testing of Fibers and Yarns**

Course code :   **C231205**

I   RATIONAL

Quality of yarn depends on the fibre properties, fibre parameters and quality of fabric on yarn properties and parameters, and their quality control and testing. The diploma engineer needs to have relevant knowledge and skills related to fibre testing and yarn testing. Fiber and Yarn testing requires recording of number of observations, which are to be analysed, interpreted and used for best results. Therefore, knowledge of fibre and yarn testing is essential for controlling yarn and fabric manufacturing process. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts of fibre and yarn testing to solve broad problems in textile manufacturing.

II   INDUSTRY / EMPLOYER EXPECTED OUTCOME
Apply the concept of fibre and yarn testing to solve textile industry-based technology problems.

III   COURSE LEVEL LEARNING OUTCOMES (COS)
Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO 1 - Select correct sampling method for given fibre, yarn and fabric and identification method for given fibre.
CO 2 - Determine fibre fineness and fibre maturity of given fibre.
CO 3 - Determine fibre length of given fibre by using appropriate method.
CO 4 – Determine linear density of given yarn.
CO 5 - Determine twist per inch and evenness of given yarn using appropriate test method.
CO 6 - Apply principles of tensile strength testing to predict yarn behaviour in subsequent processes.

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME (Abbreviation – MAS, Course Category – AEC, Paper duration – 3 hr)

Course Code	Course Title	Learning Scheme					Credits	Theory				Based on LL and TSL				Based on SL		Total Marks
		Actual Contact Hrs/ week			SLH	NLH						Practical						
		CL	TL	LL				FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
								Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
C231205	Testing of Fibres and Yarns	2	-	2	1	5	2.5	30	70	100	40	25	10	25	10	25	10	175

Total IKS hours for semester: 0 Hrs.

Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

 FA-TH represents average of two class tests of 30 marks each conducted during the semester.

1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V   THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
		SECTION I	
1	TLO 1.1 - Understand importance of textile testing. TLO 1.2 - Perform sampling of fibers and yarn TLO 1.3 - Explain sampling techniques of fiber, yarn and fabric. TLO 1.4 - Identify given fiber using appropriate method of fiber identification TLO 1.5 - Ascertain errors in testing, its causes and remedies.	**Unit – I Sampling, Introduction to Testing and Fiber Identification** 1.1 Objective of textile testing 1.2 Definition of sample, population 1.3 Sampling and its necessity 1.4 Selection of sample, random sampling and biased sampling 1.5 Sampling techniques of fibre, yarn and fabric 1.6 Errors in testing- types of errors, its causes and remedies 1.7 Introduction to testing standards- ASTM, BS, IS, ISO, SDC etc. 1.8 Importance of fiber identification 1.9 Fiber identification methods- a. Microscopic test b. Burning test c. Solubility (chemical) test d. Staining test e. Feel test	Improved Lecture, tutorial, Assignments, Demonstration, Simulation.
2.	TLO 2.1 - Define fiber fineness and explain its significance TLO 2.2 - Define Micronaire, Tex and Denier TLO 2.3 - Measure fineness of given fiber by various methods.	**Unit – II Fiber Fineness, Fiber Maturity and Trash%** 2.1 Fiber fineness and its significance 2.2 Definition- Micronaire, Tex, Denier 2.3 Measurement of fiber fineness by a) Gravimetric method	Improved Lecture, tutorial, Assignments, Demonstration, Simulation.

	TLO 2.4 - Select method for determination of fi neness of given fiber.
	 TLO 2.5 - Define fiber maturity and explain its significance.
	 TLO 2.6 - Determine maturity of given fiber using various method.
	 TLO 2.7 - Select method for determination of maturity of given fiber.
	 TLO 2.8 - Grade cotton fiber into various categories using various grading systems.
	 TLO 2.9 - Measure invisible loss, % trash, % lint in given cotton fiber sample by Shirley trash analyzer.
	 TLO 2.10 - Interpret fiber quality by computing fiber quality index (FQI)
		b) Optical method (Projection Microscope)
		 c) Electrical method- (Vibroscope).
		 d) Airflow principle- Measurement by tester based on airflow principle
		 2.4 Fiber maturity and its significance
		 2.5 Methods of determination of fiber maturity-
		   a) Caustic soda method
		   b) Polarized light method
		   c) Differential dyeing method
		 2.6 Cotton grading- American, Egyptian and Indian cotton grading
		 2.7 Invisible loss, % trash, % lint and its measurement by Shirley trash analyser
		 2.8 Fiber Quality Index (FQI)	

3.	TLO 3.1 - Elaborate significance of fiber length in cotton spinning.
	 TLO 3.2 - Determine fiber length of a given fiber by various methods.
	 TLO 3.3 - Select a method for measurement of length of given fiber.
	 TLO 3.4 - Select span length and uniformity ratio of fiber for production of required quality of yarn
	 TLO 3.5 - Use modern testing instruments like HVI and AFIS for fiber testing.
	 TLO 3.6 - Understand principle of electron microscopy and its advantages, its use in textile field.
	 TLO 3.7 - Elaborate application of SEM and AFM in advance testing of fibres
		Unit- III Fiber Length and Modern Fiber Testing Equipments
		 3.1 Significance of fiber length
		 3.2 Determination of fiber length by
		   a. Hand sampling method,
		   b. Comb sorter principle and analysis of comb sorter diagram,
		   c. Fibrograph – Principle and analysis of fibrogram
		 3.3 Span length, Uniformity ratio and its importance
		 3.4 Basic principle and its application of – a) HVI, b) AFIS
		 3.5 Principle of electron microscopy, its advantages and its various applications in textile field.
		 3.6 Applications of advance testing instruments like SEM, AFM in textiles.
			Improved Lecture, tutorial, Assignments, Demonstration, Simulation.

		SECTION II	
4	TLO 4.1 - Solve the given simple problems based on functions. TLO 4.2 - Solve the given simple problems based on rules of differentiation. TLO 4.3 - Obtain the derivatives of composite, implicit, parametric, inverse, logarithmic, exponential functions. TLO 4.4 - Apply the concept of differentiation to find given equation of tangent and normal. TLO 4.5 - Apply the concept of	**Unit – IV** **Yarn Numbering Systems** 4.1 Definition of linear density 4.2 Yarn number, direct and indirect yarn numbering systems 4.3 Direct yarn numbering: Tex, Denier 4.4 Indirect yarn numbering: British, Metric, Worsted, Woolen, Linen. 4.5 Conversion of yarn from one system to another 4.6 Resultant count calculation. 4.7 Weight, length and count of yarn numerical on Yarn numbering,	Improved Lecture, tutorial, Assignments, Demonstration, Simulation.

	differentiation to calculate maxima, minima and radius of curvature for given function.	4.8 Testing of yarn count:
		    a. Yarn in package form - Analytical method (ASTM D-1907-89)
		    b. Quadrant balance
		    b. Yarn removed from fabric- Beesley yarn count balance, (IS-3442-98)	

