

Curriculum
of
Diploma Programme
in
Textile Engineering



State Board of Technical Education (SBTE)
Bihar

Semester – IV

Teaching & Learning Scheme

Board of Study	CourseCodes	CourseTitles	Teaching & Learning Scheme (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2428401	Yarn Manufacture-II	3	-	4	2	9	6
	2428402	Yarn Preparation and Weaving Calculation -II	2	1	-	2	5	4
	2428403	Fabric Structure and Design	3	-	4	2	9	6
	2428404	Fabric Manufacture -II	3	-	4	2	9	6
	2428405	Textile Coloration and Finishing	3	-	4	2	9	6
	2400007	Indian Constitution (Common for All Programmes)	1	-	-	-	1	1
	2452107	Basics of Liberal Art (Non-exam course) (FTS, GT, TE)	1	-	-	-	1	1
Total			16	1	16	10	43	30

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

Semester - IV Assessment Scheme

Board of Study	Course Codes	Course Titles	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term work & Self-Learning Assessment (TWA)		Lab Assessment(LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2428401	Yarn Manufacture-II	30	70	20	30	20	30	200
	2428402	Yarn preparation and Weaving Calculation -II	30	70	20	30	-	-	150
	2428403	Fabric Structure and Design	30	70	20	30	20	30	200
	2428404	Fabric Manufacture -II	30	70	20	30	20	30	200
	2428405	Textile Coloration and Finishing	30	70	20	30	20	30	200
	2400007	Indian Constitution (Common for All Programmes)	25	-	-	-	-	-	25
	2452107	Basics of Liberal Art (Non-exam course)	25	-	-	-	-	-	25
Total			200	350	100	150	80	120	1000

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- A) **Course Code** : 2428401(T2428401/P2428401/S2428401)
- B) **Course Title** : Yarn Manufacture-II
- C) **Pre-requisite Course(s)** : Yarn Manufacture-I
- D) **Rationale** :

Today yarn spinning or production is a highly advanced technology that enables the engineering of different yarn structures having specifically desired properties suited for particular end use applications. The end uses include cover a broad range starting from garments for everyday use, household textiles, carpets, sports clothing and fabrics for automotive interiors, aerospace and medical and healthcare applications. A detailed understanding of how fibre properties and machine parameters are employed to produce yarn structures of appropriate properties is, therefore, an important objective in the study of yarn spinning technology. Thus this course has been designed to provide knowledge and skills for the process of making different types of yarn.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Use Speed frame machine to produce uniform roving from different hanks of draw frame sliver.
- CO-2** Use Ring frame machine to produce good quality yarn of different counts from roving.
- CO-3** Produce plied/fancy yarn using relevant machine/process as per given specification.
- CO-4** Select relevant new spinning process/system to produce yarn of given count.
- CO-5** Suggest relevant machine/process to convert spinning waste into useful products.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	3	2	2	2	-	1	1		
CO-2	3	2	3	2	-	1	1		
CO-3	3	1	3	2	1	1	1		
CO-4	3	2	2	2	-	1	1		
CO-5	3	1	2	2	3	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Textile Engineering	2428401	Yarn Manufacture-II	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Textile Engineering	2428401	Yarn Manufacture-II	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2428401**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Describe the need of roving frame. <i>TSO 1b.</i> Explain passage of material through roving frame. <i>TSO 1c.</i> Describe function of various elements in drafting zone. <i>TSO 1d.</i> Explain the principle of twisting and winding. <i>TSO 1e.</i> Distinguish between different types of flyer. <i>TSO 1f.</i> Identify the elements of flyer. <i>TSO 1g.</i> Explain the principle of builder motion. <i>TSO 1h.</i> Estimate the production in kg/shift of roving frame for given data.	Unit-1.0 Speed Frame 1.1 Introduction : Necessity, objectives, passage of material and working principle. 1.2 Various components of machine and their functions , Principle of drafting, twisting and winding in roving frame 1.3 Drafting zone: Different types of drafting system, Apron drafting, drafting rollers, draft range, cradle length and its setting for different materials, condenser, spacer 1.4 Spindle and flyer: Functions and rotation rate of each, flyer leg, various design of flyer, flyer top, pressure arm, Twisting mechanism, Turns per meter, delivery speed 1.5 Winding mechanism- Flyer leading and bobbin leading method, advantages and limitations of each, winding of the roving bobbin, shape of package, taper angle 1.6 Builder mechanism: Building of bobbin, movement of bobbin rail, lift and shift of bobbin rail, winding on package, bobbin drive, gearing diagram, differential motion, cone drive transmission, cone drums profile, belt shifting mechanism, lifter motion of bobbin 1.7 Recent developments in speed frame 1.8 Calculation regarding draft, twist and production	CO1
<i>TSO 2a.</i> Describe objectives of ring frame. <i>TSO 2b.</i> Explain working principle of ring frame. <i>TSO 2c.</i> Describe the principles of twisting and winding. <i>TSO 2d.</i> Explain the function of various elements of ring frame. <i>TSO 2e.</i> Classify different types of ring and traveller. <i>TSO 2f.</i> Select the appropriate traveller for the given situation. <i>TSO 2g.</i> Describe various yarn guiding devices. <i>TSO 2h.</i> Explain cop building mechanism.	Unit-2.0 Ring Frame 2.1 Objectives, passage of material and working principle 2.2 Machine Parts and their function : The creel, drafting arrangement, cradle, spacer, apron, lappet, balloon control ring (BCR), spindle, ring and traveller, separator, variation in yarn tension during spinning 2.3 Principle of drafting, twisting and winding in ring frame, twist flow in ring spinning	CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 2i.</i> Describe the principle of compact spinning. <i>TSO 2j.</i> Differentiate between ring spun and compact spun yarn.	2.4 Drafting system in ring frame, roller inclination, different system of top roller weighting, draft level, spinning triangle 2.5 Ring and Traveller: Various types of Ring, material, flange width, number and diameter Traveller classification, wire profile, material, mass of traveller, traveller clearer, traveller number 2.6 Winding mechanism: Structure of cop, movement of ring rail, BCR and thread guide 2.7 Builder motion: Drive used in building of cop 2.8 Spindle drive types, Forces acting on the traveller and yarn ballooning, resultant force on traveller 2.9 Calculation regarding speed, draft and draft constant, twist and twist constant, production 2.10 Compact spinning: Need, spinning triangle, factors affecting the spinning triangle, methods of compacting fibre strand, comparison between conventional ring spun and compact spun yarn	
<i>TSO 3a.</i> Define the objectives of yarn doubling. <i>TSO 3b.</i> Identify twist direction in the yarn. <i>TSO 3c.</i> Explain passage of material through given doubling frame. <i>TSO 3d.</i> Explain characteristics of double yarn <i>TSO 3e.</i> List the application of double yarn. <i>TSO 3f.</i> suggest fancy yarn based on end uses. <i>TSO 3g.</i> Explain the method of production of different fancy yarns.	Unit-3.0 Doubling Frame 3.1 Objectives, preparation for doubling, steps of manufacture of double yarn, assembly winding 3.2 Twist direction, S & Z twist, twist against twist, twist-on-twist, types of twisted yarns and their uses 3.3 Working principle of Ring doubler, Two-for-one twister (TFO), advantages of TFO 3.4 Effect of yarn parameter on doubled yarn properties, Application of double yarn 3.5 Characteristics of ply yarn 3.6 Fancy yarns: Types, methods of preparation and their uses	CO3
<i>TSO 4a.</i> Describe the limitations of conventional spinning process. <i>TSO 4b.</i> Classify unconventional spinning systems. <i>TSO 4c.</i> Describe the working principle of given type of new spinning system. <i>TSO 4d.</i> Explain the working mechanism of rotor spinning. <i>TSO 4e.</i> Describe the effects of rotor diameter and speed on the characteristics of yarn. <i>TSO 4f.</i> Differentiate between the properties of yarn spun by two different systems. <i>TSO 4g.</i> Describe the uses of yarn spun by new spinning system.	Unit-4.0 New Spinning System 4.1 Limitations of ring spinning, classification of New spinning process, common features 4.2 Open end spinning: Classification, their working principle, advantages and limitations, comparison of ring spinning and open end spinning process 4.3 Rotor spinning: Construction, working principle, raw material requirements and preparation 4.4 Important parameters, back doubling, selection of process variables for processing different materials, influence of opening roller speed and rotor speed/diameter on yarn structure and quality	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 4h.</i> Calculate the production of given rotor spinning.	4.5 Yarn structure and properties of rotor spun yarn, wrapper fibres, comparison of rotor spun yarn with ring spun yarn, applications of rotor yarns 4.6 Modern developments in rotor spinning, calculation regarding twist, draft, speed and production 4.7 Other unconventional spinning process: Introduction and working principle 4.8 Comparison of properties of yarn spun by new spinning system with ring spun yarn	
<i>TSO 5a.</i> Identify the types of waste generated during spinning process. <i>TSO 5b.</i> Suggest methods to convert waste into useful products. <i>TSO 5c.</i> Explain the given process of spinning waste conversion.	Unit-5.0 Waste Spinning 5.1 Spinning waste and their classification 5.2 Preparation and methods of converting waste into useful products. 5.3 Machineries for spinning waste conversion. 5.4 Uses of Spinning waste	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2428401

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Draw the sketch of the passage of material through speed frame. <i>LSO 1.2.</i> Identify the parts of Speed frame machine. <i>LSO 1.3.</i> Draw line and gearing diagrams of speed frame.	1.	Passage of material through speed frame	CO1
<i>LSO 2.1.</i> Draw the arrangements of drafting system. <i>LSO 2.2.</i> Demonstrate the working of different part of the speed frame. <i>LSO 2.3.</i> Use gearing diagram of the machine to determine the speed, draft, draft constant, twist, twist constant and production per spindle in kg/shift of roving frame.	2.	Production of roving using speed frame	CO1
<i>LSO 3.1.</i> Draw the sketch of the passage of material through Ring frame. <i>LSO 3.2.</i> Identify different parts of the Ring frame. <i>LSO 3.3.</i> Draw line and gearing diagrams of Ring frame.	3.	Passage of material through Ring frame	CO2
<i>LSO 4.1.</i> Draw the arrangements of drafting system. <i>LSO 4.2.</i> Demonstrate the working of different part of Ring frame.	4.	Production of yarn using Ring frame	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 4.3.</i> Demonstrate spinning triangle and angle of yarn pull. <i>LSO 4.4.</i> Use gearing diagram of the machine to determine the speed, draft, draft constant, twist, twist constant and production per spindle in kg/shift of Ring frame using gearing diagrams of the machine.			
<i>LSO 5.1.</i> Draw the sketch of the passage of yarn through the available yarn doubling frame. <i>LSO 5.2.</i> Identify the important parts of doubling frame machine.	5.	Passage of yarn through doubling frame	CO3
<i>LSO 6.1.</i> Demonstrate the assembly winding of the yarn. <i>LSO 6.2.</i> Demonstrate the twisting mechanism of ply yarn. <i>LSO 6.3.</i> Determine the production in kg/shift of doubling frame.	6.	Production of Ply yarn using doubling frame	CO3
<i>LSO 7.1.</i> Draw the sketch of the passage of material through Rotor spinning machine. <i>LSO 7.2.</i> Identify the important parts of Rotor spinning machine and label them. <i>LSO 7.3.</i> Draw line and gearing diagrams of Rotor spinning.	7.	Passage of material through Rotor spinning	CO4
<i>LSO 8.1.</i> Demonstrate the working of different parts of rotor. <i>LSO 8.2.</i> Use Rotor spinning machine to produce a given coarser count of yarn. <i>LSO 8.3.</i> Determine speed, twist and production for given material by using gearing diagrams of the machine.	8.	Production of yarn using Rotor spinning	CO4
<i>LSO 9.1.</i> Use relevant machine/process to produce fancy yarn.	9.	Produce fancy yarn samples	CO4
<i>LSO 10.1.</i> Prepare spin plan for different counts of yarn from given raw materials.	10.	Spin plan	CO1, CO2
<i>LSO 11.1.</i> Identify different types of spinning waste.	11	Identification of Spinning Waste	CO5

L) Suggested Term Work and Self Learning: S2428401 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. List down the latest developments in roving frame and ring frame.
2. Prepare a report focused on draft, speed and setting norms in roving frame and ring frame for different count of yarn.

