Curriculum

of

Diploma Programme

in

Textile Technology

State Board of Technical Education (SBTE)
Bihar

Semester – III
Teaching & Learning Scheme

Board of Study	Course Codes	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				
	2453301	**Silk Technology**	2	1	-	2	5	4
	2428302	**Textile Chemical Processing**	3	-	4	2	9	6
	2428303	**Textile Testing**	3	-	4	2	9	6
	2428304	**Man Made Fibre Technology**	2	1	-	2	5	4
	2418305	**Python Programming** (CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	3	-	4	2	9	6
	2400006	**Environmental Education and Sustainable Development** (Common for All Programmes)	1	-	1	1	3	2
	2428306	**Summer Internship – I** (After 2nd Sem) (Common for all programmes)	-	-	2	2	4	2
Total			**14**	**2**	**15**	**13**	**44**	**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 - III
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)	
	2453301	**Silk Technology**	30	70	20	30	-	-	150
	2428302	**Textile Chemical Processing**	30	70	20	30	20	30	200
	2428303	**Textile Testing**	30	70	20	30	20	30	200
	2428304	**Man Made Fibre Technology**	30	70	20	30	-	-	150
	2418305	**Python Programming** (CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT)	30	70	20	30	20	30	200
	2400006	**Environmental Education and Sustainable Development** (Common for All Programmes)	15	-	10	-	10	15	50
	2428306	**Summer Internship – I** (After 2nd Sem) (Common for all programmes)	-	-	10	15	10	15	50
Total			**165**	**350**	**120**	**165**	**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 **: 2453301(T2453301/S2453301)**

B) Course Title **:** Silk Technology

C) Prerequisite Course(s) **:** Yarn Manufacture-I, Fabric Manufacture-I

D) Rationale **:**

The yarn received from the spinning department is not adequate in quantity and quality for weaving. It contains a number of imperfections in the form of thick places, thin places, and slubs. These will pose problems in the subsequent process and ultimately hinder the cloth quality. The winding process achieves the twin objectives of reducing the imperfections in the ring yarn as well as converting it into a bigger package in the form of cone/cheese. Basic concepts and principles of winding of warp/weft, different supply packages and delivery packages, and different yarn clearers are essential for the students to understand the sequence of operations in the weaving preparatory processes and also to perform necessary weaving preparatory calculations.

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 various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in the classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Develop process sequence for conversion of yarn to woven fabrics.
CO-2 Apply the knowledge of yarn numbering system to determine the yarn count of the given yarn.
CO-3 Select the relevant winding machine for the given application.
CO-4 Select the relevant tensioning, clearing and joining devices for the winding of given yarn.
CO-5 Suggest the remedies for identified winding faults.

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/ Developmentof 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		
CO-2	3	-	-	2	-	-	1		
CO-3	3	2	-	2	-	1	1		
CO-4	3	2	2	2	-	1	1		
CO-5	3	-	-	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	2453301	Silk Technology	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	2453301	Silk Technology	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: T2453301