5	TLO 5.1 - Differentiate between type of twist and amount of twist.
	TLO 5.2 - Select relevant twist multiplier for manufacturing yarns for given application.
	TLO 5.3 - Describe the relationship between twist and yarn strength.
	TLO 5.4 - Explain the effects of twist on properties of given yarn and fabric.
	TLO 5.5 - Select relevant twist measurement method for given yarn sample.
	TLO 5.6 - Describe the procedure to determine the yarn twist by relevant method.
	TLO 5.7 - Derive relation between tpi and yarn number
	TLO 5.8 - Describe the importance of yarn evenness testing.
	TLO 5.9 - Classify the types of variation in the given yarn.
	TLO 5.10 - Identify the causes of yarn unevenness.
	TLO 5.11 - Make use of different terms of yarn irregularity.
	TLO 5.12- Measure yarn evenness by given method.
	TLO 5.13 - Interpret results of analysis of spectrogram for identifying the faults in machinery.
	TLO 5.14 - Discuss the effect Irregularity on given yarn on yarn and fabric properties.
	TLO 5.15 - Classify yarn faults into different categories of Uster Classimat.
		Unit V – Yarn Twist and Yarn Evenness
		(A) Yarn Twist
		5.1 Definition- twist, twist direction, balance twist, corkscrew twist, twist on twist.
		5.2 Function of twist in yarn structure, amount of twist, twist and yarn strength relationship, effect of twist on fabric properties.
		5.3 Relation between yarn number and twist per unit length, twist multiplier, twist Factor. Application of twist multiplier.
		5.4 Measurement of twist in single Yarn:
		    i) Single yarn twist tester
		    ii) Optical method
		    iii) Twist to break method
		    iv) Twist contraction method
		    a) Measurement of twist in doubles yarn or plied yarn.
		(B) Yarn Evenness
		5.5 Introduction and significance of yarn evenness
		5.6 Concept of variation, classification of variations, basic irregularity, Limit irregularity, expression of irregularity, addition of irregularity, irregularity index, U%, C.V.%
		5.7 Short term, medium term and long term variations.
		5.8 Causes and remedies of unevenness, interpretation of unevenness.
		5.9 Measurement of yarn unevenness:
		5.10 Cutting and weighting method
		5.11 Yarn evenness measurement by
		    a. Uster Evenness tester- Principle, working and features
		    b. Visual examination (ASTM)
		    c. Analysis of Spectrogram.
		5.12 Introduction to Uster Classimat Faults.
			Improved Lecture, tutorial, Assignments, Demonstration, Simulation

6	TLO 6.1 - Define various terms used in strength and elongation testing of	**Unit VI – Fiber and Yarn Strength Testing**	Improved Lecture,

| | textiles
TLO 6.2 - Interpret stress-strain curve of given fiber.
TLO 6.3 - Ascertain yield point of stress-strain curve of given fiber and use this information in processing of fiber.
TLO 6.4 - Define important terms like Young's modulus, work of rupture and elastic recovery.
TLO 6.5 - Enlist various factors affecting tensile properties of textiles.
TLO 6.6 - Measure strength of given fiber using various fiber strength testers.
TLO 6.7 Compare CRE and CRL principle of fiber testing.
TLO 6.8 - Use single yarn strength tester to measure single thread strength of a given yarn.
TLO 6.9 - Use Instron tester to measure single thread strength of single yarn.
TLO 6.10 - Determine CSP of a given yarn and ascertain its quality.
TLO 6.11 -Use ballistic strength tester to measure ballistic strength of given yarn. | 6.1 Definition and units of terms like stress, strain, specific stress, tenacity, breaking strength, elongation and % expression.
6.2 Force-elongation curve and stress-strain curve
6.3 Yield point and methods of yield point construction
6.4 Definition- Young's modulus, work of rupture, elastic recovery.
6.5 Time dependent and instantaneous effect
6.6 Factors affecting tensile properties of textiles
6.7 Fiber strength testing by a) Pressley tester, b) Stelometer, co-relation between both the strengths
6.8 CRE, CRL principle, pendulum lever principle
6.9 Single yarn strength tester – construction and working
6.10 Principle and working of Instron tester
6.11 Lea strength testing –
  a) Lea preparation by wrap reel
  b) construction and working of Lea tester
  c) Count strength product and its significance
6.1 Ballistic strength of yarn – Principle and working of ballistic strength tester. | tutorial, Assignments, Demonstration, Simulation |

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Identify given fiber using microscope.	1	Use microscope for identification of fiber.	2	CO1
LLO 2.1 Identify given fiber's origin by using burning test procedure.	2	Use burning test for identification of fiber.	2	CO1
LLO 3.1 Determine fineness of given fiber using cut and weight method.	3	Use cut and weight method to measure fiber fineness.	2	CO2
LLO 4.1 Determine fiber maturity of given fiber using caustic soda method.	4	Use caustic soda method to determine fiber maturity.	2	CO2
LLO 5.1 Determine mean length of given cotton fiber sample using comb sorter.	5	Use Comb sorter for measurement of fiber length	2	CO3
LLO 6.1 Determine count of given yarn using wrap reel and weighing balance.	6	Use Wrap Reel and Weighing balance to determine Yarn number and C.V. % of count.	2	CO4
LLO 7.1 Determine the count of warp	7	Determine Yarn number of yarn removed	2	CO4

LLO	Detail	#	Description	Hrs	CO
and weft of given fabric.			from fabric.		
LLO 8.1 Determine the denier of given filament yarn using cut-weight method.		8	Determine of Denier of synthetic Yarn by Cut-Weight method.	2	CO4
LLO 9.1 Determine hank and C V% of hank of given sliver and roving using wrap reel.		9	Estimation of Hank and Hank C.V. % of sliver and roving sample using wrap reel.	2	CO5
LLO 10.1 Determine twist per inch of a given yarn using twist contraction principle.		10	Use twist tester working on Twist Contraction principle to determine Twist in Single yarn	2	CO5
LLO 11.1 Determine the twist per inch in a double yarn using untwisting principle.		11	Use twist tester working on Untwisting principle to determine twist in Double yarn by Untwisting method	2	CO5
LLO 12.1 Determine evenness of given yarn using Evenness Tester based on capacitance principle.		12	Use Evenness tester based on capacitance principle for Measurement of Yarn Evenness.	2	CO6
LLO 13.1 Use ASTM Yarn appearance method to grade given yarn.		13	Grade yarn by ASTM Yarn appearance method.	2	CO5
LLO 14.1 Determine the bundle strength of fiber using Stelometer.		14	Use Stelometer for measurement of bundle strength of fibers.	2	CO6
LLO 15.1 Determine single thread strength of given yarn using single thread strength tester and calculate C V % of the same.		15	Use single thread strength tester for measurement of single thread strength of yarn. Calculate C.V.% of strength.	2	CO6
LLO 16.1 Determine Lea strength of given yarn using Lea strength tester and calculate C V % of the same.		16	Use Lea strength tester for measurement of lea strength of yarn. Calculate CSP of yarn and C.C. % of CSP.	2	CO6
LLO 17.1 Measure ballistic strength of given yarn using ballistic strength tester.		17	Use ballistic strength tester for measurement of ballistic strength of yarn	2	CO6
LLO 18.1 Determine single thread strength of given yarn using Enstron.		18	Use Instron tester to measure single thread strength of yarn.	2	CO6

Note – 1. Perform any 15 tutorials/practical out of 18 and ensure that all units are covered.
2. Take tutorial in a batch size of 20 to 30 students. 3. Give students 10 problems to solve on each unit.