3. Collect the specifications of latest Ring frame machine manufactured by various manufacturers and prepare a report.
4. Prepare a report of waste produced in different machines of spinning mentioning the reasons for the waste generation.
5. Prepare a comparative chart based on structure and properties of yarn produced by different spinning systems.

b. Micro Projects:

1. Prepare report on change in speed and setting parameters required in roving frame and ring frame while changing yarn count.
2. Collect various machine specifications and process parameters for roving frame and ring frame.
3. Collect samples of various fancy yarns and prepare a report on manufacturing process.
4. Collect photographs of defective roving package and paste on card sheet with description of their causes and remedies.
5. Collect different yarn faults and categorise them according to classimat faults on card sheet with description of causes and remedies.
6. Prepare a card sheet of yarn samples having increasing order of twist and strength level.
7. Collect different yarn and test its evenness on evenness tester and record its CV%.

c. Other Activities:

1. Seminar Topics:
 - Present a seminar PPT on any of the following relevant topic – Roving frame, Ring frame, Doubling frame, fancy yarn and New spinning systems.
 - Prepare a presentation on recent technological advancement of roving frame and ring frame.
 - Advances in spinning system
 - Rotor spinning Vs Ring Spinning.
 - Cost effectiveness of Waste Spinning process.
2. Visits:
 - Visit nearby spinning industry and prepare layout of machines.
 - Prepare report on different manufacturers of roving frame and ring frame based on your industrial visit.
 - Collection of various machine specifications and process parameters for roving frame, ring frame, doubling frame, new spinning system.
3. Self-learning topics:
 - Auto doffing in roving frame and ring frame
 - Automation in Ring Spinning System
 - Time study in Ring spinning
 - Fancy yarn manufacturing
 - Application of Fancy yarn
 - Friction Spinning
 - Cabled yarn and its application

- M) Suggested Course Evaluation Matrix:** The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	25%	25%	20%	20%	20%	25%	25%
CO-2	25%	25%	20%	20%	25%	25%	25%
CO-3	20%	20%	20%	20%	20%	15%	25%
CO-4	20%	20%	30%	20%	25%	25%	25%
CO-5	10%	10%	10%	20%	10%	10%	-
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

** : Mentioned under point- (N)

: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

- N) Suggested Specification Table for End Semester Theory Assessment:** Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Speed Frame	12	CO1	18	4	6	8
Unit-2.0 Ring Frame	12	CO2	18	4	6	8
Unit-3.0 Doubling Frame	8	CO3	12	4	4	4
Unit-4.0 New Spinning Systems	12	CO4	16	6	6	4
Unit-5.0 Waste Spinning	4	CO5	6	2	2	2
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Passage of material through speed frame	CO1	40	50	10
2.	Production of roving using speed frame	CO1	40	50	10
3.	Passage of material through Ring frame	CO2	40	50	10
4.	Production of yarn using Ring frame	CO2	40	50	10
5.	Passage of yarn through doubling frame	CO3	40	50	10
6.	Production of Ply yarn using doubling frame	CO3	40	50	10
7.	Passage of material through Rotor spinning	CO4	40	50	10
8.	Production of yarn using Rotor spinning	CO4	40	50	10
9.	Produce fancy yarn samples	CO4	40	50	10
10.	Spin plan	CO1, CO2	40	50	10
11.	Identification of Spinning Waste	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Miniature Roving Frame	Delivery: Single, Flyer speed: up to 1000 rpm, No. of sliver fed: 2, Drafting system with pressure bar, Draft range: 9-25	1,2, 10,11
2.	Miniature Ring Frame	Spindle speed: 12000 - 18000 rpm, Drafting system: 3 over 3, Draft range: 15-45, Yarn count: 1 – 120 Ne	3,4, 10, 11
3.	Doubling Frame	Spindle speed:: 10000 -12000 rpm, No. of spindle: 40-60	5,6

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
4.	Rotor Spinning machine	Rotor speed: 40000 – 150000 rpm, opening roller speed: 6000 – 9000 rpm, No. of heads: 24, Count range: 5 – 40 Ne	7,8,9

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Manual of Cotton Spinning, Volume- IV, V	W. A. Hunter and C. Shrigley	The Textile Institute, ISBN 978-0900739095
2.	A Practical guide to Combing and Drawing, Vol.-3	Klein, W	The Textile institute, Manchester, 1987 ISBN: 0900739932
3.	A Practical guide to Ring Spinning, Vol.-4	Klein, W	The Textile institute, Manchester, 1987 ISBN: 09000739940
3.	Spun Yarn Technology	Eric, oxtoby	Butterworth's Heinemann, 2013, ISBN: 13:9781483129389
4.	Handbook of Yarn production	P. R. Lord Peter	Woodhead publishing limited in association with The Textile institute, North America, 2003, ISBN 1 85573 696 9
5.	Handbook on Cotton Spinning Industry	B. Purushothama	Woodhead Publishing India Pvt. Ltd., New Delhi, 2016, ISBN 13: 978-93-85059-55-1
6.	Fundamentals of Spun Yarn Technology	Carl A. Lawrence	CRC Press publication, Florida. ISBN 0-203—00958-4 Master E-book ISBN 1-56676-821-7 (Print Edition)
7.	NCUTE Extension Program- Drawing, Combing and Roving	Dr. R. Chattopadhyay Dr. R. S. Rengasamy	NCUTE PilotProgram, Indian Institute of Technology, New Delhi, 2003
9.	Hand Book of Cotton spinning	William Taggart	Universal Pub. Corp.
10.	Essential facts of practical cotton spinning	T.K. Pattabhiram,	Soumya pub. Bombay
11.	Cotton spinning calculations	T.K. Pattabhiram	Soumya pub. Bombay
12.	Manual of cotton spinning	Ed AFW coulson	Textile Institute, Manchester
13.	New Spinning System, Vol.-5	Klein, W	The Textile institute, Manchester, 1993 ISBN: 1870812557, 9781870812559
14.	New Spinning Systems	Gowda, R.V. Mahendra	NCUTE Publications, 2003, IIT Delhi
15.	Advances in Yarn Production Technology	Lawrence, Carl A.	Woodhead Publication, 2016 ISBN: 9781845694449

(b) Online Educational Resources:

1. <https://archive.nptel.ac.in/courses/116/102/116102055/>
2. <https://archive.nptel.ac.in/courses/116/102/116102059/>
3. <https://textilelearner.net/material-passage-diagram-of-speed-frame/>
4. <https://textilestudycenter.com/speed-frame-and-function-of-speed-frame/>
5. <https://www.textileadvisor.com/2020/03/ring-frame-process-and-objectives/>
6. <https://textilelearner.net/modern-and-new-spinning-technologies/>

7. <https://textilelearner.net/list-of-waste-in-spinning-mill/>
8. <https://textilelearner.net/ring-doubling-frame-parts-specifications/>
9. <https://www.textileschool.com/421/types-of-doubling-uses-and-objectives/>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Textile Research Journal
2. Reiter Manual
3. Lab Manuals

- A) **Course Code** : 2428402(T2428402/S2428402)
- B) **Course Title** : Yarn Preparation & Weaving Calculation-II
- C) **Prerequisite Course(s)** : Yarn Preparation & Weaving Calculation-I, Textile Fibres
- D) **Rationale** :

In weaving industries for yarn preparation, to sustain various stress and abrasion during weaving, the warp yarns must be of a certain minimum strength as well as smoothness. Hence, the necessity of yarn preparation and various weaving calculation is required for successful fabric production. In this course, the students comprehend the knowledge of Warping, Sizing and Drawing-in, which will help them in performing necessary weaving preparatory calculations. This course will also help students to contribute for sustainable development in textile sector.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of the following course outcomes by the learners. For this, the learners are expected to perform activities related to three learning domains (Cognitive, Psychomotor, and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Apply the knowledge of functions of beam and sectional warping machine to convert single-end package to multi-end package.
- CO-2** Suggest the ingredients for sizing of relevant yarns.
- CO-3** Apply the knowledge of functions of the sizing machine to encapsulate the yarn surface with a protective coating.
- CO-4** Suggest the relevant process for efficient looming operation.
- CO-5** Perform various calculations required for smooth operation of preparation as well as weaving operation.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	3	2	-	-	-	1	1		
CO-2	3	2	1	-	-	1	1		
CO-3	3	2	-	-	-	1	1		
CO-4	3	3	2	-	2	2	1		
CO-5	3	2	-	1	-	1	1		

Legend: High (3), Medium (2), Low (1), and No mapping (-)

* PSOs will be developed by the respective program coordinator at the institute level. As per the latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Textile Engineering	2428402	Yarn Preparation & Weaving Calculation-II	02	01	-	02	05	04

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem-based learning, etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro-projects, industrial visits, any other student activities, etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources, etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of the teacher to ensure the outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Textile Engineering	2428402	Yarn Preparation & Weaving Calculation-II	30	70	20	30	-	-	150

Legend:

PTA: Progressive Theory Assessment in the classroom (includes class test, mid-term test, and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro-projects, industrial visits, self-learning, any other student activities, etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignments, micro-projects, seminars, and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria for internal as well as external assessment may vary as per the requirement of the respective course. For valid and reliable assessment, the internal faculty should prepare a checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW), and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to the attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020-related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS), and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2428402**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Explain the functions of the given warping process. <i>TSO 1b.</i> Select the relevant type of warping for a given situation with justification. <i>TSO 1c.</i> Suggest suitable creel type for a given situation of fabric manufacturing. <i>TSO 1d.</i> Describe the process sequence for producing stripe patterns. <i>TSO 1e.</i> Explain the leasing principle to introduce leases during the warping. <i>TSO 1f.</i> Select the appropriate tension range for the given yarn with justification. <i>TSO 1g.</i> Perform the beam and sectional warping calculations for a given situation of fabric production.	Unit-1.0 Warping 1.1 Objects and functions of the warping process 1.2 Warping types: Direct warping (Beam warping), Indirect warping (Sectional warping), Mill warping 1.3 Warping machine: components and their functions 1.4 Warping creel: Types of creel, the calculation for warping efficiency with different creels, advantages and limitations. 1.5 Direct warping (Beam warping) machine: Passage of warp, working mechanism 1.6 Headstock: Drive and braking arrangements, expanding comb, doffing, pressure systems, measuring device 1.7 Sectional warping (Indirect warping) machine: Passage of warp through the machine, creeling for colour patterns, preparation of sections, construction of warping drum, lease rod & leasing, travers motion, beaming 1.8 Beam and Sectional warping calculations – Production, efficiency, creel capacity, number of ends on warpers beam, number of beams in a set, number of sections, number of patterns per section, section width, warp width, total number of ends 1.9 Drive to warper's beam: Direct and indirect drive 1.10 Mill and Ball warping 1.11 Defects in the warping beam, Features of modern warping machines	CO1
<i>TSO 2a.</i> Explain the importance of sizing. <i>TSO 2b.</i> Explain the working principle of a given sizing machine with sketched. <i>TSO 2c.</i> Suggest the recipe of sizing for a given warp preparation. <i>TSO 2d.</i> Suggest the size paste related process parameters for a given warp preparation	Unit-2.0 Basics of Sizing 2.1 Objects and Benefits of the sizing process. 2.2 Passage of warp through sizing machine, different zones of sizing machine 2.3 Size paste preparation: Sizing ingredients and their functions, cooking of size paste, pressure	CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
scenario.	cooker and storage 2.4 Size paste properties: Size paste concentration, viscosity, size pick-up, size add-on 2.5 Size recipe for different types of yarns	
<i>TSO 3a.</i> Suggest the suitable creel for a given set of beams for sizing with justification <i>TSO 3b.</i> Choose the suitable process parameters of the saw box for the given type of yarn. <i>TSO 3c.</i> Explain the importance of different control devices in sizing machine. <i>TSO 3d.</i> Explain relevant factors affecting size pick-up during sizing. <i>TSO 3e.</i> Suggest the remedies for defects identified during sizing process.	Unit-3.0 Sizing Machine Components 3.1 Creel: Types, advantages and limitations of various types of creel 3.2 Size box: Elements of the size box and their functions 3.3 Drying zone: Methods of drying, temperatures and its control 3.4 Splitting zone: Splitting, leasing, and lease rods 3.5 Headstock: Marking and measuring device, expanding comb, drag roller, drive to weaver beam, beaming 3.6 Characteristics of sized yarn, quality evaluation of sized yarns, Sizing-weaving curve 3.7 Factors affecting size pick-up, Control systems in sizing machine: Temperature control, size level control, moisture control, stretch control, tension control 3.8 Sizing defects and their remedies 3.9 Features of modern sizing machine	CO3
<i>TSO 4a.</i> Select the appropriate looming process for the given weaver's beam. <i>TSO 4b.</i> Describe the Drawing-in process. <i>TSO 4c.</i> Explain conditions for knotting and gaiting of a beam. <i>TSO 4d.</i> Explain the working mechanism of auto drawing-in machine.	Unit-4.0 Looming 4.1 Objects of the looming process 4.2 Drawing-in, knotting and gaiting, Conditions for knotting and gaiting 4.3 Manual and mechanical drawing-in, their limitations and advantages 4.4 Automatic drawing-in process	CO4
<i>TSO 5a.</i> Describe the reed count and heald count of the given machine. <i>TSO 5b.</i> Calculate production of beam warping, sectional warping and sizing from the given parameters. <i>TSO 5c.</i> Analyze the beam performance of the given loom. <i>TSO 5d.</i> Calculate the required warp and weft quantity to produce a given fabric.	Unit-5.0 Weaving Calculations 5.1 Heald count 5.2 Reed count: Different systems of counting reed 5.3 Production related to beam warping, sectional warping and sizing, Beam count 5.4 Loom production and efficiency 5.5 Calculation of warp and weft in a fabric by indirect and direct methods	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (NOT Applicable)

L) Suggested Term Work and Self-Learning: S2428402 Some sample suggested assignments, micro-projects, and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

- Prepare a report on specifications of the latest beam warping, sectional warping and sizing machine.
- Prepare a report on machine manufactures related to beam warping, sectional warping, sizing and Drawing-in machine.
- Prepare a comparative table of salient features of various sectional/beam warping machine manufacturers.
- Prepare a chart for tension ranges in warping process for different types of yarns.
- Prepare a PPT presentation on latest developments in warping and sizing machines.
- Deduce a formula for warp beam density calculation.
- Calculate the warp sheet tension in different zones of sizing machine for the given warp.
- Calculate the stretch produced in the warp sheet during sizing process for the given parameters.
- Calculate the sizing cost with respect to yarn weight and yarn length for the given parameters.

b. Micro Projects:

1. Prepare a card sheet displaying photographs of various creels used for the warping machine with features.
2. Prepare a card sheet displaying photographs of a sequence of leasing operations in sectional warping.
3. Prepare a card sheet displaying photographs of various creels used for sizing and label the features of the creel.
4. Prepare a comparative chart of salient features of various sizing machine manufacturers.
5. Analyze the warp breakages during warping and its consequences in the sizing process.
6. Analyze the effect of size add-on%, sizing speed, and squeeze roller pressure on the warp yarn breakage rate during weaving.
7. Prepare a booklet of the photographs of the modern-size box with features of each component.
8. Analyze migration in sizing and its consequence on loom productivity.

c. Other Activities:

1. Seminar Topics:
 - Recent technological advancement of beam warping/sectional warping machines.
 - Latest development in sizing machine.
 - Modern drying technology used in sizing.
 - Sizing of synthetic blends.
 - Looming of fine filaments.
2. Visits: Visit nearby weaving industry and prepare the layout of weaving preparatory machines. Prepare a report on different manufacturers' warping machines based on your industrial visit. Collection of various machine specifications and process parameters for warping and sizing machines.
3. Self-learning topics:
 - Beaming of Linen yarn
 - Warping of fancy yarns
 - Dye sizing.
 - Single-end sizing.