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the functions of the weaving preparatory process to produce a given fabric. *TSO 1b.* Identify warp and weft of a given fabric. *TSO 1c.* Develop process flow for conversion of yarn to fabric.	**Unit-1.0 Weaving Preparatory Process** 1.1 Introduction: Fabric, warp, and weft 1.2 Flow chart of conversion of yarn to fabric 1.3 Principles, purpose, and requirements of the preparatory process	**CO1**
TSO 2a. Explain the yarn numbering system. *TSO 2b.* Compare different systems of yarn numbering. *TSO 2c.* Calculate the yarn count for a given yarn. *TSO 2d.* Calculate the resultant and average counts of folded and single yarns. *TSO 2e.* Estimate the cost of folded yarn.	**Unit-2.0 Yarn Numbering System** 2.1 Yarn Numbering (Count): Concept, Type of yarn numbering System 2.2 Count Conversion 2.3 Folded yarns and resultant counts, Average counts 2.4 Costing of folded yarns 2.5 Simple calculations based on the above yarn numbering system	**CO2**
TSO 3a. Explain functions of the winding machine. *TSO 3b.* Identify the type of given yarn package. *TSO 3c.* Explain the working principle of the given type of winding machine. *TSO 3d.* Distinguish between precision and random winding. *TSO 3e.* Select the relevant winding machine for producing end packages for a given requirement. *TSO 3f.* Explain the function of pirn winding machine.	**Unit-3.0 Winding** 3.1 Purpose of Winding, Types of yarn feed and delivery packages 3.2 Wind, Traverse ratio or wind ratio or wind per double traverse, Angle of wind, Coil angle 3.3 Winding machine: Passage of material through the winding machine, Zones of winding machine (Unwinding zone, Yarn tensioning, clearing zone and Winding zone) 3.4 Classification of winding principle: Drum-driven or random winders, Spindle-driven or precision winders, and Digicone 3.5 Patterning: Introduction, Path of yarn on the package, Condition of patterning, Anti-patterning devices 3.6 Pirn winding: Objectives, principle, Non-automatic and automatic Pirn winding machines 3.7 Conditions for uniform package (cone/cheese) building	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.8 Winding for package dyeing, Technological developments in winding machine	
TSO 4a. Select the most suitable tensioner for the given yarn. *TSO 4b.* Distinguish between the given types of clearer. *TSO 4c.* Distinguish between splicing and knotting mechanism. *TSO 4d.* Select the most suitable yarn joining method for the given yarn. *TSO 4e.* Identify the objectionable faults in a given yarn using principal of Classimat. *TSO 4f.* Explain the given yarn traversing method.	**Unit-4.0 Tensioner & Clearer** 4.1 Yarn Tensioning: Objectives, Types of Tensioning Device (Additive type or Disc type tensioner, Multiplicative type tensioner, Gate or grid bar type tensioner), Relation between input and output tension in Multiplicative Tensioner, Tension variation during unwinding 4.2 Yarn Clearer: Objectives, Types of Yarn Clearer – Mechanical Type (Fixed, Swinging) and Electronic Type, Principle of measurement (Capacitance principle and Optical principle), Yarn Imperfections, Chart for Classimat faults, Different types of yarn faults in ring spun yarn, Significance of objectionable faults, 4.3 Yarn Traversing: Reciprocating traverse, Rotary traverse, Multipede traverse 4.4 Methods of joining the yarn –Splice and Knot, Principle of splicing, Types of knots, Knotting devices	**CO4,**
TSO 5a. Select winding parameters for a given yarn count. *TSO 5b.* Identify the different types of package defects. *TSO 5c.* Use relevant technique to minimize the winding package defects. *TSO 5d.* Calculate the clearing efficiency of the given machine. *TSO 5e.* Calculate the output production of the winding machine from given data. *TSO 5f.* Calculate the number of winding machine required to produce given quantity.	**Unit-5.0 Winding Assessment** 5.1 Types of package: Parallel, Cross wound, End uses of winding packages 5.2 Defects in winding packages, their causes and remedies 5.3 Winding Parameters – Traverse length, traverse ratio, winding speeds, coil angle, wind angle, scroll of drum, Gain 5.4 Assessment of clearer performance: knot factor, clearing efficiency 5.5 Production calculations of winding machines, Planning calculation for winding section for the given lot,	**CO5**

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

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

L) Suggested Term Work and Self-Learning: S2453301 **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 list of weaving preparatory machines manufacturers with specifications.
- Prepare a chart of count conversion from one system to another system.
- Prepare a report on the possible source of origin of objectionable faults.
- Prepare a report by doing a survey regarding winding parameters used for different materials.
- Prepare a ppt on the latest development in yarn clearer.

b. Micro Projects:

1. Prepare a swatch book of woven fabrics and mark warp and weft directions.
2. Draw a flow chart of the preparatory process involved in manufacturing various fabrics.
3. Prepare a Sample Card by collecting samples of yarn and label their yarn numbers in English and Tex systems.
4. Prepare a card sheet of different yarn sizes arranged in increasing yarn count.
5. Categorize the collected different yarn faults according to classimat faults.
6. Prepare a card sheet of different splicers and clearers and with its specification.
7. Prepare the report of pirn winding machines with their specifications.
8. Prepare a card sheet of various package defects.

c. Other Activities:

1. Seminar Topics:
   - Recent technological advancement of winding machine.
   - Latest developments in drum winding.
   - Modifications in Pirn winding machine.
2. Visits:
   - Visit the nearby weaving industry and prepare the layout of preparatory machines.
   - Prepare a report on different manufacturer's winding machines based on your industrial visit.
   - Collection of various machine specifications and process parameters for the winding machine
3. Self-learning topics:
   - USTER instrument for imperfections.
   - Waste in winding.