VII - SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

- **Testing standards**: Each batch will make a table of standards of important fibre and yarn properties for test procedures of international standards like ASTM, BS etc.
- **Fiber Identification**: Each batch will make chart of fibre identification by one method.
- **Fiber Fineness**: Each batch will make a table of fineness of different fibres used in textile industry.
- **Fiber Maturity:** Each batch will make a table of maturity of different cotton varieties used in textile industry.
- **Fiber Length:** Each batch will collect 10 samples of cotton fibre and perform comb sorter experiment for each sample. Analyse comb sorter diagram and present the readings in tabular format.
- **Advance Testing Equipment:** Make a PPT on advance testing equipment like SEM, AFM and their importance in textile testing.
- **Yarn Numbering:** Each batch will 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.
- **Yarn Numbering:** Each batch will solve 50 numerical on yarn numbering.

- **Yarn Twist:** Collect different yarn samples used for different applications like hosiery, warp, weft, voile, fancy yarn, crepe yarn.
- **Twist Multiplier**: Identify direction of twist and calculate amount of twist and twist multiplier. Prepare chart for the same.
- **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.
- **Yarn Evenness:** Collect and prepare a chart of yarn samples for different count and find out U% of the same using Uster evenness tester.
- **Tensile Strength:** Each batch will 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

ASSIGNMENTS –

- Market survey of different fibres of natural and man-made origin of different linear density based on application and price.
- Market survey of different yarns of natural and man-made origin of different yarn numbers based on application and price.
- Library survey of different fibres used in the industry with respect to name of manufacturer, current price, linear density of fibre.
- Library survey of different yarns used in the industry with respect to name of manufacturer, current price, counts of yarn and blend proportion
- Prepare table for norms published by different research organizations for different yarn properties for various types of yarns.
- Prepare question bank referring old SIMMT question papers for fibre and yarn testing.
- Collect data on count of yarn, lea strength of yarn, Count Strength Product (CSP), Single thread strength of yarn. Find out Standard deviation, Variance and co-efficient of variation (CV%).
- Collect at least 10 examples on application of derivatives based on real world uses.
- Attempt any 5 – 7 assignments, out of the above assignments.

VIII – LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
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..	3, 6, 7 and 8
2	Microscope, with magnification ranges 5x to 100 x.	1 and 4
3	British wrap reel	6, 7
4	Metric wrap reel	6, 7
5	Electric oven inner size 18''x18''x18''; temperature range 100 to 250^0 C. with the capacity of 40 liters, moisture tester.	9
6	Single yarn twist tester	10
7	Double yarn twist tester	11
8	Evenness tester based on capacitance principle	12
9	ASTM standard photo graph	13
10	Use Wrap Reel and Weighing balance to determine hank of sliver and calculate C.V. % of hank.	9
11	Black board wrapping machine.	13
12	Single Yarn Strength Tester	15
13	Lea Strength tester	16
14	Ballistic strength tester.	17

15	Stelometer	14
16	Instron	18

IX SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R-Level	U-Level	A–Level	Total Marks
1	I	Sampling, Introduction to Testing and Fiber Identification	CO1	4	2	4	4	10
2	II	Fiber Fineness, Fiber Maturity and Trash%	CO2	6	2	4	6	12
3	III	Fiber Length and Modern Fiber Testing Equipments	CO3	5	3	4	6	13
4	IV	Yarn Numbering Systems	CO4	4	2	4	6	12
5	V	Yarn Twist and Yarn Evenness	CO5	6	3	4	6	13
6	VI	Fiber and Yarn Strength Testing	CO6	5	2	4	4	10
				30	14	24	32	70

X   ASSESSMENT METHODOLOGY /TOOLS
   Formative Assessment (Assessment for learning)

- Tests
- Rubrics for Cos Assignments
- Midterm Exams
- Self-learning
- Term work
- Seminar / Presentation

   Summative Assessment (Assessment of Learning)

- End term Examination
- Micro-projects
- Tutorial performance

XI   SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Lifelong learning	PSO-1	PSO-2	PSO-3
CO1	3	1	1	1	-	-	1	2	-	-
CO2	3	1	1	1	1	1	-	2	-	-
CO3	3	2	1	1	-	-	-	-	2	-
CO4	3	3	2	1	1	1	1	-	2	-
CO5	3	2	1	1	-	1	1	-	2	-
CO6	3	2	1	1	1	1	1	-	-	2

Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping
PSO 1: Perform spinning, weaving, knitting using various relevant technologies.
PSO 2: Perform designing and garmenting using various relevant technologies.
PSO 3: Maintain various textile machines to produce various types of quality textiles at optimum cost.

XII   SUGGESTED LEARNING RESOURCES / BOOKS

Sr. No.	Author	Title	Publisher
1	Morton, W.E; Hearle, J.W.	Physical Properties of Textile Fibres'	Wood head publishing 2008. ISBN 978-1-84569-220-9.
2	--	Hand book of Textile Testing-part-1: Testing and grading of textile fibres.	SP 15-1:Published 1989 Bureau of Indian Standards(BIS)
3	Skinkle, John H.	Textile Testing Physical, Chemical and Microscopical	Chemical Publishing Co Inc (1940) ASIN: B001OMN6VS
4	Booth, J. E.	Principles of Textile Testing	CBS publishers and distributors private ltd. 1996.New Delhi India. ISBN 10:81-239-O515-7. ISBN 13:9788123905150
5	Kothari, V.K.	Testing & Quality Management	IAFL, New Delhi 1999 ISBN 819010330X, 9788190103305
6	Grover,E.B; Hamby, D.C .	Hand book of Textile Testing & Quality Control	Textile Book Publishers, 1960 - Technology and Engineering the University of Michigan.
7	Saville, B.P.	Physical Testing of Textiles	Wood head publishing limited -2002 Cambridge England. ISBN :1 85573 367 6 CRC press ISBN: 0-8493-0568-3.
8	--	Methods of Tests, Fibre, Yarn & Fabric	CIRCOT, Mumbai
9	Amutha,K.	A Practical Guide to Textile Testing	Wood head Publishing New Delhi India.2016. ISBN:978-93-85059-07-0 .