- Hot Melt sizing.
- Solvent sizing.
- Cold sizing.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use the appropriate assessment strategy and its weightage in theory, laboratory, and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	30%	30%	25%	20%	20%	-	-
CO-2	10%	10%	10%	20%	20%	-	-
CO-3	25%	25%	25%	20%	20%	-	-
CO-4	10%	10%	10%	20%	25%	-	-
CO-5	25%	25%	30%	20%	15%	-	-
Total Marks	30	70	20	20	10	-	-
			50				

Legend:

*: Other Activities include self-learning, seminar, visits, surveys, product development, software development, etc.

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In the case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided among all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises questions related to the achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: The specification table represents the reflection of sample representation of assessment of the cognitive domain of the full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Warping	14	CO1	20	6	6	8
Unit-2.0 Basics of Sizing	6	CO2	8	2	4	2
Unit-3.0 Sizing Machine Components	12	CO3	18	4	6	8
Unit-4.0 Looming	6	CO4	8	4	2	2
Unit-5.0 Weaving calculations	10	CO5	16	4	6	6
Total	48	-	70	20	24	26

Note: Similar table can also be used to design class/mid-term/ internal question papers for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Labs, Field Information, and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs, etc.

Q) List of Major Laboratory Equipment, Tools, and Software: (Not Applicable)**R) Suggested Learning Resources:****(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Weaving: Conversion of Yarns to Fabric	Lord. P.R; Mohamed. M.H.	Merrow Publishing Limited, England, 1992 ISBN:0-900 -54178-4
2.	Textile Sizing	Bhuvnesh C. Goswami, Rajesh D. Anandjiwala, David M. Hall	Marcel Dekker, New York ISBN: 0-8247-5035-5
3.	Weaving: Machines, Mechanisms, Management	Talukdar M.K, Ajgaonkar D.B, Sriramulu P.K	Mahajan Publisher Private Ltd, ISBN: 81-85401-16-0
4.	Modern Preparation and Weaving Machinery	Ormerod A.	Butterworth, (Publishers), 1983 ISBN: 9780408012126
5.	Modern weaving calculations: Preparatory	Singh, R.B.	Mahajan Book Distributors, 1994 ISBN 8185401039, 9788185401034
6.	An Introduction to winding and warping	Talukdar, M.K.	Mahajan Publisher Private Ltd, ISBN: 81-85401-16-0
7.	Industrial practices in weaving preparatory	Dr. Mukesh Kumar Singh	Woodhead Publishing India Pvt. Ltd. ISBN: 978-93-80308
8.	Sizing: Material, Methods, Machines	Ajgaonkar D.B, Talukdar M.K and V.R. Wadekar	Textile Trade Press ASIN : B0007BF8KY
9.	Yarn Preparation Vol.-II	R. Sen Gupta	Mahajan Publication, Ahmedabad.
10.	Weaving Calculation	R. Sen Gupta	D.B. Taraporevala Sons and Company,
11.	Weaving Preparation Technology	Gokarneshan N.	Abhishek Publications, Chandigarh, ISBN: 978-81-8247- 247-1
12.	Textile Mathematics: Volume III	J. E. Booth	The Textile Institute, Manchester. ISBN: 978-0900739248

(b) Online Educational Resources:

1. <https://nptel.ac.in/courses/116102005>
2. <https://textilelearner.net/shedding-mechanism-in-weaving/>
3. <https://textilelearner.net/automation-in-warping-and-sizing-process/>
4. <https://www.textileadvisor.com/2019/07/sizing-process-object-of-sizing.html>
5. <https://www.textileschool.com/1080/sizing-operation-for-textiles/>
6. <https://www.textilecalculations.com/warp-sizing-calculation-in-weaving/>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. Principle of Weaving by Marks & Robinson, The Textile Institute, Manchester, England, 1976 ISBN: 0-900739258
2. Principles of Fabric Formation by P.K. Banerjee, Taylor & Francis Group ISBN: 13: 978-1-4665-5445-0

- A) **Course Code** : 2428403(T2428403/P2428403/S2428403)
- B) **Course Title** : Fabric Structure and Design
- C) **Pre-requisite Course(s)** : Fabric Manufacture
- D) **Rationale** :

The quality of woven fabric depends on its functional and aesthetic properties. These in turn are governed by raw material selection, yarns used, fabric construction, structure and texture and ornamentation of fabric. Some of the end uses emphasize only on the functional aspects and others on functional as well as aesthetic aspects. In this context fabric structure is of immense importance. This course covers the topic such as basics of fabric structure with reference to weave, raw material, feel, weight and appearance & encompasses methods of terry pile and technical aspects of fabric construction which will helps the students to design a fabric suitable for a particular end use application.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/industry.

After completion of the course, the students will be able to-

- CO-1** Identify basic elements of Fabric Structure and Design.
- CO-2** Construct elementary fabric structures using principles of design.
- CO-3** Modify the elementary structure to create derivatives of elementary weave.
- CO-4** Develop the fancy weaves for a given textile fabric.
- CO-5** Suggest a relevant method to produce given advanced fabric structures and colour design.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	3	-	-	2	-	1	1		
CO-2	3	2	-	2	1	1	1		
CO-3	3	3	3	2	2	1	1		
CO-4	3	3	3	2	2	1	1		
CO-5	3	2	-	2	1	1	1		

Legend: High(3), Medium (2), Low(1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

- G) **Teaching & Learning Scheme:**

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Textile Engineering	2428403	Fabric Structure and Design	03	-	4	02	09	06

Legend:

- CI: Class room Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)
- LI: Laboratory Instruction (Includes experiments/practical performances /problem based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)
- Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.
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- SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.
- C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Textile Engineering	2428403	Fabric Structure and Design	30	70	20	30	20	30	200

Legend:

- PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)
- PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)
- TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro-projects, industrial visits, self learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2428403

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>LSO 1.a.</i> Explain Importance of fabric structure and design analysis. <i>LSO 1.b.</i> Classify woven fabrics on the basis of weave. <i>LSO 1.c.</i> Represent the fabric design with the help of point paper. <i>LSO 1.d.</i> Describe the basic elements of a woven design. <i>LSO 1.e.</i> Explain different systems of drafting for the given fabric. <i>LSO 1.f.</i> Construct the design, draft and lifting plan for the given design with justification. <i>LSO 1.g.</i> List various types of fabric trade name and their particulars. <i>LSO 1.h.</i> Select weave according to end use of the fabric.	Unit-1.0 Fundamentals of Fabric Structure and Design 1.1 Fabric structure and design analysis: Importance, general principle. 1.2 Woven fabrics and their classification 1.3 Methods of fabric representation. 1.4 Repeat of the design/Weave repeat unit. 1.5 Basic elements of a woven design: design (weave), draft or Drawing-in, lifting or peg plan, Dentering Plan (or dentering order). 1.6 Systems of drafting. 1.7 Construction of drafts and lifting plans: (i) Methods of indicating drafts and lifting plans, (ii) Relations between design, draft, and lifting plan. (iii) Construction of drafts and lifting plan from given designs. (iv) Construction of drafts from given designs and lifting plans, (v) Construction of designs from given drafts and lifting plans. 1.8 End use of the fabric based on their weaves	CO1
<i>TSO 2a.</i> Describe the characteristics features and end use of given fundamental weaves (such as plain, twill, satin and sateen). <i>TSO 2b.</i> Describe the methods of ornamentation of plain weave. <i>TSO 2c.</i> Explain the Rib and cord effects produced in plain weave. <i>TSO 2d.</i> Classify the given twill weave into different categories of twill weave. <i>TSO 2e.</i> Draw the design, draft and peg plan of the given fabric with elementary weave. <i>TSO 2f.</i> Describe the influence of twist on fabric properties. <i>TSO 2g.</i> Compare the firmness of given twill weave fabrics/design. <i>TSO 2h.</i> Select the suitable move number for the given weave repeat to construct satin/sateen weave. <i>TSO 2i.</i> Differentiate between satin and sateen design.	Unit-2.0 Construction of Elementary Weaves 2.1 General characteristics of fundamental weaves. 2.2 Construction of plain weave, its characteristic features and end use. 2.3 Ornamentation of Plain Weave. 2.4 Rib and cord effects produced in plain weave. 2.5 Construction of simple (continuous) twill weave, its characteristic features and end use. 2.6 Classification of basic twills - Balance twill and unbalanced twill (warp and weft faced twill). 2.7 The Angle of Twill. 2.8 Factors determining the prominence of twill weaves 2.9 Characteristic features of sateen and satin woven fabrics, Interlacement diagram, Concept of move number. 2.10 Development of regular and irregular satin/sateen weave, Draft, dentering order (plan) and lifting plan, interlacing diagram of regular and irregular satin/sateen.	CO2
<i>TSO 3a.</i> Identify the derivatives of elementary weaves. <i>TSO 3b.</i> Differentiate between the fabrics for the given derivatives of twill weave. <i>TSO 3c.</i> List down the derivatives of satin/sateen weaves. <i>TSO 3d.</i> Develop design, draft and peg plan for given fabric with modified weave repeat from elementary bases. <i>TSO 3e.</i> Describe the features and use of the diamond and diaper weaves.	Unit-3.0 Development of Weaves from Elementary Bases 3.1 Plain weave derivatives: Warp rib, Weft rib, Hopsack or mat or basket weaves. 3.2 Derivatives of Twill weave: Waved twills or Pointed or Zig-zag twills, Herringbone twills, Broken twills, Elongated twills, Combined twills and Fancy twills. 3.3 Weaves constructed on satin or sateen bases 3.4 Diamond and Diaper Designs: Characteristic features and end use of the diamond and diaper	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3f. Draw the design, draft and peg plan for diamond and diaper weaves.	weaves, Construction of diamond and Diaper designs.	
TSO 4a. Describe the features of the given type of fancy weave. TSO 4b. Draw the design, draft and peg plan for given type of fancy weave. TSO 4c. Distinguish between given types of honey comb structures. TSO 4d. Describe the characteristic features of crepe weaves. TSO 4e. Describe Bedford cord effect. TSO 4f. Classify the given Bedford cords weave based on construction factors. TSO 4g. Develop a Wadded Bedford cord design to obtain required width of cords/ inch in warp direction. TSO 4h. Differentiate between given types of welt Bedford cord and pique structures. TSO 4i. Develop the Stripe and Check design for a given weave repeat.	Unit-4.0 Simple Fancy Weaves 4.1 Principles of designing honey comb weave. 4.2 Types of honey comb weaves: Ordinary honey comb and Brighton honey comb weaves. 4.3 Huckaback weaves. 4.4 Mock Leno Weaves. 4.5 Crepe weave - Development and construction of crepe weave. 4.6 Bedford cords: Principle and its features; Classification of Bedford Cords, Methods for producing cord effects. 4.7 Welts and piques. 4.8 Stripe and check weave combinations. 4.9 Standard quality particulars and Loom equipment required for above Weaves.	CO4
TSO 5a. Identify the fabric ornamented with extra threads. TSO 5b. Describe the methods to select the motif and ratio of ground and figuring threads. TSO 5c. Compare extra warp figure with extra weft figure. TSO 5d. Describe purposes and uses of producing backed cloths. TSO 5e. Compare warp backed with weft backed fabrics. TSO 5f. Classify double cloths into different categories. TSO 5g. Classify Pile fabrics structures. TSO 5h. Elaborate different special mechanisms required on terry loom. TSO 5i. Differentiate between different theories of colour. TSO 5j. Create textile designs by using concept of colour modification for given application. TSO 5k. Explain various effects produced by simple colour and weave combination.	Unit-5.0 Advanced Fabric Structure and colour application 5.1 Extra Figuring: Extra Warp and Extra weft figured fabrics, Principle of figuring with extra threads, methods of introducing extra threads, methods of disposing extra threads. 5.2 Backed cloth: Concept of backed cloth and its objectives, Warp Backed and Weft Backed Cloth. 5.3 Double Cloths: Introduction, Classification of Double Cloths, End uses of double cloth. 5.4 Pile Fabrics: Introduction, Classification of pile fabrics. Methods of producing warp and weft pile fabrics. 5.5 Terry Pile Fabrics: Introduction, Types of terry structures. Pile Formation in Terry. Loom requirements for terry weaving. Special mechanism require in terry Weaves, End Uses. 5.6 Colour and its Application: Fundamental basis of Colour, Theory of colour: Light theory and Pigment theory, Visual effects or attributes of various colours, Modification of colours, Colours in combination. 5.7 Simple Colour and Weave Effects: Introduction. Representation of Colour and Weave effects upon design Paper. Classification of Colour and Weave effects. Effects produced by simple colour and weave combination: Continuous line effects, Hound's tooth patterns, Bird's eye and spot effects, Step patterns.	CO5

Note: One major TSO may require more than one theory session/period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2428403