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	10%	10%	20%	20%	20%	-	-
CO-2	20%	20%	20%	20%	-	-	-
CO-3	35%	35%	20%	20%	20%	-	-
CO-4	20%	20%	20%	20%	30%	-	-
CO-5	15%	15%	20%	20%	30%	-	-
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 (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Yarn Preparatory Process	04	CO1	06	2	2	2
Unit-2.0 Yarn Numbering System	08	CO2	12	4	4	4
Unit-3.0 Winding	18	CO3	26	6	8	12
Unit-4.0 Tensioner & Clearer	10	CO4	14	4	4	6
Unit-5.0 Winding Assessment	08	CO5	12	4	4	4
Total	**48**	**-**	**70**	**20**	**22**	**28**

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): (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, Tutorials, 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, 1992ISBN:0-900 -54178-4
2.	Fundamentals of yarn winding	Koranne, M.K.	Woodhead Publication India PVT Ltd., New Delhi, 2013 ISBN: 978-93-80308-38-8
3.	Modern weaving calculations: Preparatory	Singh, R.B.	Mahajan Book Distributors, 1994 ISBN 8185401039, 9788185401034
4.	An Introduction to winding and warping	Talukdar, M.K.	Textile Trade Press, Mumbai.
5.	Principle of Weaving	Marks & Robinson	The Textile Institute, Manchester, England,1976 ISBN:0-900739258
6.	Industrial practices in weaving preparatory	Dr Mukesh Kumar Singh	Woodhead Publishing India Pvt. Ltd. ISBN: 978-93-80308

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
7.	Yarn Preparation Vol.-I	R. Sen Gupta	Mahajan Publication, Ahmedabad.
8.	Weaving Calculation	R. Sen Gupta	D.B. Taraporevala Sons and Company,
9.	Principles of Fabric Formation	P.K. Banerjee	Taylor & Francis Group ISBN: 13: 978-1-4665-5445-0

(b) Online Educational Resources:

1. https://saurer.com/en/products/machines/winding/autoconer
2. https://nptel.ac.in/courses/116102005
3. https://textilelearner.net/shedding-mechanism-in-weaving/

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. Winding Manual of The Bombay Textile Research Association

******

A) Course Code : **2428302(T2428302/P2428302/S2428302)**

B) Course Title : Textile Chemical Processing

C) Pre- requisite Course(s) : Textile Fibres

D) Rationale :

Chemical processing of textiles is one of the main activity, which is being carried out in textile industry to impart required attribute to the textile materials after their manufacturing. Diploma holders in textile Engineering are being assigned with various roles at various level where the basic knowledge of Textile chemical processing is required to solve issues related to not only day to day production activity but also for the new developmental activities. This course develops necessary skills in using the chemicals which are used during pretreatment process for improving absorbency and whiteness of fabrics. This course also gives the basic knowledge about dyeing and printing processes of textile which improves the aesthetic value of textile substrate.

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 principles of pretreatment of fabrics in textile manufacturing.

CO-2 Apply relevant method for singeing, desizing, scouring and bleaching of fabrics.

CO-3 Select relevant method of Mercerization for given cotton substrate.

CO-4 Use relevant dyes and dyeing methods for given cellulosic and protein textiles.

CO-5 Select relevant printing method for given textile substrate.

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/ Developmentof 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		
CO-2	3	1	1	2	-	1	1		
CO-3	3	2	-	2	3	1	2		
CO-4	3	1	2	2	-	1	1		
CO-5	3	1	1	2	-	1	2		

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	**2428302**	Textile Chemical Processing	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	**2428302**	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)