XIII   LEARNING WEBSITES AND PORTALS

Sr. No.	Links / Portals	Description
1	https://www.slideshare.net/MizanurRehmanShobuj/important-of-textile-testing	Importance of Textile Testing.
2	https://www.textileschool.com/321/fiber-identification-tests-to-identify-a-fibre/	Identification of Fibers
3	https://study.com/academy/lesson/iso-textile-testing-standards.html	ISO Textile Testing Standards
4	https://nptel.ac.in/courses/116102029/14	Fineness

5	https://www.slideshare.net/malarmeganathan/fibre-strength-and-fibre-fineness	Fiber Strength and Fiber Fineness
6	https://nptel.ac.in/courses/116102029/15	Fiber length
7	https://www.scribd.com/doc/97265301/Fiber-Maturity	Fiber Maturity
8	https://nptel.ac.in/courses/116102029/12	Sampling
9	https://clothingindustry.blogspot.com/2018/01/types-fiber-length.html	Types of Fiber Length
10.	https://textilelearner.blogspot.com/2015/03/list-of-equipments-used-in-spinning-lab.html	List of instruments used in Spinning laboratory.
11.	http://textilelearner.blogspot.in/2012/05/yarn-numbering-system-yarn-count-direct.html	Yarn Numbering system
12.	http://textilestudycenter.com/yarn-numbering-system/	Yarn Numbering system
13.	https://www.slideshare.net/islammajharul/yarn-testing-machines	Yarn Testing Machines
14.	https://www.uster.com/en/knowledge/textile-know-how/yarn-testing/	Uster Tester 6
15.	https://archive.nptel.ac.in/courses/116/102/116102029/	Yarn Evenness Testing
16.	https://www.uster.com/products/staple-yarn-testing/uster-tester/	Uster testing machine
17.	https://www.textileadvisor.com/2021/06/yarn-twist-testing.html	Yarn Twist Testing
18.	https://textilelearner.net/twist-measurement-of-yarn/	Yarn Twist Measurement
19.	https://textilelearner.net/yarn-testing-in-textile/	Different Yarn Tests
20	https://textilelearner.net/determination-of-yarn-tensile-strength/	Yarn Strength Tests
21.	https://www.instron.com/en/testing-solutions/astm-standards/astm-d2256	ASTM -D2256 Yarn Testing Method.

XIV   COURSE CURRICULUM DEVELOPMENT COMMITTEE
   <u>**Faculty Members from Polytechnics**</u>

S. No.	Name & Designation	Institute	Contact No.	Email
1.	Mr. A. S. Deshmukh, Sr. Lecturer (Selection Grade).	Sasmira Institute, Worli, Mumbai	9833570740	asdeshmukh@sasmira.edu.in

Textile Colour and Design   **C232206**

Program Name	:	**Diploma in Textile Technology / Diploma in Textile Chemistry / Diploma in Knitting Technology**
Program Code	:	**TT / TC /KT**
Semester	:	**Second**
Course Title	:	**Textile Colour and Design**
Course code	:	**C232206**

I   RATIONAL

When fabric or garments made out of it are purchased by consumers, the consumer looks for innovative designs, new prints, colour scheme**.** Consumer's perception depends on many factors, but the design concept, texture, feel, colour scheme, arrangement of motif are some of the important factors he is looking for.

A textile engineer should have relevant knowledge of inspiration of design, principles of design, various colour schemes methods of composing design which can help him to understand consumer's preference and choice. This course intends to equip students with the concepts, principles of textile designs, colour schemes and their attributes.

This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts of textile designs and colour scheme to create innovative designs to meet ever changing consumer demands.

II   INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry identified outcome through various teaching learning experiences: 1) Apply design principles to create innovative pint and woven designs.

III   COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning
CO1 - Use various elements of art proficiently to create attractive designs as per requirement.
CO2 - Apply various principles of design judiciously to evolve innovative designs.
CO3 - Create innovative textile designs by using various colour harmonies.
CO4 - Use various methods of composing all over designs to develop innovative textile designs as per requirement.
CO5 – Create innovative designs for various types of textiles
CO6 - Explain role of designer, forecasting and market trends

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Course Category	Learning Scheme						Assessment Scheme												Total Marks
			Actual Contact Hrs/ week			SLH	NLH	Credits	Paper Duration (hrs)	Theory				Based on LL and TL				Based on SL		
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
C232206	Textile Colour and Design	DSE	1	0	3	1	5	2.5	-	-	-	-	-	25	10	25	10	25	10	75

Total IKS hours for semester: 2 Hrs.
Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:
 FA-TH represents average of two class tests of 30 marks each conducted during the semester.
1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V   **THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
SECTION I			
1	TLO 1.1 Use different inspiration techniques to produce a design TLO 1.2 Define lines and use different types of lines to create design. TLO 1.3 Explore importance of direction while composing a design TLO 1.4 Use elements of arts like shapes, sizes and texture to create innovative designs as per requirement. TLO 1.5 Apply various elements of arts to compose design as per requirement of end use.	**Unit - I Inspiration of Design and Elements of Arts** 1.1 Inspiration of design – Nature, Man-made objects, combination and designs by other designers 1.2 Line – Concept, definition, types of lines. 1.3 Directions- types. 1.4 Shapes – definition, different types. 1.5 Size – Concept development. 1.6 Textures – concepts and application. 1.7 Value – Concept, use of element in art. 1.8 Colour – definition, sensation process and use.	Hands-on Demonstration Presentations
2.	TLO 2.1 Employ repetition and alternation principles of design while composing a textile design. TLO 2.1 Apply harmony, gradation and contrast principles of design to create innovative textile designs. TLO 2.3 Use unity, balance and dominance and application principles of design to compose textile design for given end use. TLO 2.4 Apply various principles of design to create innovative textile designs for given application.	**Unit - II Principles of Textile Design** 2.1 Repetition – Technical concept 2.2 Alternation – Size, direction, colour shapes, permutation, & combination. 2.3 Harmony – Pure and Discard. 2.4 Gradation – Shape, size and colour. 2.5 Contrast – Hue, colour and value contrast. 2.6 Unity – concept development. 2.7 Balance – Formal and informal balance. 2.8 Dominance and sub-ordination –	Hands-on Demonstration Presentations

		concept and application.	

3.	TLO 3.1 Apply concept of light theory of colour and draw and colour chromatic circle.
	TLO 3.2 Apply concept of pigment theory of colour and draw and colour colour wheel.
	TLO 3.3 Create textile designs by using concept of colour modification for given application.
	TLO 3.4 Select colour harmony for textile design intended for a particular application.
	TLO 3.5 Use various colour harmonies textile designs suitable for required end uses.
		Unit - III Colour Theories
		3.1 Light theory of colour- concept and application, chromatic circle and colour vision.
		3.2 Pigment theory of colour – concept and application, colour wheel.
		3.3 Attributes of primary, secondary and tertiary colours
		3.4 Colour modification – concept and application.
		    a) High key
		    b) Mid key
		    c) Low key
		    d) Change in hue
		    e) Change in value
		    f) Neutralised colour
		3.5 Colour harmonies- Concept, need and requirement.
		    a) Achromatic colour harmony
		    b) Monochromatic colour harmony
		    c) Analogous colour harmony
		    d) Complementary colour harmony
		    e) Split complementary colour harmony
		    f) Double split complementary colour harmony
		    g) Tirade colour harmony
			Hands-on Demonstration Presentations

		SECTION II	

4.	TLO 4.1 Apply principle of unit repeating design while composing textile design.
	TLO 4.2 Apply principle of drop device to create textile design suitable for given application.
	TLO 4.3 Select a base for composing textile design suitable for given application.
	TLO 4.4 Create textile design using concept of drop reverse.
	TLO 4.5 Use sateen system of distribution to create an all-over design for required end use.
		Methods of composing all over designs
		4.1 Unit repeating design – concept and example.
		4.2 Drop device – Principle of half drop, one third drop and quarter drop designs, advantages of drop device.
		4.3 Different bases used for application of half drop principle
		    • Diamond base
		    • Ogee base
		    • Diagonal waved line base
		    • Rectangular base
		    • Drop revers design – advantages
		4.4 Sateen system of distribution – Regular sateen and irregular sateen, advantages and disadvantages.
			Hands-on Demonstration Presentations