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Identify the face side and back side of the given cloth. <i>LSO 1.2.</i> Identify and mark warp and weft direction. <i>LSO 1.3.</i> Find ends per inch and picks per inch. <i>LSO 1.4.</i> Represent the design of given sample on point paper. <i>LSO 1.5.</i> Draw draft, peg-plan and denting order. <i>LSO 1.6.</i> Identify the design or weave of given fabric. <i>LSO 1.7.</i> Calculate various particulars from the samples like count of threads, threads density, crimp% heald and reed count, weight of warp and weft, Cover factor.	1.	Cloth construction Analysis	CO1
<i>LSO 2.1.</i> Use analysis tool kit to analyze the fabric weave: <i>LSO 2.2.</i> Estimate fabric construction parameters such as EPI, PPI, warp/weft – count, colour pattern, twist direction, Cover factor, crimp percentage of warp and weft threads, reed count, healds count and weight per unit area. <i>LSO 2.3.</i> Represent the design on point paper. <i>LSO 2.4.</i> Draw draft, peg plan and denting plan.	2.	Construction Analysis of Plain weave fabrics	CO2
<i>LSO 3.1.</i> Use analysis tool kit to analyze the regular twill weave sample. <i>LSO 3.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 3.3.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	3.	Construction Analysis of Twill weaves fabrics	CO2
<i>LSO 4.1.</i> Use analysis tool kit to analyze the Satin and Sateen weave sample to: <i>LSO 4.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 4.3.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	4.	Construction Analysis of Satin and Sateen weave fabrics.	CO2
<i>LSO 5.1.</i> Use analysis tool kit to Analyze the warp/weft rib weave sample <i>LSO 5.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.3.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	5.	Construction Analysis of warp rib/weft rib weaves fabrics.	CO3
<i>LSO 6.1.</i> Use analysis tool kit to Analyze the Mat rib weave sample <i>LSO 6.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.4.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	6.	Construction Analysis of Mat rib weave fabrics.	CO3
<i>LSO 7.1.</i> Use analysis tool kit to Analyze the Pointed twill weave sample. <i>LSO 7.2.</i> Estimate the fabric construction parameters as per practical 2.	7.	Construction Analysis of Pointed twill weave fabrics.	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 5.5.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.			
<i>LSO 8.1.</i> Use analysis tool kit to analyze the Herringbone twill sample. <i>LSO 8.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.6.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	8.	Construction Analysis of Herringbone twill weave fabrics.	CO3
<i>LSO 9.1.</i> Use analysis tool kit to Analyze the derivatives of Satin and Sateen weave sample. <i>LSO 9.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.7.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	9.	Construction Analysis of the derivatives of Satin and Sateen woven fabric.	CO3
<i>LSO 10.1.</i> Use analysis tool kit to analyze the Diamond weave sample. <i>LSO 10.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.8.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	10.	Construction Analysis of Diamond weave fabrics.	CO3
<i>LSO 11.1.</i> Use analysis tool kit to Analyze the Diaper weave sample. <i>LSO 11.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.9.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	11.	Construction Analysis of Diaper weave fabrics.	CO3
<i>LSO 12.1.</i> Use analysis tool kit to analyze the Honey comb and Brighton Honey comb weave sample to: <i>LSO 12.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.10.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	12.	Construction Analysis of Honey comb and Brighton Honey comb weaves fabrics	CO4
<i>LSO 13.1.</i> Use analysis tool kit to analyze Huck- a-back weave sample to: <i>LSO 13.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.11.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	13.	Construction Analysis of Huck-a-back weave fabrics.	CO4
<i>LSO 14.1.</i> Use analysis tool kit to Analyze the Mock leno weave sample. <i>LSO 14.2.</i> Estimate the fabric construction parameters as per practical 2. <i>LSO 5.12.</i> Represent the design, draft, peg plan, denting order and cross section on point paper.	14.	Construction Analysis of Mock leno weave fabrics.	CO4
<i>LSO 15.1.</i> Draw Chromatic and Brewster's circle. <i>LSO 5.13.</i> Explain visual effect of colour.	15.	Preparation of colour charts showing primary, secondary, and tertiary colour and colour wheel	CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 16.1.</i> Represent Colour and weave effect by preparing given patterns on paper. <i>LSO 16.2.</i> Explain various effects produced by simple colour and weave combination.	16.	Preparation of mixed colour effect (such as Continuous line effects, Hound's tooth patterns, Bird's eye and spot effects, Step patterns, All over effects and Stripe and Check Colour and Weave effects).	CO5

L) Suggested Term Work and Self Learning: S2428403 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions / Problems / Numerical / Exercises to be provided by the course teacher in line with the targeted COs.

1. Collect various samples of fabric from market analyse their weave structure (Lab assignment).
2. Collect two different type of twill weave fabric and compare their drafting and peg plan.
3. Prepare a swatch book containing samples of different derivative of elementary weave.
4. Collect the information from library regarding different types of fancy weave and prepare a report.
5. Analyse the yarns used in different fancy weave and prepare a report.
6. Prepare a report by conducting market survey on stripe and check effect on fabric.
7. Collect the information regarding various software used for weave structure using internet and prepare a report.

b. Micro Projects:

1. Collect at least 10 samples of stripes and checks shirting and analyse their warp colour and weft colour pattern. Prepare a report on this analysis.
2. Develop a plain weave stripe and checks designs by selecting suitable warp pattern.
3. Develop all possible designs of regular twills which can be made using 5 or 6 heald shafts.
4. Develop point paper designs of horizontal pointed twill, vertical pointed twill, herringbone twill, curved twill, broken twill, elongated twill, rearranged twill, combination of twill and prepare a swatch book.
5. Construct different types of Bed-ford cord designs and Write their characteristics.
6. Construct point paper designs of wadded Pique weaves corresponding to different motifs.
7. Prepare a table giving details of construction particulars of popular fabrics -Cambric, Chiffon, Georgette, Crepe, Denim, Damask, Drills, Madras shirting, Poplin, Quilts, Taffeta, Dhotis.
8. Prepare a file of various types of backed cloth designs, their construction particulars and end use.
9. Prepare a file of various types of double cloth designs, their construction particulars and end use.
10. Collect various interchanging double cloth samples from market and prepare a report by analyzing them.
11. Find out cover factors of various types of fabric we use day to day.
12. Collect various terry towel samples from market and prepare a report by analyzing them.

c. Other Activities:

1. Seminar Topics:
 - Furnishing and toweling structures.
 - Market trends of fancy weave
 - leno structures: Construction and their applications.
 - Terry weaving.
 - Colour and weave effect in Fabric.
2. Visits: Visit nearby tool room/industry with CATD software facilities for textile designs. Prepare report of visit with special comments of CATD software technique used, material used, and cost of CATD software.
3. Self-learning topics:
 - Modifications in Elementary Weaves
 - Velvets and Velveteens.

- Collect information about various CATD software used in industry, their advantages, hardware requirements and cost of the software.
- Damask and Brocade Fabric.
- Modern Technique of creating colour and weave effect

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work& Self-Learning Assessment			Progressive Lab Assessment(PL A)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	20%	12%	20%	20%
CO-2	22%	22%	20%	20%	22%	25%	25%
CO-3	16%	16%	20%	20%	22%	20%	20%
CO-4	22%	22%	20%	20%	22%	20%	20%
CO-5	20%	20%	20%	20%	22%	15%	15%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

- * : Other Activities include self-learning, seminar, visits, surveys, product development, software development etc.
 ** : Mentioned under point (N)
 # : Mentioned under point - (O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Fundamentals of Fabric Structure and Design	10	CO1	14	4	5	5
Unit-2.0 Construction of Elementary Weaves	10	CO2	15	4	6	5
Unit-3.0 Development of Weaves from Elementary Bases	08	CO3	12	4	4	4
Unit-4.0 Simple Fancy Weaves	10	CO4	15	4	6	5
Unit-5.0 Advanced Fabric Structure and colour application	10	CO5	14	4	6	4
Total Marks	48	--	70	20	27	23

Note: Similar table can also be used to design class/mid-term/internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Cloth construction Analysis	CO1	40	50	10
2.	Construction Analysis of Plain weave fabrics	CO2	40	50	10
3.	Construction Analysis of Twill weaves fabrics	CO2	40	50	10
4.	Construction Analysis of Satin and Sateen weave fabrics.	CO2	40	50	10
5.	Construction Analysis of warp rib/weft rib weaves fabrics.	CO3	40	50	10
6.	Construction Analysis of Mat rib weave fabrics.	CO3	40	50	10
7.	Construction Analysis of Pointed twill weave fabrics.	CO3	40	50	10
8.	Construction Analysis of Herringbone twill weave fabrics.	CO3	40	50	10
9.	Construction Analysis of the derivatives of Satin and Sateen woven fabric.	CO3	40	50	10
10.	Construction Analysis of Diamond weave fabrics.	CO3	40	50	10
11.	Construction Analysis of Diaper weave fabrics.	CO3	40	50	10
12.	Construction Analysis of Honey comb and Brighton Honey comb weaves fabrics	CO4	40	50	10
13.	Construction Analysis of Huck-a-back weave fabrics.	CO4	40	50	10
14.	Construction Analysis of Mock leno weave fabrics.	CO4	40	50	10
15.	Preparation of colour charts showing primary, secondary, and tertiary colour and colour wheel	CO5	40	50	10
16.	Preparation of mixed colour effect (such as Continuous line effects, Hound's tooth patterns, Bird's eye and spot effects, Step patterns, All over effects and Stripe and Check Colour and Weave effects).	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/ Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/ outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Portfolio Based Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field, Information and Communications Technology (ICT) Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Sessions, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	Counting glass, Needle, Scale, Scissor, Point Paper, Eraser and Pencil- HB,	Reflex type 1 inch counting glass, Needle, 12 inch steel ruler, Tape, Scale of 0.1 mm, Scissor, Point Paper/Design paper, Eraser and Pencil - HB.	All
2.	Counting Glass/ Pick Glass	To determine ends and picks in fabrics. Specifications: • 10x - 1 inch x 1 inch with Pointer with carrying case 1 No • 10x - 20 mm x 20 mm with Pointer with carrying case 1 No Magnifying Capacity: 10x Zoom LED Light	All
3.	Automatic thread counter	Specifications: 40x travelling microscope is attach to magnify the fabrics. Inbuilt reference line inside the travelling microscopes eases accurate checking. Two filament bulbs from bottom to view the sample. Complete with all accessories along with two templates. Slot size: 10 mm, 20 mm, and 50 mm Slot size: ¼ inch, ½ inch and 1 inch. Standards: ASTM D 3775-98, ISO 7211, BSEN 1049.	All
4.	Beesley Balance	To determine direct yarn count of Warp and Weft form Fabric and Garments. Template with two nos. of riders As per Standard ASTM D 3776, ISO 7211, BS 2865 Accurate determination of Sample and its Weight.	All
5.	Quadrant Balance	Suitable for measuring count yarn in Ne and weight of fabric sample.	All
6.	Fabric GSM Cutter	Fabric GSM cutter and weighing balance having 0.01 mm LC (Cutter for measuring GSM of fabric).	All
7.	weighing balance / Electronic balance	Electronic balance, with the scale range of 0.001 g to 500 g. Pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	All
8.	Crimp tester	Specification: Maximum test length : 400 mm Maximum elongation : 125 mm Tension load : 3 g. to 20 g. (Crimp tester having 0.1 mm LC).	All
9.	Single yarn twist tester	Automatic Twist Tester with Micro-controller based electronic twist tester	All
10.	Double/plied yarn twist tester	Specification: Yarn test length 25 mm to 500 mm adjustable, capable for single and double yarn, S / Z switch for selection of twist type, TPM range: up to 9999 TPM (DIRECTLY TPM ON DISPLAY).	All
11.	Image Analyzer with Fabric Analysis Software	Specifications for Image Analyzer with Fabric Analysis Software: Image Analyzer with Fabric Analysis Software (Computerized high definition microscopic analysis of fabric) with following specifications: 1. High quality precision microscope with 6.4 : 1 zooming ratio. 2. Illuminated base, adjustable light intensity and direction particularly suitable for the analysis of the fabric. 3. High precision focusing device with minimum 45X magnification. 4. Binocular Observation head with Camera Port. 5. Focusing through rack and pinion. 6. Wide field eye piece 10X.	All

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
		- Working distance 150 mm or more. - Dioptric adjustment in both oculars. - System should be incorporated with Analysis Software and Fabric cross section preparation kit as per Indian Standard (supplier must specify the IS Number). - Software must be capable of identifying the samples, structures and defects, measure impurities in the material, measure section surface and perimeters, micro as well as macro analysis of sample. Beside pre loaded library, user friendly software offer to create own library of samples and retrieved the same within programme. - Image should be stored in file directory for further assessment. - Provision for showing multiple images of abraded fabrics on the computer screen for the Observer who can rank the fabrics manually based on abrasion damage of fabric/fibre. Software should have provision to summarize average rank of the fabric for more than one observer in excel format. - Progressive Scan Color CMOS Camera with optically interaced C-Mount adopter having ERS and Calibration Device - Resolution: 2590 × 1949 pixels or better - Sensor Size: 1/2.5" - Pixel Size: 2.2 μm × 2.2 μm minimum - Branded data acquisition system - Must supply NABL Calibration certificate for the system	
12.	Textile CAD for weave and print design	- Tools and features to develop and edit the solid colour design for weaving: cut, paste, scale, mirror, rotate, scale, colour conversion, masking of colour, protect colour /standard & geometrical tools. - Minimum Weaves derivatives in library: 30000 - Producing and taking output for design up to 40000 picks - Real-time and online simulation, 3D simulation view of fabric and cross section view of fabric - Import of Vector Image - Support for CIE Lab based colorimetry for color matching on different printers - Yarn database editor and thread pattern generator for making complex thread patterns. - Fabric Price and Productions Calculations - Drawing thread pattern (yarns) directly in the fabric simulation. - Compatibility of outputs with computerized Jacquard card or Dobby Card punching machine - Draping on any colour shade of object images	16
13.	CAD (Textile Designing) Software	Wonder weave CAD Software: Dobby Master, Jacquard Master	16

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
14.	Computer System	Computer System (4 GB RAM/ Core I7/Windows) with Digitizer, Colour Monitor, Colour Printer, Card Punching Machine.	16
15.	Drawing Sheet (A4 size), Pencil- HB, Tracing paper, etc.	Drawing Sheet (A4 size), Pencil- HB, Tracing paper- Gateway Quality, Poster colour, Colouring Brush- Round (0,2, 4), Flat (1/2 inch), Bow pen, Bow compass, Sketch pen set.	15,16
16.	Sample loom	Textile Laboratory – Sample loom	All
17.	Fabric Samples for Analysis	Plain, Twill, Satin/Sateen and its derivatives, Honeycomb, Huckaback, Mock-leno, Bedford cord cloths sample, etc.	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Principle of Weaving The Textile	Marks & Robinson, A.T.S.	Manchester Institute, 1976 ISBN: 0-900739258
2.	Watson's Elementary Textile Design	Z.J. Grosicki	WOODHEAD PUBLISHING LIMITED, Cambridge England, ISBN 1 85573 996 8
3.	Watson's Advance Textile Design	Z.J. Grosicki	WOODHEAD PUBLISHING LIMITED, Cambridge England, ISBN 1 85573 996 8
4.	Fabric Structure And Design	N. Gokarneshan	New age international (P) limited, New Delhi, ISBN (10) : 81-224-2307-8

(b) Online Educational Resources:

- <https://www.textileschool.com/460/weaving-loom-mechanisms/>
- <https://www.textileschool.com/123/plain-weaves/>
- <http://nptel.ac.in/courses/116102005/27>
- <http://textilelearner.blogspot.in/2013/07/different-types-of-twill-weave.html>
- <https://www.textileschool.com/357/broken-twills/>
- <http://textilefashionstudy.com/sateen-weave-properties-of-sateen-weave-typesof-sateen-weave/>
- <https://www.heddels.com/2017/12/7-weave-patterns-to-know-twill-basketweavesatin-and-more/>
- <https://textilestudycenter.com/textile-books-free-download/>
- <http://www.textileassociationindia.org/>
- <http://textileschool4u.blogspot.com/2013/12/bedford-cords.html>
- <http://textileschool4u.blogspot.com/2013/12/welts-and-piques.html>
- <http://www.tigercolor.com/color-lab/color-theory/color-harmonies.htm>
- <https://anneroselt.com/2018/03/26/creating-colour-harmony/>
- <https://simplicable.com/new/color-harmony>
- <https://www.slideshare.net/mjrtipu/different-software-use-for-textile-design>
- <http://textilesandfolklores.blogspot.com/2012/11/figuring-with-extra-warpweftthreads.html>
- <http://textileschool4u.blogspot.com/2013/12/backed-fabrics.html>
- <https://www.slideshare.net/isarothossan/double-cloth-65179194>
- https://en.wikipedia.org/wiki/Double_cloth
- <https://www.slideshare.net/shivrajaiswal1/terrya-pile-fabric>
- <https://en.wikipedia.org/wiki/Velvet>

22. <https://en.wikipedia.org/wiki/Velveteen>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Handbook of Textile Design, Jacquie Wilson; Woodhead Publishing 2001, e-ISBN: 9781855737532.
2. Design of Woven Fabrics; I. Blinov, MIR Publishers, Mascow, 1988. ISBN: 5-03-000020-8.
3. Advanced Woven Fabric Design, J. Hayavadana, Woodhead Publishing India Pvt Ltd, 2019.
4. Woven Textile Design, JAN SHENTON, LAURENCE KING PUBLISHING, 2014
5. Woven Cloth Construction, Robinson and Marks, Woodhead publishing, The Textile Institute.
6. Lab Manuals.