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 Unit: T2428302

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Describe sequential Process flow of Pre-treatment required for a particular requirement. *TSO 1b.* Select relevant method of singeing for a particular textile substrate. *TSO 1c.* Describe the principle of Desizing. *TSO 1d.* Select relevant method of Desizing for a given textile substrate. *TSO 1e.* Select relevant method of Scouring for a given textile substrate. *TSO 1f.* List down advantages and disadvantages of Batch and continuous Scouring process. *TSO 1g.* Explain working principle of different scouring machine with sketch.	**Unit-1.0 Pre-Treatment of Textiles** 1.1 Introduction, Objective and Advantages, Sequential process flow chart 1.2 Singeing: Objectives, Plate singeing, Roller singeing, Gas singeing, Merits and demerits of these singeing methods. 1.3 Desizing: Objectives, Methods of desizing 1.4 Hydrolytic desizing method - Rot steep, Acid steep, Enzymatic desizing, 1.5 Oxidative desizing method - chlorine desizing, chlorite desizing, Bromite desizing, 1.6 Continuous desizing method 1.7 Scouring: Objectives, Methods of Scouring: Saponification, Emulsification Detergent action, Prolonged boiling, Enzymatic Scouring 1.8 Machines used for batch wise and continuous Scouring: Vertical Kier, Horizontal Kier, Steam injector Kier, Jigger, Winch, J-box System	**CO1, CO2**
TSO 2a. Describe the need of Bleaching process. *TSO 2b.* Select appropriate Bleaching agent for given textile substrate. *TSO 2c.* Select appropriate bleaching recipe for given textile substrate. *TSO 2d.* Explain advantages and disadvantages of different machines used for bleaching. *TSO 2e.* Select optimum condition for selected bleaching agent for bleaching operation of a given substrate. *TSO 2f.* Select a method to determine the degradation of cotton during scouring and bleaching. *TSO 2g.* Suggest the remedy for the faults identified in bleaching.	**Unit-2.0 Bleaching** 2.1 Objects of bleaching, Different types of bleaching agents 2.2 Bleaching process: - Bleaching powder, Sodium hypochlorite, Hydrogen peroxide, sodium chlorite. 2.3 Advantages and limitations of different Bleaching Process 2.4 Bleaching of Cotton, Wool, Silk, P/C, P/V, and P/W blend 2.5 Batch wise, continuous method of bleaching and mixed bleaching 2.6 Machines used for bleaching: Jiggers, winch, soft flow, continuous bleaching range. 2.7 Optimum conditions for various Bleaching operations. 2.8 Methods used for determination of degradation of cotton during scouring and bleaching. 2.9 Faults in bleaching and their prevention.	**CO1, CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Describe the need and importance of mercerization. *TSO 3b.* Explain the different factors that affect mercerization. *TSO 3c.* Explain the changes in cotton due to mercerization. *TSO 3d.* Select the appropriate machine to be used for mercerization of cotton substrate. *TSO 3e.* Select the appropriate recipe for the mercerization of cotton for a given scenario. *TSO 3f.* Suggest modification in the existing mercerization process.	**Unit-3.0 Mercerization** 3.1 Introduction: History and developments of mercerization, Objects of mercerization 3.2 Factors determining the efficiency of mercerization 3.3 Physical and chemical changes in cotton due to mercerization 3.4 Methods and Machines used for mercerization: chain cloth mercerizing machines, chainless cloth mercerizing machine, chainless padless mercerizing machine 3.5 Hank Mercerization and Hot mercerization 3.6 Evaluation of different chemicals, solvents used in Mercerization and their importance. 3.7 Modern Developments in Mercerization	**CO3**
TSO 4a. Identify the type of dye based on their classification. *TSO 4b.* Explain the different principles involved in dyeing of textile substrate. *TSO 4c.* Describe the process of dyeing textile substrate with the given dye. *TSO 4d.* Compare the properties of two different dye used for dyeing of textile substrate made from natural fibre. *TSO 4e.* Select suitable dye and dyeing process for a textile substrate made from natural fibre. *TSO 4f.* Describe the process of after treatment required for dyed textile substrate.	**Unit-4.0 Dyeing** 4.1 Historical developments of dyes and their applications 4.2 Classification of dyes 4.3 Theory of dyeing: Introduction to physical and chemical principles involved in dyeing, Factors affecting dyeing 4.4 Direct dyes: Properties, method of application, after treatments on direct dyed goods 4.5 Reactive dyes: Properties, Classification, method of application. 4.6 Vat Dyes: Properties, Classification, method of application. 4.7 Acid Dyes: Properties, Classification, method of application. 4.8 Basic Dyes: Properties, Classification, method of application. 4.9 Sulphur Dyes: Properties, method of application, after treatments on Sulphur dyed goods	**CO4**
TSO 5a. Explain the scope of printing on textile substrate. *TSO 5b.* Describe the printing process of textile material. *TSO 5c.* Differentiate between dyeing and printing process. *TSO 5d.* Describe the Block printing process. *TSO 5e.* Describe with sketch the working principle of Screen printing, Roller printing. *TSO 5f.* Explain the principle of Rotary Screen Printing, Transfer Printing and Foam Printing. *TSO 5g.* Compare different methods of printing used for textile materials.	**Unit-5.0 Printing** 5.1 Historical developments of Textile Printing, scope of printed textiles. 5.2 Overview of printing process 5.3 Methods of printing 5.4 Block printing - Preparation and use of blocks 5.5 Screen printing - Principle and working of screen printing 5.6 Roller printing- Principle and working of Roller printing 5.7 Rotary Screen printing 5.8 Transfer printing and Foam printing.	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2428302