5.	TLO 5.1 Construct required stripe colour and weave effect using various methods TLO 5.2 Construct required check colour and weave effect using various methods	**Unit - V Designs for various types of Textiles** 5.1 Design for Woven Fabrics • Colour strips and checks	Hands-on Demonstration Presentations

TLO5.3 Create designs for Printed Textiles
TLO 5.4 Create designs for Dyed Textiles
TLO 5.5 Create designs simulating surface embellishment on Textiles
	• Stripe colour and weave
	• Check colour and weave
	5.2 Design for Printed Textiles
	  • Methods of Printing
	5.3 Design by Dyeing Textiles
	  • Resisting the yarns (Ikat)
	  • Tie and Dye (Bandhni)
	  • Resisting by Wax (Batik)
	  • Resist through floding and stitching (Shibori)
	  • Clamp Technique (Jiaxia)
	5.4 Surface embellishment on Textiles
	  • Embroidery
	  • Applique
	  • Patch work
	  • Fabric Gathering
	  • Smocking
	  • Fabric folding
	  • Thread pulling	

6.	TLO 6.1 Explain Role of Textile Designer TLO 6.2 Explain Timing and Planning in Textile Industry TLO 6.3 Explain Forecast and Market Trends	**Unit - VI Textile Designer** 6.1 Role of Textile Designer 6.2 Timing and Planning in Textile Industry 6.3 Forecast and Market Trends	Hands-on Demonstration Presentations

VI   LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Identify different elements of Art LLO 1.2 Identify use of different elements of art in a design	1	*Create motif from natural or man-made object and draw its decorative, geometrical and abstract form.	3	CO1
LLO 2.1 Identify different principles of design. LLO 2.2 Identify use of different principles in a design.	2	*Elaborate use of each principle of designs with example.	3	CO2
LLO 3.1 Identify different colours in Light theory LLO 3.2 Apply knowledge of Light theory of colour for drawing light theory colour chart	3	Draw and colour Light theory of colour	3	CO3
LLO 4.1 Identify different colours in Pigment theory LLO 4.2 Apply knowledge of Pigment theory of colour for drawing pigment theory colour chart	4	*Draw and colour Pigment theory of colour	3	CO3
LLO 5.1 Apply knowledge of Pigment		*Draw and colour Colour wheel		

theory of colour for drawing colour wheel	5		3	CO3
LLO 6.1 Identify different methods for changing value of colour LLO 6.2 Apply knowledge of value of colours for drawing value charts	6	*Draw and colour Grey Scale, shades and tints.	3	CO3
LLO 7.1 Identify different colour harmonies LLO 7.2 Identify different bases for placement of motif LLO 7.3 Apply Knowledge of colour harmonies and bases for creating allover design	7	Create a allover design of 8" X 8" size for Dress Material (Casual Wear) – select your own motif, colour harmony and method of placement of motif	3	CO3, 4
LLO 8.1 Identify different colour harmonies LLO 8.2 Identify different bases for placement of motif LLO 8.3 Apply Knowledge of colour harmonies and bases for creating allover design	8	Create a allover design of 8" X 8" size for Dress Material (Party Wear) – select your own motif, colour harmony and method of placement of motif	3	CO3,4
LLO 9.1 Identify different colour harmonies LLO 9.2 Identify different bases for placement of motif LLO 9.3 Apply Knowledge of colour harmonies and bases for creating allover design	9	Create a allover design of 8" X 8" size for Bed sheet – select your own motif, colour harmony and method of placement of motif	3	CO3,4
LLO 10.1 Identify different colour harmonies LLO 10.2 Identify different bases for placement of motif LLO 10.3 Apply Knowledge of colour harmonies and bases for creating allover design	10	Create a allover design of 8" X 8" size for Curtains – select your own motif, colour harmony and method of placement of motif	3	CO3,4
LLO 11.1 Identify different colour harmonies LLO 11.2 Identify different bases for placement of motif LLO 11.3 Apply Knowledge of colour harmonies and bases for creating allover design	11	Create a allover design of 8" X 8" size for Kids Wear – select your own motif, colour harmony and method of placement of motif	3	CO3,4
LLO 12.1 Identify different colour harmonies LLO 12.2 Identify different bases for placement of motif LLO 12.3 Apply Knowledge of colour harmonies and bases for creating allover design	12	Create a allover design of 8" X 8" size for Night Suits (Men's/Women's/Kid's) – select your own motif, colour harmony and method of placement of motif	3	CO3,4
LLO 13.1 Identify different colour harmonies LLO 13.2 Identify different bases for placement of motif LLO 13.3 Apply Knowledge of colour harmonies and bases for creating allover design	13	*Create a allover design of 8" X 8" size for Saree – select your own motif, colour harmony and method of placement of motif	3	CO3,4

LLO 14.1 Identify different methods of printed textiles LLO 14.2 Identify different methods of designs by dyeing textiles LLO 14.3 Apply Knowledge of designs by printing and dyeing textiles for creating allover design	14	Create a allover design of 8" X 8" size for Ethnic Wear – select your own motif, printed / dyed textiles	3	CO5
LLO 15.1 Identify different methods of printed textiles LLO 15.2 Identify different methods of designs by dyeing textiles LLO 15.3 Apply Knowledge of designs by printing and dyeing textiles for creating allover design	15	Create a allover design of 8" X 8" size for Traditional Textiles – select your own motif, printed / dyed textiles	3	CO5
LLO 16.1 Identify different methods of woven stirp effect LLO 16.2 Apply knowledge of woven strip effect to produce shirting design	16	Create a allover design of 8" X 8" size for woven Strip Shirting	3	CO5
LLO 17.1 Identify different methods of woven check effect LLO 17.2 Apply knowledge of woven strip effect to produce shirting design	17	Create a allover design of 8" X 8" size for woven check Shirting	3	CO5

Note: Out of above suggestive LLOs -
- '*' Marked Practical (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs is to be performed to achieve desired outcomes.