- A) **Course Code** : 2428404(T2428404/P2428404/S2428404)
- B) **Course Title** : Fabric Manufacture-II
- C) **Pre- requisite Course(s)** : Fabric Manufacture-I; Textile Fibre
- D) **Rationale** :

To Produce woven fabric and maintain quality aspects of fabric, knowledge of various components of automatic looms is very important. This course, Fabric Manufacture-II is designed to develop understanding of different types of shedding, automatic motions and weft insertion system used in weaving. It also covers different mechanism involved in weaving machinery which lays the foundation to understand weaving related problems in machine and other relevant mechanism. This course will facilitate students to use the principles of Dobbies, jacquards and mechanism of automatic loom to reproduce the given type of fabric and rectify the looms related problems in the industries.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Use dobby mechanism to produce different design of fabric.
- CO-2** Use jacquard mechanism to develop attractive designs of fabric.
- CO-3** Use Box motions to produce weft patterned fabrics.
- CO-4** Use automatic machine to manufacture woven fabric.
- CO-5** Select particular shuttle less loom for efficient production of a given fabric.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	3	2	1	2	-	1	1		
CO-2	3	2	1	2	-	1	1		
CO-3	3	2	1	2	-	1	1		
CO-4	3	2	-	2	2	1	1		
CO-5	3	1	-	2	2	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Textile Engineering	2428404	Fabric Manufacture -II	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Textile Engineering	2428404	Fabric Manufacture-II	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) **Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) **Theory Session Outcomes (TSOs) and Units: T2428404**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Describe the limitations of given types of shedding mechanism. <i>TSO 1b.</i> Differentiate between given types of dobbies based on features and working principle. <i>TSO 1c.</i> Identify different parts of the dobby. <i>TSO 1d.</i> Describe the construction & working of given dobby with a neat sketch. <i>TSO 1e.</i> Select relevant dobby for manufacturing of a given fabric having a particular design. <i>TSO 1f.</i> Calculate the number of healds required to produce the given design. <i>TSO 1g.</i> Apply the method of pegging for the given type of dobby.	Unit-1.0 Dobby 1.1 Dobby: Principle, Scope and uses of dobby 1.2 Types of Dobbies: Single lift and double lift dobby, Negative and Positive dobby, Centre shed and open shed dobby, Horizontal and Vertical dobby, Right and Left-Hand dobby 1.3 Mechanism of double lift single jack and double-lift double jack dobby 1.4 Mechanism of Cam dobby, Negative Cam dobby and its advantages 1.5 Paper cam Dobby: Working principle, Heald selection mechanism on paper cam dobby 1.6 Positive dobby- Working Principle and its advantages 1.7 Rotary Dobby - Function and working of mechanical and electronic rotary dobby, features and advantages of Rotary Dobby 1.8 Methods of Pegging Lags. Method of pegging for right- and left-hand dobby 1.9 Causes of 'Jack-Missing', Dwell of dobby, Features of Modern dobby 1.10 Cross – Border dobby: necessity, construction and working of two-cylinder mechanism, cylinder selection mechanism	CO1
<i>TSO 2a.</i> Explain with sketches the working of the given type of Jacquard mechanism <i>TSO 2b.</i> Differentiate between two given types of Jacquards based on features and principle of working. <i>TSO 2c.</i> Explain the merits and demerits of the given types of Jacquards. <i>TSO 2d.</i> Describe the principle of the given type of harness tie. <i>TSO 2e.</i> Calculate the figuring capacity of a given Jacquard. <i>TSO 2f.</i> Prepare design on graph paper from given motif.	Unit-2.0 Jacquard 2.1 Objects of Jacquard, Jacquard shedding, Principle of Jacquard shedding 2.2 Types of Jacquards: - Coarse Pitch, Medium Pitch and Fine-Pitch Jacquard, Single Lift Jacquard, Double Lift Single Cylinder Jacquard, Double Lift Double Cylinder Jacquard. Working, features, advantages and disadvantages of these Jacquard 2.3 Mechanism of Cross-border Jacquards, Vincenzi Jacquard, The Verdol Jacquard 2.4 Jacquard for Special use, Size of Jacquard, Figuring Capacity of Jacquard	CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.5 Harness, Lingoe, Mail-Eyes, Coupling, Comber board, Harness mounting. 2.6 System of Harness Mounting, Norwich System, London System, Casting- out 2.7 Transferring design methods: from motif to graph paper, selection of point paper counts 2.8 Electronic Jacquards- Features of electronic jacquards, its advantages over mechanical jacquard, construction and working of electronic jacquards	
<i>TSO 3a.</i> Describe the need of Multiple Box motion <i>TSO 3b.</i> Compare the given types of Multiple box motion <i>TSO 3c.</i> Select suitable Box motion for a given pattern. <i>TSO 3d.</i> Prepare card chain for a given pattern. <i>TSO 3e.</i> Explain the principle of weft patterning.	Unit-3.0 Box Motions 3.1 Object and Importance of Multiple Box motion 3.2 Types of Multiple Box Motions: Drop-Box motion, Circular Box motion 3.3 Weft-mixing motion, Four Box motion, Pick-at - will Box motion 3.4 Conditions for Good Multiple Box Motion, 3.5 Types of cards used for Drop Box motion, card saving devices, preparation of card chain 3.6 Weft Patterning on Unconventional Looms	CO3
<i>TSO 4a.</i> Distinguish between given type of looms. <i>TSO 4b.</i> Explain the principle of different type of Automatic looms. <i>TSO 4c.</i> Describe the function of warp stop motion. <i>TSO 4d.</i> Select particular type of warp stop motion based on given requirement. <i>TSO 4e.</i> Explain the principle of automatic cop/bobbin and shuttle changing mechanism. <i>TSO 4f.</i> Select particular type of the warp protector motion required in the loom for given scenario.	Unit-4.0 Automatic Looms 4.1 Historical developments in Automatic Loom, Characteristic features, Advantage of Automatic Loom over Non-Automatic Loom 4.2 Types of Automatic Looms: Shuttle- Changing automatic loom, Bobbin or Pirn or Cop changing automatic Loom. Comparison between Cop-changing and Shuttle changing Looms 4.3 Types of Automatic Cop (or, Bobbin) Changing mechanism, Automatic Supply of Weft, Weft Feeler motion, bunching motion, Types of Automatic Bobbin Change Loom, Types of Shuttle changing Looms 4.4 Warp Stop motion: Function, Types of Warp Stop motion, Electrical Warp Stop motion, Mechanical Warp stop motion 4.5 Shuttle Protector and Weft Cutter, Three Miss – Thread motion	CO4
<i>TSO 5a.</i> Explain the need and scope of Shuttle-less weaving. <i>TSO 5b.</i> Describe the principle and working of given shuttle-less loom. <i>TSO 5c.</i> Compare between two given types of shuttle-less loom. <i>TSO 5d.</i> Select the type of shuttle-less loom for production of a given fabric based on requirements. <i>TSO 5e.</i> Identify various fabric fault and loom fault occurring during weaving of a fabric.	Unit-5.0 Shuttleless Looms: 5.1 Shuttle-less Weaving: Advantage of Shuttle-less weaving as compared to conventional Loom, Classification of Shuttle-less Loom. 5.2 Working principle, special features, advantages and limitations of Sulzer Projectile Shuttle-less Loom, Rapier Shuttle-less Weaving, Air Jet Loom and Water – Jet Loom 5.3 Cloth faults: Warp defects; Broken ends, Wrong ends, Selvage defects, Sticking, and Floats, Weft defects; Weft Breakages and Miss-picks, Bareness or Thin and Thick places, Tight	CO5

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5f. Suggest remedy for a particular fabric fault occurred during fabric weaving.	pick, Picks –out, Weft Curling, kinky fabrics, slugs, cracks, shuttle Marks, Cloth defects; Oil Spots, Dirty Cloth, Hairy or Flossy cloth, rough surface cloth and Harness skips 5.4 Loom Faults: Reed marks and cover of cloth, Shuttle Flying out, Shuttle Trapping in warp, Loom Banging- off, Loom stopping, Weft Cutting, Bumping and splitting or cops knocking - off	

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2428404

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Demonstrate the function of various parts of Dobby shedding mechanism. LSO 1.2. Use loom with dobby shedding mechanism to produce fabric.	1.	Mechanism of Dobby shedding	CO1
LSO 2.1. Produce fabric with a given design on a loom with dobby shedding by using wooden lattice chain LSO 2.2. Modify the peg plan for the loom with for Right-handed and Left-handed dobby	2.	Peg Plan for Dobby Shedding	CO1
LSO 3.1. Adjust the setting of Dobby shedding mechanism on a loom as per requirement. LSO 3.2. Follow safety precautions required for dismantling and refitting.	3.	Dismantle, refit and set timings of Dobby shedding mechanisms	CO1
LSO 4.1. Demonstrate the function of various parts of Jacquard shedding mechanism. LSO 4.2. Use loom with Jacquard shedding mechanism to produce fabric.	4.	Mechanism of Jacquard shedding mechanism	CO2
LSO 5.1. Prepare card for a given motif/design for Jacquard shedding. LSO 5.2. Use piano card cutting machine for the card preparation for a given motif/design.	5.	Card Preparation for Jacquard Shedding	CO2
LSO 6.1. Demonstrate fabric production of fabric with given design on a loom with Jacquard shedding by using card lacing	6.	Fabric Manufacturing using Jacquard shedding	CO2
LSO 7.1. Adjust the setting of Jacquard shedding mechanism on a loom as per requirement. LSO 7.2. Follow safety precautions required for dismantling and refitting.	7.	Dismantle, refit and set timings of Jacquard shedding mechanisms	CO2
LSO 8.1. Demonstrate the working of a Drop box mechanism	8.	Drop box mechanism	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 8.2.</i> Explain the function of each part of Drop box mechanism.			
<i>LSO 9.1.</i> Prepare card chain for a given weft pattern. <i>LSO 9.2.</i> Produce the fabric samples with given weft pattern using box motion.	9.	Card chain for weft patterning	CO3
<i>LSO 10.1.</i> Adjust the setting of Jacquard shedding mechanism on a loom as per requirement. <i>LSO 10.2.</i> Follow safety precautions required for dismantling and refitting.	10.	Dismantle, refit and set timings of Drop box mechanism	CO3
<i>LSO 11.1.</i> Identify the various parts of Automatic looms. <i>LSO 11.2.</i> Demonstrate the function of various parts of Automatic looms.	11.	Function of various parts of Automatic looms	CO4
<i>LSO 12.1.</i> Demonstrate the function of automatic Bobbin changing mechanism.	12.	Automatic Bobbin changing mechanism	CO4
<i>LSO 13.1.</i> Demonstrate the function of Warp stop motion on Automatic loom. <i>LSO 13.2.</i> Dismantle and refit the warp stop motion.	13.	Warp stop motion on Automatic loom	CO4
<i>LSO 14.1.</i> Demonstrate the function of various parts of Shuttle less loom. <i>LSO 14.2.</i> Use shuttle less loom for fabric manufacturing.	14.	Shuttle less Loom	CO5

L) Suggested Term Work and Self Learning: S2428404 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Prepare peg plan for manufacturing a fabric with given motif using dobby shedding.
2. Calculate the size of Jacquard required to produce a fabric with given motif.
3. Prepare a comparative table for different types of box motion.
4. List down the features of modern automatic looms.
5. Prepare a list of different types of fabric faults and describe their causes and remedies.
6. Collect the specifications of different types of shuttle-less machine and make a comparative chart.

b. Micro Projects:

1. Prepare a small video clip explaining the working of different types of dobbies.
2. Analyze the capacity of jacquard required for production of the collected fabric samples of woven fabric from local market.
3. Prepare a decorative fabric using different weft patterning with the help of box motion.
4. Prepare a report on different types of automations available on looms by visit nearby weaving industry.
5. Analyze the down time of different types of shuttle-less machine.

c. Other Activities:

1. Seminar Topics:

- Electronic dobby
- Modern Development in Jacquard shedding.
- Weft patterning using box-motion.
- Advancement in automatic looms.
- Shuttle-less loom for finer filaments
- Loom faults
- 3-D weaving

2. Visits: Visit nearby Fabric weaving industry and Prepare report of visit with special comments on various types of yarns used, Fabric produced, looms used, shedding used and cost of final Fabric produced.