VII   SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)
Self-Learning

Following are some suggestive self-learning topics: 1) Role of Textile Designer. 2) Timing and Planning in Textile Industry. 3) Colour Forecasting 4) Market Trends

Micro project

The microproject has to be industry application based, internet-based, workshop-based, laboratory-based or field- based as suggested by Teacher. 1)Do a survey of various elements of arts using internet.
2) Survey various principles of design using internet. 3) Study different design from books of textile design and recognize the colour harmonies used in those design. 4) Collect sample of fabric swatches from market which show effect of fabric characteristics on appearance of colour. 5) Collect sample of fabric swatches from market which show compound colour and weave effect and analyze them. 6) Use internet to study history of textile design. 7) Collect information about various CATD softwares used in industry, their advantages, hardware requirements and cost of the software

VIII   LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
1	Drawing sheets, Pensil HB, 2B, 4B, 6B, eraser, Poster Colour Box, Colour pallet, Colouring brush of different numbers, 12" Scale, Set squares, Rounder, Tracing paper, Waste cloth piece, Small water container/flask	All

IX SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R- Level	U- Level	A– Level	Total Marks
1	I	Inspiration of Design and Elements of Arts	CO1	2	0	0	0	0
2	II	Principles of Textile Design	CO2	3	0	0	0	0
3	III	Colour Theories	CO3	2	0	0	0	0
4	IV	Methods of composing all over designs	CO4	3	0	0	0	0
5	V	Designs for various types of Textiles	CO5	3	0	0	0	0
6	VI	Textile Designer	CO6	2	0	0	0	0
				15	0	0	0	0

X   ASSESSMENT METHODOLOGY /TOOLS
     Summative Assessment (Assessment for learning)

- Lab. Performance (Term work)

XI   SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Lifelong learning	PSO-1	PSO-2	PSO-3
CO1	-	-	3	1	-	-	-	1	2	-
CO2	1	-	3	1	-	-	-	1	3	-
CO3	2	-	3	1	-	-	1	1	3	-
CO4	2	-	1	1	-	-	1	1	3	-
CO5	3	1	-	-	-	2	1	1	1	-
CO6	2	2	1	-	-	-	-	1	1	-
Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping										
PROGRAM SPECIFIC OUTCOMES (PSO's)										
(What s/he will continue to do in the textile technology specific industry soon after diploma programme)										
PSO 1: Perform spinning, weaving, Knitting and garmenting processes using various relevant technologies.										
PSO 2: Execute designing and development of various textile products using various relevant technologies.										
PSO 3: Maintain various textile machines to produce various types of quality textiles at optimum cost.										

XII SUGGESTED LEARNING RESOURCES / BOOKS

Sr. No.	Author	Title	Publisher
1	Z. Grosicki	Watson's Textile Design and Colour	Universal Publishing Corporation, Mumbai - India. ISBN 81-85027-11-0.
2	V.A.Shenai	History of Textile Designs	Sevak Publications, Mumbai
3	C.R. Sadhale	Instruction Package on Application of Arts and Design to Textiles	Private circulation TTTI, Bhopal and DKTE, Ichalkaranji

XIII LEARNING WEBSITES AND PORTALS

Sr.No.	Links / Portals	Description
1	https://en.wikipedia.org/wiki/Elements_of_art	Elements of Art
2	http://www.artyfactory.com/art_appreciation/visual-elements/visual-elements.html	Elements of Art
3	https://artclasscurator.com/principles-of-design-examples/	Principles of Design
4	https://www.slideshare.net/erinsmith.art/principles-of-design-252201	Principles of Design
5	https://clivepowseyartinstruction.weebly.com/visual-examples-of-the-principles-of-design.htm	Principles of Design
6	http://www.tigercolor.com/color-lab/color-theory/color-harmonies.htm	Colour Harmony
7	https://anneroselt.com/2018/03/26/creating-colour-harmony/	Colour Harmony
8	https://simplicable.com/new/color-harmony	Colour Harmony
9	https://www.tandfonline.com/doi/abs/10.1080/00405000.2014.887239	Colour Harmony
10	https://www.researchgate.net/publication/260165373_Effect_of_cotton_fiber_and_yarn_characteristics_on_color_variation_in_woven_fabric_dyed_with_vat_dyes	Effect of Fabric Properties
11	https://www.researchgate.net/publication/221913744_Color_and_Weave_Relationship_in_Woven_Fabrics	Effect of Fabric Properties
12	https://www.culturalindia.net/indian-crafts/indian-textiles.html	Traditional Textiles
13	http://www.india-crafts.com/textile/weaving_traditions/brocade/	Traditional Textiles
14	https://en.wikipedia.org/wiki/Shawl	Traditional Textiles
15	https://en.wikipedia.org/wiki/Embroidery_of_India	Embroidery
16	https://www.craftsvilla.com/blog/indian-prints-fabrics-bandhani-ikat-batik/	Traditional Textiles
17	https://study.com/academy/lesson/textile-design-techniques-process.html	Traditional Textiles
18	https://www.slideshare.net/mjrtipu/different-software-use-for-textile-design.	CAD
19	https://www.youtube.com/watch?v=mtZWIHHpGOo	CAD

XIV COURSE CURRICULUM DEVELOPMENT COMMITTEE
   Faculty Members from Polytechnics

Sr. No	Name & Designation	Institute	Contact No.	Email ID
1.	Mr. S.S. Joglekar Sr. Lecturer (Selection Grade)	Sasmira's Institute of Man-made Textiles, Worli, Mumbai – 30.	9833909871	shirishjoglekar@sasmira.edu.in

Programme Name: Diploma in Textile Technology/Diploma in Knitting Technology

Programme Code : DTT/DKT

Semester   **: SECOND**

Course   **: Fundamentals of Wet Processing**

Course Code   **: T233203**

I   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 pre-treatments 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.

II   INDUSTRY/EMPLOYER EXPECTED OUTCOME

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."

III   COURSE LEVEL LEARNING OUTCOMES (CO'S)

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**:**

(CO 1) Use principles of pre-treatment of fabrics in textile manufacturing
(CO 2) Use relevant methods for bleaching treatments of fabrics.
(CO 3) Use relevant method for dyeing of textile fabrics fabrics.
(CO 4) Use basic methods of printing of textiles fabrics
(CO 5) Choose relevant finishing process according to the end uses.
(CO 6) Select relevant evaluation of fastness properties and fibre identification methods.

IV   TEACHING-LEARNING AND ASSESSMENT SCHEME

Course Code	Course Title	Course Category	Learning Scheme					Credits	Paper Duration (hrs)	Assessment Scheme											Total Marks
			Actual Contact Hrs/ week			SLH	NLH			Theory				Based on LL and TSL				Based on SL			
														Practical							
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA			
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min		
T233203	FUNDAMENTALS OF WET PROCESSING	DSE	2	-	3	1	6	3	3	30	70	100	40	25	10	25	10	25	10	175

Total IKS hours for semester: 02 Hrs.

Abbreviations: CL- Class room Learning, TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH- Notional Learning Hours, FA- Formative Assessment, SA-Summative assessment, IKS - Indian Knowledge System, SLA- Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, *# On Line Examination, @$ Internal Online Examination

Note:

 FA-TH represents average of two class tests of 30 marks each conducted during the semester.

1. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
2. If candidate is not securing minimum passing marks in SLA of any course, then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
3. Notional Learning hours for the semester are (CL+LL+TL+SL) hrs.* 15 Weeks
4. One credit is equivalent to 30 Notional hrs.
5. * Self-learning hours shall not be reflected in the Time Table.
6. * Self-learning includes micro project/ assignment/ other activities.