3. Self-learning topics:

- Developments in dobby shedding.
- Application of Jacquard shedding in modern fabric production
- Weft patterning on shuttle less looms
- Circular weaving.
- Fabric defects on shuttle less looms

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	20%	20%	20%	20%	20%	25%	20%
CO-2	25%	25%	20%	20%	15%	20%	20%
CO-3	10%	10%	10%	20%	10%	15%	20%
CO-4	20%	20%	20%	20%	25%	30%	20%
CO-5	25%	25%	30%	20%	25%	10%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

*: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.

**.: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Dobby	11	CO1	16	4	6	6
Unit-2.0 Jacquard	10	CO2	15	4	5	6
Unit-3.0 Box Motions	5	CO3	7	2	1	4
Unit-4.0 Automatic Looms	11	CO4	16	4	4	8
Unit-5.0 Shuttleless Looms	11	CO5	16	6	4	6
Total	48	-	70	20	20	30

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Working of Dobby shedding mechanism	CO1	40	50	10
2.	Peg Plan for Dobby Shedding	CO1	40	50	10
3.	Dismantle, refit and set timings of Dobby shedding mechanisms	CO1	40	50	10
4.	Working of Jacquard shedding mechanism	CO2	40	50	10
5.	Card Preparation for Jacquard Shedding	CO2	40	50	10
6.	Fabric Manufacturing using Jacquard shedding	CO2	40	50	10
7.	Dismantle, refit and set timings of Jacquard shedding mechanisms	CO2	40	50	10
8.	Drop box mechanism	CO3	40	50	10
9.	Card chain for weft patterning	CO3	40	50	10
10.	Dismantle, refit and set timings of Drop box mechanism	CO3	40	50	10
11.	Automatic looms	CO4	40	50	10
12.	Automatic Bobbin changing mechanism	CO4	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Warp stop motion on Automatic loom	CO4	40	50	10
14.	Shuttle less Loom	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1	Plain Power Loom (positive dobby)	With cam/positive dobby shedding mechanism Fabric Width: 54-60 inch Machine speed: 200 rpm or more Automatic loom	1,2,3
2	Plain Power Loom (rotary dobby)	With rotary dobby shedding mechanism Fabric Width: 54-60 inch Machine speed: 200 rpm or more Automatic loom	1,2,3
3	Jacquard Loom	With jacquard shedding mechanism Fabric Width: 54-60 inch Machine speed: 200 rpm or more Automatic loom	4,5,6
4	Plain Power Loom (drop box mechanism)	With drop box mechanism Fabric Width: 54-60 inch Machine speed: 200 rpm or more Automatic loom	8,9,10
5	Plain Power Loom (Stop motion)	With warp stop, weft stop and bobbin changing mechanism Fabric Width: 54-60 inch Machine speed: 200 rpm or more Automatic loom	11,12, 13
6	Shuttle less loom	With rapier/projectile/air jet/water jet mechanism Fabric Width: 54-60 inch Machine speed: 1000 ppm aprox Automatic loom	14
7	Fabric defect analyzer	screen size 60inch x 24 inch or bigger Under and over light provision Automatic fabric rapping	ALL

R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Principle Of Weaving	R. Marks & A.T.S. Robinson	The Textile Institute, Manchester, 1976 ISBN:0-900739258
2.	Weaving, Machines, Mechanisms, Management	M.K. Talukdar	Mahajan Publishers Ahmedabad,1998 ISBN: 8185401160
3.	Weaving: Conversion of Yarn to Fabric	P.R. Lord & M.H. Mahamed,	Woodhead Publication, USA, 1982 ISBN:9781855734838
4.	Principles of fabric formation	Prabir Kumar Banerjee	CRC Press, Taylor & Francis Ltd, 2014 ISBN: 9780429097331
5.	Principles of Woven Fabric Manufacturing	Abhijit Majumdar	CRC Press, 2016 ISBN-13 : 978-1498759113
6.	Advanced Weaving Technology	Francois Boussu, Yordan Kyosev	Springer International Publishing, 2022 ISBN: 9783030915155

(b) Online Educational Resources:

1. <https://archive.nptel.ac.in/courses/116/102/116102017/>
2. <https://archive.nptel.ac.in/courses/116/102/116102005/>
3. <https://www.textileschool.com/360/types-of-fabric-weaving-loom/>
4. <http://www.columbia.edu/cu/computinghistory/jacquard.html>
5. <https://dynamiclooms.com/>
6. <https://www.toyota-industries.com/products/textile/weaving/>
7. <https://www.youtube.com/watch?v=fjyWmP2jjPg>
8. https://www.youtube.com/watch?v=awGjOG0_Mis
9. <https://www.youtube.com/watch?v=valHdaWrOCA>
10. <https://www.youtube.com/watch?v=KaxuEOXSZKE>
11. <https://www.youtube.com/watch?v=sqchTLyS2W4>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational resources before use by the students.

(c) Others:

1. Handbook of Textile and Industrial Dyeing; M Clark; Woodhead Publication, 2011, ISBN: 9780081016510
2. <https://nopr.niscpr.res.in/handle/123456789/19309>
3. Recent developments in rapier weaving machines in textiles, S Maity, K Singha, M Singha - American Journal of Systems Science, 2012
4. <https://www.youtube.com/watch?v=sVefNu9dVAo>
5. <https://www.textileworld.com/textile-world/features/2021/10/weaving-machine-developments/>
6. <https://textilelearner.net/types-of-modern-loom/>
7. Lab Manuals

- A) **Course Code** : 2428405(T2428405/P2428405/S2428405)
- B) **Course Title** : Textile Coloration and Finishing
- C) **Pre- requisite Course(s)** : Textile Fibres, Textile Chemical Processing
- D) **Rationale** :

Within Textile industry, textile coloration and finishing are pivotal processes that enhance the aesthetic appeal, functionality, and marketability of textiles. This course in Textile Coloration and Finishing aims to equip students with comprehensive knowledge, practical skills, and a deep understanding of the principles, techniques, and advancements in the critical areas of dyeing, printing and finishing of textile products. This course aligns with the evolving needs of the textile industry, equipping students with the knowledge, skills, and mindset necessary for success. By combining theoretical understanding with practical application, this course will produce skilled professionals who can uphold sustainable practices, and contribute to the growth and development of the global textile sector.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Use relevant dyes and dyeing methods for given synthetic and blend textile substrates.
- CO-2** Apply suitable mordant or pre-metallised dye to the given textile substrate.
- CO-3** Use relevant style, dyes, pigments, ingredients and fixation method to print on a given textile material.
- CO-4** Apply relevant finishing formulation to textile fabrics.
- CO-5** Estimate quality parameters of different wet processing effluent.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	3	1	1	-	-	1	2		
CO-2	3	1	-	2	-	1	1		
CO-3	3	2	2	2	3	1	1		
CO-4	3	1	-	2	-	1	1		
CO-5	3	2	2	2	3	1	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) Teaching & Learning Scheme:

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
Textile Engineering	2428405	Textile Coloration and Finishing	03	-	04	02	09	06

Legend:

CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)

Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.

TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)

SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.

C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

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H) Assessment Scheme:

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			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
Textile Engineering	2428405	Textile Chemical Processing	30	70	20	30	20	30	200

Legend:

PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)

PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)

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Note:

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J) **Theory Session Outcomes (TSOs) and Units: T2428405**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Identify the key properties of disperse dyes that make them suitable for synthetic fibers. <i>TSO 1b.</i> Differentiate between various methods of applying disperse dyes on polyester fibers. <i>TSO 1c.</i> Select the relevant dyeing machine for given polyester fabric. <i>TSO 1d.</i> Select suitable dye and its recipe for dyeing of the given synthetic fabric. <i>TSO 1e.</i> Analyze the challenges of dyeing blended textiles and garments made of different synthetic and natural fibers.	Unit-1.0 Dyeing of Synthetic Fibre 1.1 Disperse Dyes – Introduction and properties. 1.2 Methods of application of Disperse dyes on Polyester by High temperature dyeing process, Thermosol process, Carrier method, Rapid dyeing technique. 1.3 Dyeing machine used for Polyester: conventional and Modern HTHP Beam Dyeing machine, HTHP Jet Dyeing machine, Winch Dyeing machine. 1.4 Dyeing of Polyamide fabric with Disperse dyes, Acid dyes. 1.5 Dyeing of Viscose rayon with Direct Dyes, Sulphur Dyes and Vat Dyes. 1.6 Dyeing of Acetate rayon with disperse Dyes. 1.7 Dyeing of blended textiles: Cotton/Polyester, Wool/Polyester, Nylon/Wool, Polyester/Acrylic blends	CO1, CO2
<i>TSO 2a.</i> Describe the application methods of mordant dyes on given textile fibers. <i>TSO 2b.</i> Explain the characteristics of pre-metallised dyes and their application in dyeing textiles. <i>TSO 2c.</i> Explain the application techniques specific to azoic dyes, including diazotization and coupling. <i>TSO 2d.</i> Suggest relevant after-treatment processes to improve color fastness for the given dye.	Unit-2.0 Special Dyes and Fastness Properties 2.1 Mordant dyes: Properties, application of mordant dyes 2.2 Pre-metallised dyes: Properties, application of pre-metallised dyes 2.3 Azoic dyes: Properties, application of Azoic dyes 2.4 Benefits and limitations of these dyes. 2.5 Fastness properties of dyeing and their assessment 2.6 After treatment process to improve fastness	CO2
<i>TSO 3a.</i> Differentiate between Discharge Style, Direct Style, and Resists Style printing techniques. <i>TSO 3b.</i> Analyze the advantages, limitations, and visual effects of Discharge, Direct, and Resists Styles of printing. <i>TSO 3c.</i> Suggest suitable style of printing for a given scenario.	Unit-3.0 Printing 3.1 Styles of printing – Discharge Style, Direct Style and Resists Style. 3.2 Comparative study of different styles of printing and their importance. 3.3 Special styles of printing 3.4 Pigment printing 3.5 Fixation and aftertreatment processes 3.6 Digital Textile Printing	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 3d.</i> Explain the application of pigment printing on different textile substrates. <i>TSO 3e.</i> Select the relevant type of fixation in textile printing to ensure color fastness and durability. <i>TSO 3f.</i> Explain the advantages of digital printing in terms of customization, color accuracy, and reduced environmental impact.		
<i>TSO 4a.</i> Classify textile finishing techniques based on their effects and applications. <i>TSO 4b.</i> Explain the principles and applications of given mechanical finishing methods <i>TSO 4c.</i> Explain the effects and benefits of chemical finishes on textile properties. <i>TSO 4d.</i> Suggest suitable functional finishes for a particular application. <i>TSO 4e.</i> Explain the importance of eco-friendly finishing solutions for sustainable textile production.	Unit-4.0 Textile Finishing 4.1 Introduction, Objective & Classification of Textile Finishing 4.2 Mechanical finishing methods: Calendering, Embossing and surface texturing techniques, Sanforization, Heat Setting, Brushing, Napping and shearing processes for fabric softening 4.3 Chemical Finishes: Anticrease finishes, Anti-static finishes, Anti-pilling finishes, Flame retardant Finishes, water repellent treatments, stiffening and softening finishes, Soil release and stain resistance treatments 4.4 Other Functional Finishes: Moisture management and wicking finishes, UV protection and antimicrobial finishes, Thermal insulation and conductive finishes, Electromagnetic shielding 4.5 Emerging Trends in Textile Finishing: Nanotechnology applications in finishing, Smart textiles and wearable technology integration, Digital printing advancements in finishing, Eco-friendly finishing solutions	CO4
<i>TSO 5a.</i> Analyze the potential environmental impacts of toxic chemicals used in textile processes. <i>TSO 5b.</i> Identify the specific pollutants introduced into water during various textile processes. <i>TSO 5c.</i> Explain the adverse effects of textile pollutants on human health and aquatic ecosystems. <i>TSO 5d.</i> Describe the importance of effluent testing as a means of monitoring water quality. <i>TSO 5e.</i> Suggest relevant effluent testing method for a given scenario. <i>TSO 5f.</i> Explain the significance of effluent treatment plant in Textile Industry.	Unit-5.0 Water Pollution in Textile Industry 5.1 Introduction, Effect of toxic chemicals used in textile industry on environment, ISO 14000 series: Purpose, norms. 5.2 Quality parameters: Pollutants added in water during scouring, bleaching, mercerizing, dyeing, printing and finishing. Norms as per pollution control board 5.3 Effect of textile pollutants on human and aquatic life, remedies to control water pollution 5.4 Effluent testing methods: Physical methods, chemical methods 5.5 Physical method: Turbidity, pH testing, colour, total solids and dissolved solids by evaporation, 5.6 Chemical testing: Hardness, Chloride content, chemical oxygen demand and dissolved oxygen 5.7 Effluent Treatment Plant: Function & its advantages	CO5