V   **THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr. No.	Theory Learning Outcomes (TLOs) aligned to Cos	Learning content mapped with Theory Learning Outcomes (TLOs) and (Cos)	Suggested Learning Pedagogies.
		SECTION I	
1	TLO 1.1 introduction to wet processing TLO 1.2Describe with sketches the features of the given system TLO 1.3 Describe with sketches the procedure to carry out the given type of desizing. TLO 1.4 Describe the scouring process for textile fabrics TLO 1.5 Describe with sketches the procedure to carry out given type of Scouring with machines. TLO 1.6 Explain the importance of mercerisation process.	**Unit – I Basics of Pretreatments** 1.1 Process flow chart for wet processing of textiles, Grey inspection process 1.2 Shearing and cropping process: Objective and process 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 1.6Mercerization: factors affecting the process of mercerization, Machine used for mercerization.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
2.	TLO 2.1 Explain with sketches the procedure for bleaching of the given type of fibre. TLO 2.2 Explain with sketches the procedure for continuous processing of the given type of blend TLO 2.3 Explain with sketches the Batch wise bleaching process	**Unit– II Bleaching of Textile fibres** 2.1 objective and importance of bleaching process 2.2 Bleaching process with sodium chlorite, sodium hypochlorite and H2O2 bleaching. 2,2Batch wise and continuous methods of bleaching	Lectures, Presentations, Assignments, Practical, You-tube simulation.

	TLO 2.4 Explain the process parameters for bleaching of cellulosics and blends TLO 2.5 Suggest the method of evaluation of bleached fabric	2.3 Machines used for bleaching: Jiggers, winch, soft flow, continuous bleaching range. 2.4 Bleaching of cellulosics and blends 2.5 Evaluation of bleaching efficiency of bleached fabrics.	
3.	TLO 3.1 Explain the principle of dyeing TLO 3.2 Describe with sketches for Dyeing of given type of Cellulosic fibre. TLO 3.3Describe with sketches the given type of dyeing method with procedures TLO 3. 4Describe with sketch the principle and working of Dyeing Machineries. TLO 3.5 Explain the comparison between batch-wise and continuous dyeing minachines. TLO 3.6 Explain ancient method used for dyeing of cellulosic fibres.	**Unit III – Dyeing of Textile fibres** 3.1 Colouring matter: classification of dyes. 3.2 Classification, Methods of application and after treatments of Direct, Reactive, Vat dyes etc. 3.3 Disperse dyes: dyeing mechanism, Carrier dyeing, HTHP dyeing process of Polyester 3.4 Dyeing processes, process parameters, faults and remedies. 3.5Machines for dyeing: batch wise and continuous and comparison 3.6 Ancient dyeing method: dyeing cellulosics with natural colors	Lectures, Presentations, Assignments, Practical, You-tube simulation.
SECTION --II			
04	TLO 4.1 Describe with sketches the procedure for of the given method of printing. TLO 4.2 Describe the features of the given style of printing. TLO 4.3 Describe with sketches the construction of given type of printing machine TLO 4.4 Describe with sketches the procedure for printing of the given type of fabric sample TLO 4.5 Describe with sketches the procedure for of the given method of printing. TLO 4.6 Describe the features of the given style of printing. TLO 4.7 Describe with sketches the construction of given type of printing machine.	**Unit IV – Basic concepts of printing** 4.1 Printing: objective, Methods and Styles of Printing Fixation of printed textiles 4.2 Screen printing: Flatbed 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. 4.3 Printing with direct dye :Print paste, ingredients for direct and discharge style of printing 4.4 Printing with reactive dyes: Print paste ingredients for direct,discharge and resist style ofprinting. 4.5 Pigments printing: mechanism and method of printing.	Lectures, Presentations, Assignments, Practical, You-tube simulation.
05	TLO 5.1 Describe the features of the given type of finishing machinery. TLO 5.2 Describe with sketches the mechanism of the given type of	**Unit V – Basic concepts of finishing** 5.1 Finishing: objective of textile finishing, classification of finishing	Lectures, Presentations, Assignments, Practical, You-

	finishing TLO 5.3 Describe with sketches the given type of softening treatment TLO 5.4 Describe with sketches the mechanism of flame retardent finishing for the given type of fabrics. TLO 5.5 Select appropriate softener/stiffeners for required finish.	5.2 Finishing machinery : Calendaring,Decatising , VDR , Sanforising, Stenter etc 5.3 Resin finishing :Mechanism of creasing and resin finishing, Types of resin finishing, methods of application 5.4 Flame retardant finishing: Concept of flame proof and flame retardancy. Limiting oxygen Index and its importance, Thermal behaviour of textile fibres. 5.5 Softening and stiffening treatments: classification of softeners, Properties, application of softener.	tube simulation.
06	TLO 6.1 6a. Explain various methods for Identification of textile fibres. TLO 6.2 Describe with procedures the objectives of fastness properties. TLO 6.3 Explain methods of assessment of fastness properties	**Unit VI – Fibre identification and Blend analysis** 6.1 Methods of fibre identification: Burning test and solubility test. 6.2 Fastness properties –light ,rubbing, washing, sublimation, etc. 6.3 Blend analysis method-physical and chemical.	Lectures, Presentations, Assignments, Practical, You-tube simulation.

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr. No.	Laboratory Experiment / Practical Title / Tutorial Title	No. of Hours	Relevant COs
LLO 1.1 Identify various apparatus and glassware used for practical. LLO 1.2 Select suitable apparatus and glassware for the practical execution. LLO 1.3 Use relevant apparatus and glassware for the practical execution and understand the effect of change in finish on cotton fabric.	1	Desize the given grey cotton fabrics by using acid/enzyme.	03*	CO1
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of after treatments on dyed of cotton.	2	Scour the given cellulosic and synthetic fabrics.	03*	CO1
LLO 2.1 Identify various apparatus and	3		3	CO2

glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different concentrations of exhausting agents on dyeings of cotton.		Bleach the given cotton fabric by using sodium hypochlorite.		
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different MLR on dyeing of cotton.	4	Bleach the given cellulosic and synthetic fabrics by using H2O2	3	CO2
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different concentration of fixing agents on dyeing of cotton.	5	Bleach the given cellulosic and synthetic fabrics by using hydrogen peroxide.	3	CO2
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	6	Dye the given fabric sample by using direct dyes.	03*	CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	7	Dye the given fabric sample by using reactive dyes.	3	CO3
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	8	Dye the given polyester/nylon fabric with disperse dyes by using H.T.H.P./ Carrier dyeing method	3	CO3
LLO 2.1 Identify various apparatus and	9		3	CO4

glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.		Dye the given acrylic fabric by using cationic dyes.		
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	10	Print the given fabric sample by direct style of printing by using direct dyes	3	CO6
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	11	Print the given fabric sample by discharge styles of printing by using reactive dyes.	3	CO6
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	12	Print the given fabric sample by discharge styles of printing by using reactive dyes	3	CO5
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	13	Print the given fabric sample by pigment printing method.	3	CO4
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	14	Carry out soft finish on the given fabric samples	3	CO5
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and	15		3	CO6

glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.		Carry out Blend analysis of given fabric		
LLO 2.1 Identify various apparatus and glassware used for practical. LLO 2.2 Select suitable apparatus and glassware for the practical execution. LLO 2.3 Use relevant apparatus and glassware for the practical execution and understand the effect of different dye class on dyeing of cotton.	16	Carry out Washing fastness test of colored fabrics	3	CO6

VII - SUGGESTED MICRO PROJECTS / ASSIGNMENTS / ACTIVITIES FOR SPECIFIC LEARNING / SKILL DEVELOPMENT (SELF LEARNING)

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:

(a) Market survey of different processed fabrics and compare the following points.
❖ construction and type of weave
❖ processes carried out
❖ Applications of the given fabric.
(b) Visit any synthetic process house nearby to your house and take the help of processing in-charge to know the various processes.
(d) Write report on visit to dye house and compare the existing process conditions.
(e) Read the safety precautions of various chemicals and machinery used in process house.
 (f) Do internet survey and prepare chart of various finishes, chemicals and machines in market.
(g) Guide student(s) in undertaking micro-projects.
(h) Library/ Internet survey of developments in all fibre finishing.
(i) Prepare power point presentation for understanding various finishing processes
(j) Understand faults in dyeing and find relevant remedies.
(k) Understand good work practices in synthetic fabric dyeing.