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2428405

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Select relevant ingredient and process condition for dyeing of polyester fabric using disperse dye. <i>LSO 1.2.</i> Produce the dyed fabric samples using Disperse dye.	1.	Dyeing of Polyester fabric with Disperse dyes	CO1
<i>LSO 2.1.</i> Apply principle of dyeing with disperse dye for polyamide fabrics. <i>LSO 2.2.</i> Produce the dyed fabric samples using Disperse dye	2.	Dyeing of Polyamide fabric with Disperse dyes	CO1
<i>LSO 3.1.</i> Select relevant ingredient and process condition for dyeing of polyester fabric using disperse dye. <i>LSO 3.2.</i> Produce the dyed fabric samples using Disperse dye.	3.	Dyeing of Acetate Rayon fabric with Disperse dyes	CO1
<i>LSO 4.1.</i> Perform dyeing experiments using Sulphur/vat dyes on viscose rayon fabric. <i>LSO 4.2.</i> Select right ingredients for dyeing of viscose rayon fabric.	4.	Dyeing of Viscose rayon with Sulphur Dyes /Vat Dyes.	CO1
<i>LSO 5.1.</i> Select relevant ingredients for dyeing of cotton/polyester blend fabric. <i>LSO 5.2.</i> Perform the dyeing of cotton/polyester blend fabric using relevant dyes.	5.	Dyeing of Cotton/Polyester blend fabric.	CO1
<i>LSO 6.1.</i> Select relevant ingredients for dyeing of wool/polyester blend fabric. <i>LSO 6.2.</i> Perform the dyeing of wool/polyester blend fabric using relevant dyes.	6.	Dyeing of Wool/Polyester blend fabric.	CO1
<i>LSO 7.1.</i> Select relevant ingredient for dyeing of Silk/wool/Nylon based fabric using mordant dye. <i>LSO 7.2.</i> Perform dyeing of Silk/wool/Nylon based fabric using mordant dye.	7.	Dyeing of Silk/wool/Nylon based fabric using mordant dye	CO2
<i>LSO 8.1.</i> Select relevant ingredient for dyeing Acrylic fibre/yarn/fabric. <i>LSO 8.2.</i> Perform dyeing of Acrylic fibre/yarn/fabric using relevant dye.	8.	Dyeing of Acrylic fibre/yarn/fabric.	CO1, CO2
<i>LSO 9.1.</i> Prepare printing paste for direct style of printing using disperse dye. <i>LSO 9.2.</i> Use direct style of printing to apply disperse dye on the given polyester fabric sample.	9.	Direct style of Printing using disperse dye	CO3
<i>LSO 10.1.</i> Select relevant ingredient for discharge style of printing for a given fabric. <i>LSO 10.2.</i> Use discharge style of printing to produce colour discharge effect on the given fabric sample.	10.	Practice of discharge style of printing	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 11.1.</i> Select relevant ingredient for resist style of printing. <i>LSO 11.2.</i> Perform resist style of printing to produce colour resist effect on the given fabric sample.	11.	Practice of Resist style of printing	CO3
<i>LSO 12.1.</i> Select relevant ingredient for water proof/water repellent finish for a given fabric. <i>LSO 12.2.</i> Use lab padding mangle to get water proof and water-repellent finish on the given fabric.	12.	Practice water proof/water repellent finish on the given fabric.	CO4
<i>LSO 13.1.</i> Use relevant softener to evaluate its effect of application on the given cotton /wool /silk /blended fabric sample.	13.	Practice softener finish on the given cotton /wool /silk /blended fabric sample.	CO4
<i>LSO 14.1.</i> Produce anti-creasing finish on the given cotton fabric using relevant ingredients. <i>LSO 14.2.</i> Use crease recovery tester to evaluate the anti-creasing finish.	14.	Practice anti-creasing finish on the given cotton fabric.	CO4
<i>LSO 15.1.</i> Use titration method to determine chemical oxygen demand of the given effluent sample.	15.	Determination of chemical oxygen demand of the given effluent sample.	CO5
<i>LSO 16.1.</i> Use titration method to determine biological oxygen demand of the given effluent sample.	16.	Determination of biological oxygen demand of the given effluent sample.	CO5

L) Suggested Term Work and Self Learning: S2428405 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

1. Prepare a comparative chart for different methods of dyeing of polyester fabric.
2. Collect the detail specifications of different machine used for dyeing and prepare power point presentation on the same.
3. Prepare a report on different styles of printing methods used in different states of India.
4. Collect the recipe used for water repellency of cotton and prepare a report.
5. Prepare a report on effluent treatment methods used in Indian dye house.

b. Micro Projects:

1. Prepare a comparative report on dyeing of polyester fabric using disperse dye by different methods.
2. Apply mordant dye on the silk and wool fabric and conduct their colour fastness analysis and prepare a report.
3. Collect information from different manufacturers of machineries used in dyeing of synthetic fabrics and compare their working, structure and techno commercial importance.
4. Produce colour resistance and colour discharge effect on different cotton dyed fabric (direct, reactive and vat dyed) using resist and discharge style of printing and do a comparative analysis.
5. Visit nearby Textile processing industry and collect the details of process sequence and machinery used.
6. Study the role of TDS of water on crease resistance finish of cotton fabric.
7. Estimate the COD and BOD of the effluent water after dyeing of Polyester fabric with disperse dye using different methods and conduct the comparative analysis.

c. Other Activities:

1. Seminar Topics:

- Waterless dyeing
- Modern machineries for dyeing of Textiles.
- Blend dyeing methods
- Nanotechnology in Textile Finishing
- Lotus effect on Fabric
- Ink-jet printing of Fabric
- Methods to reduce chemical discharge from Textile Processing unit

2. Visits: Visit nearby Textile Processing industry and Prepare report of visit with special comments on various pretreatment technique used, material used, machinery used, batch production/mass production and cost of final dyed/printed material.

3. Self-learning topics:

- Developments in dyeing of polyester using disperse dye.
- Computer colour matching
- Printing Ingredients
- Finishing faults in Textile Industries and their remedy.
- Effluent treatment in Indian dye house.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	26%	26%	20%	20%	20%	30%	20%
CO-2	17%	17%	20%	20%	20%	15%	20%
CO-3	18%	18%	20%	20%	20%	20%	20%
CO-4	22%	22%	20%	20%	20%	20%	20%
CO-5	17%	17%	20%	20%	20%	15%	20%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

- *: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
 **: Mentioned under point- (N)
 #: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: Specification table represents the reflection of sample representation of assessment of cognitive domain of full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Dyeing of Synthetic Fibre	12	CO1	18	5	6	7
Unit-2.0 Special Dyes and Fastness Properties	8	CO2	12	3	5	4
Unit-3.0 Printing	9	CO3	13	3	6	4
Unit-4.0 Textile Finishing	11	CO4	15	5	5	5
Unit-5.0 Water Pollution in Textile Industry	8	CO5	12	4	4	4
Total	48	-	70	20	26	24

Note: Similar table can also be used to design class/mid-term/ internal question paper for progressive assessment.

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Dyeing of Polyester fabric with Disperse dyes	CO1	50	40	10
2.	Dyeing of Polyamide fabric with Disperse dyes	CO1	50	40	10
3.	Dyeing of Acetate Rayon fabric with Disperse dyes	CO1	50	40	10
4.	Dyeing of Viscose rayon with Sulphur Dyes /Vat Dyes.	CO1	50	40	10
5.	Dyeing of Cotton/Polyester blend fabric.	CO1	50	40	10
6.	Dyeing of Wool/Polyester blend fabric.	CO1	50	40	10
7.	Dyeing of Silk/wool/Nylon based fabric using mordant dye	CO2	50	40	10
8.	Dyeing of Acrylic fibre/yarn/fabric.	CO2	50	40	10
9.	Direct style of Printing using disperse dye	CO3	50	40	10
10.	Practice of discharge style of printing	CO3	50	40	10
11.	Practice of Resist style of printing	CO3	50	40	10
12.	Practice water proof/water repellent finish on the given fabric.	CO4	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Practice softener finish on the given cotton /wool /silk /blended fabric sample.	CO4	50	40	10
14.	Practice anti-creasing finish on the given cotton fabric.	CO4	50	40	10
15.	Determination of chemical oxygen demand of the given effluent sample.	CO5	50	40	10
16.	Determination of biological oxygen demand of the given effluent sample.	CO5	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student performance.

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1	Laboratory Glass Ware	Beaker- 100 ml, 250 ml, 1L, measuring cylinder-250 ml, 1 L Flask, Conical Flask: 250 ml; 500 ml Funnel Pipettes Glass rods = 6 inch	All
2 L	Laboratory steamer	Laboratory steamer 150 psi	All
3	Dye pot	capacity 500 ml	1,2,3,4,5,6,7,8
4	Dye bath	Dye bath with stirring/shaking motion with 6 or 12 pots General Material = Cr-Ni Stainless Steel Max. Temperature = 100°C Working Speed= 0-35 rpm Machine Capacity=12*250 ml Flask Heating Type = Resistance Automatic programmable, Digital Display Power Supply=220 V, 50 Hz	1,2,3,4,5,6,7,8
5	Laboratory Rota dyer	Capacity 250ml 6 or 12 pots Digital, Programmable Material: Cr-Ni Stainless Steel Power Supply=220 V, 50 Hz	1,2,3,4,5,6,7,8

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
6	Laboratory Open Bath beaker dyeing machine	Laboratory open bath beaker dyeing machine capacity 250ml (12 or 24 pots), Digital, Programmable Material: Cr-Ni Stainless Steel Power Supply=220 V, 50 Hz	1,2,3,4,5,6,7,8
7	Printing screen	screen size 12 x 12 inch	9,10,11
8	Rubber squeeze	Rubber squeeze for screen printing	9,10,11
9	Rubbing Fastness tester	Crock meter as per ISO & AATCC standard Shoe Diameter 16 mm Friction Weight 9 N Friction Test Fabric 5*5 cm Movement Distance 104 mm +/- 2 mm Test Specimen 25*5 cm Control with Digital/manual Counter Power Supply 220 V, 50 Hz	1,2,3,4,5,6,7,8
10	Curing chamber	Air/Steam curing Material: SS Maximum working width: 300mm to 1200mm Dwell time: 45 sec to 12 min Saturated steaming: 104 Degree C Thermo Fixing: 210 Degree C (optional)	All
11	Padding mangle	Roller size $\varnothing 110 \times 350$ mm Roller material Rubber (Thickness 15mm) Roller speed 0.5~20m/min. Roller hardness 70° Shore Air cylinder pressure: 0~7kgf/cm ² Trust cylinder: Diaphragm type	1,2,3,4,5,6,7,8,12,13,14
12	Washing Fastness tester	As per ISO and AATCC standard	7,8,9
13	Weighing Balance	digital weighing balance Capacity: 1000 gm with least count 0.05gram	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Dyeing and chemical Technology of Textile Fibres	Trotman, E. R. T.	John Willey and Sons Inc, 1985 ISBN: 978-0471809104
2.	Fundamental Principles of Textile Processing	Shenai, V.A	Sevak Publications, Bombay, 1984 ISBN: 9783659686047
3.	Blends dyeing	John Shore	Published by Society of Dyers and Colourists (1998) ISBN: 0 901956 74 0
4.	Textile Printing	Miles, L.W.C	Published by Society of Dyers and Colourists (1995) ISBN: 0901956686
5.	An Introduction to Textile Printing	Clarke, W	CBS Publishers and Distributors Pvt. Ltd., New Delhi 2004; ISBN: 9781855739949
6.	Technology of Printing	Shenai, V.A	Sevak Publications, Bombay, 1990 ISBN: 9783659686047

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
7.	Introduction to textile finishing	Marsh J.T	Springer US, 1966 ISBN: 9781504127936
8.	Chemical after treatments of textiles	Marks, Atlas; Wooding	A Wiley Inter Science Publication, 1971, ISBN-9781563675164
9.	Principles of Textile Finishing	Asim Kumar Roy Choudhury	Woodhead Publishing, 2017, ISBN: 978-0-08-100646-7
10.	Textile Effluents Treatment Methods	Shanmugasundaram O. L	Woodhead Publishing India Pvt Ltd, 2020, ISBN: 9789388320313
11.	Engineering Chemistry	Jain & Jain	Dhanpat Rai and sons; New Delhi, 2015, ISBN:9352160002

(b) Online Educational Resources:

1. <https://archive.nptel.ac.in/courses/116/102/116102052/>
2. <https://archive.nptel.ac.in/courses/116/102/116102054/>
3. www.dyes-pigments.standardcon.com/batch-dyeing-process.html
4. www.onlineclothingstudy.com/2015/11/mechanical-finishes-textiles.html
5. www.technicaltextile.net/articles/protective-clothing/detail.aspx?article_id=2686
6. indiantextilejournal.com/articles/FAdetails.asp?id=3729
7. [nopr.niscair.res.in/bitstream/123456789/19293/1/IJFTR%2021\(I\)%2079-89.pdf](http://nopr.niscair.res.in/bitstream/123456789/19293/1/IJFTR%2021(I)%2079-89.pdf)
8. textileapex.blogspot.in/2014/03/pigment-printing-advantagesdisadvantages.html?m=1
9. <https://www.youtube.com/watch?v=DlwyPHVX3-A>
10. www.textileleamer.blogspot.com/printing-method-method-of-printing
11. <https://www.youtube.com/watch?v=ael5dEynU9M&list=PLp6ek2hDcoNBZvRAkU71CeCKZvdcRErKa&index=8>
12. <https://www.youtube.com/watch?v=PSNfzKFqFQs>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. Handbook of Textile and Industrial Dyeing; M Clark; Woodhead Publication, 2011, ISBN: 9780081016510
2. Technology of Dyeing, Shenai, V. A., Sevak Publications Mumbai, 1984
3. Technology of finishing, Shenai, V. A., Sevak Publications Mumbai, 1990
4. Principles of Textile Printing; Asim Kumar Roy Choudhury; CRC press 2022, ISBN 9781138478305
5. Environmental Aspects of Textile Dyeing; R.M. Christie; CRC Press; 1st edition (6 June 2007); ISBN: 978-1420044454
6. <https://textiletuts.com/types-of-dyeing-machines/>
7. Lab Manuals

- A) **Course Code** : 2400007(T2400007)
- B) **Course Title** : Indian Constitution (Common for all Programmes)
- C) **Pre-requisite Course(s)** :
- D) **Rationale** :

This course will focus on the basic structure and operative dimensions of Indian Constitution. It will explore various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The Constitution of India is the supreme law of India. The document lays down the framework demarcating the fundamental political code, structure, procedures, powers, and sets out fundamental rights, directive principles, and the duties of citizens. The course on constitution of India highlights key features of Indian Constitution that makes the students a responsible citizen. In this online course, we shall make an effort to understand the history of our constitution, the Constituent Assembly, the drafting of the constitution, the preamble of the constitution that defines the destination that we want to reach through our constitution, the fundamental right constitution guarantees through the great rights revolution, the relationship between fundamental rights and fundamental duties, the futurist goals of the constitution as incorporated in directive principles and the relationship between fundamental rights and directive principles.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course out comes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/laboratory/workshop/field/ industry.

After completion of the course, the students will be able to-

CO-1 List salient features and characteristics of the constitution of India.

CO-2 Follow fundamental rights and duties as responsible citizen and engineer of the country.

CO-3 Analyze major constitutional amendments in the constitution.