SUGGESTED ASSIGNMENTS –
A suggestive list is given here. Similar ASSIGNMENTS could be added by the concerned faculty:
(a) Pretreatments: Prepare models to demonstrate Fundamental methods of desizing, scouring, bleaching, mercerization and OBA treatment.
(b) Dyeing and Printing: Prepare models to demonstrate Fundamental methods of Dyeing & printing of different textile fibre varieties with different class of dyes and machines
(c) Finishing & Testing: Prepare models to demonstrate Fundamental methods of

finishing processes, chemicals and machineries, testing of textiles for different test parameters.

VIII – LABORATORY EQUIPMENTS / INSTRUMENTS / TOOL AND SOFTWARES REQUIRED.

Sr. No	Equipment Name with Borad Specifications	Relevant LLO Number
1	Padding mangle machine, pots each with 250 / 500 ml. capacity.	1, 2,3, 4, 5, 6
2	Water bath with steel dye pots with 250 / 500 ml. capacity.	7,8,9, 10,11,12, 13,14,15
3	Drying, Curing & Setting Chamber (Oven), Max. Temperature -200°C	All
4	Electronic balance with 0.001gm accuracy, capacity 300 gm.	All
5	Glassware – Watch glass, Beaker, Glass rod, Pipette, cylinders etc.	All
6	Relative finishing agents samples and chemicals	All

IX SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTES AND ASSESSMENT PURPOSE (Specification Table)

Sr. No.	Unit	Unit Title	Applied Cos	Learning Hours	R- Level	U- Level	A– Level	Total Marks
1	I	Basics of pretreatment processes	CO1	10	6	4	4	14
2	II	Bleaching of regenerated and synthetic fibres	CO2	06	5	3	2	10
3	III	Dyeing of Textile fibres	CO3	08	5	3	3	11
4	IV	Basic concepts of printing	CO4	09	6	4	3	13
5	V	Basic concepts of finishing	CO5	10	6	4	4	14
6	VI	Fibre identification& blend analysis	CO6	05	4	2	2	*08*
				48	32	20	18	70

X. ASSESSMENT METHODOLOGY /TOOLS
Formative Assessment (Assessment for learning)

- Lab. Performance (Term work)

Summative Assessment (Assessment of Learning)
- End of Term examination – Practical Exam and Viva-voce

XI . SUGGESTED CO-PO MATRIX FORM

Course Outcomes Cos	Program Outcomes (Pos)							Program Specific Outcomes (PSOs)*		
	PO-1 Basic & Discipline specific knowledge	PO-2 Problem Analysis	PO-3 Design Development of solutions	PO-4 Engineering tools	PO-5 Engineering practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life long learning	PSO-1	PSO-2	PSO-3
CO1	2	2	3	1	1	1	2	2	3	3
CO2	2	2	3	1	1	1	2	2	3	3
CO3	2	2	3	1	1	1	2	2	3	3
CO4	2	2	3	1	1	1	2	2	3	3
CO5	2	2	3	1	1	1	2	2	3	3
CO6	2	2	3	1	1	1	2	2	3	3

Legends: - High: 03, Medium: 02, Low: 01, 0: No mapping

PROGRAM SPECIFIC OUTCOMES (PSO's)
(What s/he will continue to do in the textile and related industry soon after diploma programme)

PSO 1: **Perform preparatory, Colouration and Finishing of Textiles using various relevant technologies.**

PSO 2: **Perform Quality identification,evaluation of textiles, Fibres, Yarns, Fabrics, Dyes and Chemicals using various standard test methods.**

PSO 3: **Maintain various textile machines to produce various types of quality textiles at optimum and sustainable cost.**

XII SUGGESTED LEARNING RESOURCES / BOOKS

Sr. No.	Author	Title	Publisher
1	Datya .K.V & Vaidya .A.A	Chemical processing of synthetic and its blends	A wiley inter science publication ISBN-0901956740 ,1984
2	Trotman, E. R. T.	Dyeing and chemical Technology of Textile Fibres	John willey and Sons Inc,**1985** ISBN**:** 978-0471809104
3	Shenai, V.A	Fundamental Principles of Textile Processing .	Sevak Publications, Bombay, 1984 *ISBN* 13: 9783659686047.
4	Clarke, W.	An Introduction to Textile Printing	CBS Publishers and Distributors Pvt. Ltd., New Delhi 2004; ISBN: 9781855739949
5	Gulrajani, M. L.	Silk Dyeing printing and finishing	BPB Publications, New Delhi 2016, ISBN:978-8183331630

6	Grover, E.B; Hamby, D.C.	Hand book of Textile Testing & Quality Control	John Wiley & Sons Inc., 1960, ISBN: 9780470329016
7	Hurst, George and Henry	Silk Dyeing, Printing and Finishing	Ratebooks club.com,2012 ISBN-9781130986525
8	Amutha K.	A Practical Guide to Textile Testing	Wood Head Publishing, New Delhi, 2016. ISBN: 9789385059070
9	Basak Anindita	Environmental Studies	Pearson education
10	Heywood	Textile Finishing	*SDC Publications ISBN-9780901950811*
11			

XIII   LEARNING WEBSITES AND PORTALS

Sr. No.	Links / Portals	Description
1	Textilelearner.blogspot.in/2011/03/description-of-textile-finishing_1796.html	
2	Textilelearner.blogspot.in/2012/03/textile-softening-fabric-softening.html	
3	www.onlineclothingstudy.com/2015/11/mechanical-finishes-textiles.html	
4	Textileapex.blogspot.in/2015/03/resin-finishing-importance.html	
5	Textilelearner.blogspot.in/2011/05/description-of-optical-brightening_4142.html	
6	www.teonline.com/knowledge-centre/flame-retardants.html	
7	Textilelearner.blogspot.com/printing-method-method-of-printing	
8	www.tikp.co.uk/knowledge/technology/finishing/textile-finishing	
9	Textilefashionstudy.com/finishing-of-textiles-definitions-objective	
10	www.fibre2fashion.com/industry-article/1240/antimicrobial-finishes	

XIV   COURSE CURRICULUM DEVELOPMENT COMMITTEE

S. No.	Name	Institute	Contact No.	Email
1	Shri. Bhagwan R Khade Lecturer	Sasmira, Mumbai	9930602109	bhagwankhade@sasmira.edu.in