- F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	1	-	-	-	2	-	-		
CO-2	1	-	-	-	2	-	-		
CO-3	1	2	-	-	2	-	1		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

- G) **Teaching & Learning Scheme:**

Board of Study	Course Code	Course Title	Scheme of Study (Hours/Week)					
			Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
			L	T				
	2400007	Indian Constitution	01	-	-	01	01	01

Legend:

- CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture(L), Tutorial(T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)
- LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)
- Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.
- TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)
- SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.
- C: Credits= (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Assessment Scheme:

Board of Study	Course Code	Course Title	Assessment Scheme (Marks)						Total Marks (TA+TWA+LA)
			Theory Assessment (TA)		Term Work & Self-Learning Assessment (TWA)		Lab Assessment (LA)		
			Progressive Theory Assessment (PTA)	End Theory Assessment (ETA)	Internal	External	Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)	
	2400007	Indian Constitution	25	-	-	-	-	-	25

Legend:

- PTA: Progressive Theory Assessment in class room (includes class test, mid-term test and quiz using online/offline modes)
- PLA: Progressive Laboratory Assessment (includes process and product assessment using rating Scales and rubrics)
- TWA: Term work & Self Learning Assessment (Includes assessment related to student performance in assignments, seminars, micro projects, industrial visits, self-learning, any other student activities etc.)

Note:

- ETA & ELA are to be carried out at the end of the term/ semester.
- Term Work is to be done by the students under the guidance of internal faculty but its assessment will be done **internally (40%)** as well as **externally (60%)**. Assessment related to planning and execution of Term Work activities like assignment, micro project, seminar and self-learning is to be done by internal faculty (Internal Assessment) whereas assessment of output/product/ presentation related to these activities will be carried out by external faculty/expert (External Assessment). However, criteria of internal as well as external assessment may vary as per the requirement of respective course. For valid and reliable assessment, the internal faculty should prepare checklist & rubrics for these activities.

- I) Course Curriculum Detailing:** This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

J) Theory Session Outcomes (TSOs) and Units: T2400007

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the meaning of preamble of the constitution. TSO 1b. List the salient features of constitution. TSO 1c. List the characteristics of constitution.	Unit-1.0 Constitution and Preamble 1.1 Meaning of the constitution of India. 1.2 Historical perspective of the Constitution of India. 1.3 Salient features and characteristics of the Constitution of India. 1.4 Preamble to the Constitution of India.	CO1
TSO 2a. Enlist the fundamental rights. TSO 2b. Identify fundamental duties in general and in particular with engineering field. TSO 2c. identify situations where directive principles prevail over fundamental rights.	Unit-2.0 Fundamental Rights and Directive Principles 2.1 Fundamental Rights under Part-III. 2.2 Fundamental duties and their significance. 2.3 Relevance of Directive Principles of State Policy under part-IV.	CO2
TSO 3a. Enlist the constitutional amendments. TSO 3b. Analyze the purposes of various amendments.	Unit-3.0 Governance and Amendments 3.1 Amendment of the Constitutional Powers and Procedure 3.2 Major Constitutional Amendment procedure - 42nd, 44th, 74th, 76th, 86th and 91st	CO3

Note: One major TSO may require more than one Theory session/Period.

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: (Not Applicable)

L) Suggested Term Work and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Role of Media in Spreading Awareness regarding Fundamental Rights
2. Analysis of Situations where directive principle of State policy has prevailed over Fundamental rights
3. Analyze 42nd and 97th Amendment of Indian Constitution

c. Other Activities:

1. Seminar Topics:
 - Democracy and Political Participation in India
 - Situations where directive principles prevail over fundamental rights.
2. Visits:
 - Arrange Mock Parliament.
3. Design games and simulation on emergencies declared in last thirty years.

4. Group discussions on current print articles.
 - Adoption of Article 365 in India.
 - Need of amendments in the constitution.
5. Prepare collage/posters on current constitutional issues.
 - Emergencies declared in India
 - Seven fundamental rights
6. Cases: Suggestive cases for usage in teaching:

Case	Relevance
A.K. Gopalan Case (1950)	SC contended that there was no violation of Fundamental Rights enshrined in Articles 13, 19, 21 and 22 under the provisions of the Preventive Detention Act, if the detention was as per the procedure established by law. Here, the SC took a narrow view of Article 21.
Shankari Prasad Case (1951)	This case dealt with the amendability of Fundamental Rights (the First Amendment's validity was challenged). The SC contended that the Parliament's power to amend under Article 368 also includes the power to amend the Fundamental Rights guaranteed in Part III of the Constitution.
Minerva Mills case (1980)	This case again strengthens the Basic Structure doctrine. The judgement struck down 2 changes made to the Constitution by the 42nd Amendment Act 1976, declaring them to violate the basic structure. The judgement makes it clear that the Constitution, and not the Parliament is supreme.
Maneka Gandhi case (1978)	A main issue in this case was whether the right to go abroad is a part of the Right to Personal Liberty under Article 21. The SC held that it is included in the Right to Personal Liberty. The SC also ruled that the mere existence of an enabling law was not enough to restrain personal liberty. Such a law must also be "just, fair and reasonable."

7. Self-learning topics:

- Parts of the constitution and a brief discussion of each part.
- Right to education.
- Right to equality.

M) Suggested Course Evaluation Matrix: The course teacher has to decide and use appropriate assessment strategy and its weightage in theory, laboratory and Term Work for ensuring CO attainment. The response/performance of each student in each of these designed activities is to be used to calculate **CO attainment**.

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	30%	-	30%	-	-	-	-
CO-2	40%	-	40%	50%	50%	-	-
CO-3	30%		30%	50%	50%		
Total Marks	25	-	5	10	10	-	-
			25				

Legend:

- *: Other Activities include self- learning, seminar, visits, surveys, product development, software development etc.
 **: Mentioned under point- (N)
 #: Mentioned under point-(O)

Note:

- The percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

N) Suggested Specification Table for End Semester Theory Assessment: (Not Applicable)**O) Suggested Assessment Table for Laboratory (Practical): (Not Applicable)**

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)**R) Suggested Learning Resources:****(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	The Constitution of India	P.M.Bakshi	Universal Law Publishing, New Delhi 15th edition, 2018, ISBN: 9386515105
2.	Introduction to Indian Constitution	D.D.Basu	Lexis Nexis Publisher, New Delhi, 2015, ISBN:935143446X
3.	Introduction to Constitution of India	B. K. Sharma	PHI, New Delhi, 6th edition, 2011, ISBN:8120344197
4.	The Constitution of India	B.L. Fadia	Sahitya Bhawan, Agra, 2017, ISBN:8193413768
5.	The Constitutional Law of India	Durga Das Basu	LexisNexis Butterworths Wadhwa, Nagpur 978-81-8038-426-4

(b) Online Educational Resources:

- <https://www.coursera.org/learn/principles-of-management>
- <http://www.legislative.gov.in/constitution-of-india>
- https://en.wikipedia.org/wiki/Constitution_of_India
- <https://www.india.gov.in/my-government/constitution-india>
- <https://eci.gov.in/about/about-eci/the-setup-r1/>
- <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>
- <https://main.sci.gov.in/constitution>
- <https://nios.ac.in/media/documents/srsec317newE/317EL8.pdf>
- <https://legalaffairs.gov.in/sites/default/files/chapter%203.pdf>

10. https://www.concourt.am/armenian/legal_resources/world_constitutions/constit/india/india-e.htm
11. <https://constitutionnet.org/vl/item/basic-structure-indian-constitution>

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

- A) **Course Code** : 2452107(T2452107)
- B) **Course Title** : Basics of Liberal Art (Non-Exam Course) (FTS, GT, TE)
- C) **Pre-requisite Course(s)** :
- D) **Rationale** :

The Liberal Art education aims to provide students with a foundational understanding of various aspects of liberal arts, including literature, history, philosophy, and social sciences for holistic approach towards education. The skills and knowledge gained after studying liberal arts can advance their chances in succeeding in selected career. This course of Basics of Liberal Art is designed for diploma graduates to develop certain liberal arts such as critical thinking skills, promote liberal art awareness, and foster creativity.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

After completion of the course, the students will be able to-

- CO-1** Demonstrate knowledge of key concepts and theories in literature, history, philosophy, and social sciences.
- CO-2** Apply critical thinking skills to evaluate and assess information from diverse sources.
- CO-3** Use creative thinking to perform disruptive engineering tasks.

F) **Suggested Course Articulation Matrix (CAM):**

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and 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
CO-1	-	-	-	-	3	1	3		
CO-2	-	-	1	-	3	1	3		
CO-3	-	-	1	-	3	11	3		

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional

G) **Teaching & Learning Scheme:**

Course Title	Scheme of Study (Hours/Week)				
	Classroom Instruction (CI)		Notional Hours (TW+ SL)	Total Hours (CI+TW)	Total Credits (C)
	L	T			
Basics of Liberal Art	01	-	-	01	01

Legend:

- CI: Classroom Instruction (Includes different instructional/implementation strategies i.e. Lecture (L), Tutorial (T), Case method, Demonstrations, Video demonstration, Problem based learning etc. to deliver theoretical concepts)
- LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop, field or other locations using different instructional/Implementation strategies)
- Notional Hours: Hours of engagement by learners, other than the contact hours for ensuring learning.
- TW: Term Work (includes assignments, seminars, micro projects, industrial visits, any other student activities etc.)
- SL: Self Learning, MOOCs, spoken tutorials, online educational resources etc.
- C: Credits = (1 x CI hours) + (0.5 x LI hours) + (0.5 x Notional hours)

Note: TW and SL have to be planned by the teacher and performed by the learner under the continuous guidance and feedback of teacher to ensure outcome of learning.

H) Course Curriculum Detailing: This course curriculum detailing depicts learning outcomes at course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (TW) and Self Learning (SL). Students are expected to demonstrate the attainment of Theory Session Outcomes (TSOs) and Lab Session Outcomes (LSOs) leading to attainment of Course Outcomes (COs) upon the completion of the course. While curriculum detailing, NEP 2020 related reforms like Green skills, Sustainability, Multidisciplinary aspects, Society connect, Indian Knowledge System (IKS) and others must be integrated appropriately.

I) Theory Session Outcomes (TSOs) and Units: T2452107

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 1a.</i> Define the concept of liberal arts and its significance. <i>TSO 1b.</i> Identify the different disciplines encompassed by liberal arts. <i>TSO 1c.</i> Discuss the historical development and evolution of liberal arts.	Unit-1.0 Introduction to Liberal Arts 1.1 Definition and significance of liberal arts 1.2 Historical development and evolution of liberal arts 1.3 Overview of interdisciplinary approaches in liberal arts 1.4 Liberal arts education and its benefit	CO1
<i>TSO 2a.</i> Analyze information and arguments is essential for success in liberal arts. <i>TSO 2b.</i> Analyze assumptions and identify biases <i>TSO 2c.</i> Draw logical conclusions from the evidence.	Unit-2.0 Critical Thinking 2.1 The Role of Critical Thinking in Liberal Arts Education 2.2 Arguments in Liberal Arts Disciplines, Information Assumptions, biases 2.3 Critical Thinking and Interpretation, logical conclusions from the evidence 2.4 Media Literacy and Critical Thinking in the Digital Age	CO1, CO2
<i>TSO 3a.</i> Devise original ideas and interpretations in give situation <i>TSO 3b.</i> Use new and unconventional approaches to problem-solving. <i>TSO 3c.</i> Use both primary and secondary sources effectively.	Unit-3.0 Creativity 3.1 Creative Thinking Skills in Education 3.2 Primary and Secondary Sources in Research for Academic Studies 3.3 Critical Thinking in Research: A Focus on Higher Education 3.4 Innovative Approaches to Analysis in Different Academic Fields	CO1, CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.5 Collaborative Research in Academic Settings 3.6 Feel free to let me know if you would like further information or if you have any other specific requests! 3.7 FDM based 3D printing process details. 3.8 Conduct research, Sources of information. 3.9 Primary and secondary data sources.	

Note: One major TSO may require more than one Theory session/Period.

J) Suggested Term Work/ Activities and Self Learning: Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments: Questions/Problems/Numerical/Exercises to be provided by the course teacher in line with the targeted COs.

b. Micro Projects:

1. Perform 3D printing of plastic casing of inhaler used by Asthma patients and estimate the cost.
2. Download 5 videos on 3D printing of different components, watch them and write a report to detail out the steps involved, 3D Printer used, 3D Printing software used, material used, complexity involved, printing time, post processing steps used.
3. Print two pieces of same components using ABS and PLA and compare their strength, surface roughness, weight, cost.
4. Download two 3D printing free software and try to check their compatibility with your lab printer.

c. Other Activities:

1. Seminar Topics:
 - Commercially available 3D printers and software.
 - Strength of 3D printed Plastic components as compared to Die cast Plastic components.
 - Properties of PLA and ABS 3D printing materials.
 - Reverse engineering application of 3D Printing.
2. Visits: Visit nearby tool room/industry with 3D Printing facilities. Prepare report of visit with special comments of 3D printing technique used, material used, single component/batch production/mass production and cost of printed component.
3. Self-learning topics:
 - 3D printing of flexible plastic components.
 - 3D printing of micro/mini components.
 - Conversion of CAD file formats into IGES.
 - 3D scanning process.

K) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, Field Trips, Portfolio Based, Learning, Role Play, Live Demonstrations in Classrooms, Lab, Field Information and Communications Technology (ICT)Based Teaching Learning, Blended or flipped mode, Brainstorming, Expert Session, Video Clippings, Use of Open Educational Resources (OER), MOOCs etc.

L) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)**M) Suggested Learning Resources:****(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Liberal Arts and Sciences: Thinking Critically, Creatively, and Ethically	Ed. D., Christopher a Ulloa Chaves	Trafford Publishing, 2014 ISBN: 1490736999, 9781490736990
2.	Art of Creative Thinking	Rod Judkins	Hachette Book Publishing 2015 ISBN: 9781444794489
3.	Introduction to Creativity and Innovation for Engineers	Stuart Walesh	Pearson, 2017 ISBN: 9781292159287

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview

Note: Teachers are requested to check the creative commons license status/ financial implications of the suggested, online educational recourses before use by the students.

(c) Others:

1. 3D Printing Projects DK Children; Illustrated edition, 2017
2. The 3D Printing Handbook: Technologies, design and applications Ben Redwood, Filemon Schöffner, Brian Garret, 3D Hubs; 1st edition, 2017
3. 3D Printer Users' Guide