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use principle of desizing for Cotton fabrics. *LSO 1.2.* Calculate the weight loss due to desizing process.	1.	Desizing of cotton fabrics by using acid /enzyme	CO1, CO2
LSO 2.1. Apply principle of Scouring for Cotton fabrics. *LSO 2.2.* Calculate the weight loss due to Scouring process.	2.	Scouring of the given cotton fabric	CO1, CO2
LSO 3.1. Select right ingredients for Scouring of wool. *LSO 3.2.* Perform the scouring of wool.	3.	Scouring of Wool fibre	CO1, CO2
LSO 4.1. Select right ingredients for bleaching of cotton fabric. *LSO 4.2.* Perform the bleaching of cotton fabric using sodium hypochlorite.	4.	Bleaching of Cotton fabric using sodium hypochlorite.	CO1, CO2
LSO 5.1. Select right ingredients for bleaching of cotton fabric. *LSO 5.2.* Perform the bleaching of cotton fabric using Hydrogen peroxide,	5.	Bleaching of Cotton fabric using Hydrogen peroxide.	CO1, CO2
LSO 6.1. Select right ingredients for bleaching of synthetic blends. *LSO 6.2.* Perform the bleaching of synthetic blends.	6.	Bleaching of synthetic blends.	CO1, CO2
LSO 7.1. Select relevant ingredient for dyeing with Direct dyes. *LSO 7.2.* Produce the dyed fabric samples using Direct dye. *LSO 7.3.* Perform after treatment for direct dyed fabric.	7.	Dyeing of the given fabric sample by using direct dyes.	CO4
LSO 8.1. Select relevant ingredient for dyeing with Reactive dyes. *LSO 8.2.* Produce the dyed fabric samples using Reactive dye.	8.	Dyeing of the given fabric sample by using reactive dyes.	CO4
LSO 9.1. Select relevant ingredient for dyeing with Vat Dyes. *LSO 9.2.* Produce the dyed fabric samples using Vat dye.	9.	Dyeing of the given fabric sample by using vat dyes.	CO4
LSO 10.1. Select relevant ingredient for dyeing with Acid Dyes. *LSO 10.2.* Produce the dyed woolen fabric samples using Acid dye.	10.	Dyeing of the given Wool or Silk fabric sample by using Acid dyes.	CO4
LSO 11.1. Select relevant ingredient for dyeing with Basic Dyes. *LSO 11.2.* Perform dyeing of Silk fabric samples using Basic dye.	11.	Dyeing of the given Wool or silk or Cotton fabric sample by using Basic dyes.	CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 12.1. Select relevant ingredient for dyeing with Sulphur Dyes. *LSO 12.2.* Produce the dyed fabric samples using Sulphur dye.	12.	Dyeing of the given fabric sample by using Sulphur dyes.	CO4
LSO 13.1. Prepare relevant printing paste for Block printing. *LSO 13.2.* Produce printed textile articles using block printing method.	13.	Practice of block printing on paper and fabrics (cotton, silk)	CO5
LSO 14.1. Prepare relevant printing paste for Screen printing. *LSO 14.2.* Produce printed textile articles using Screen printing method.	14.	Practice of Screen printing on fabrics	CO5
LSO 15.1. Produce printed textile articles using Transfer printing method.	15.	Practice of Transfer printing on paper and fabrics	CO5
LSO 16.1. Apply the principle of mercerization to the given cotton sample	16.	Mercerization of cotton fabric using sodium hydroxide.	CO3

L) Suggested Term Work and Self Learning: S2428302 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 desizing & scouring.
2. Collect the detail specifications of different machine used for bleaching and prepare a power point presentation on the same.
3. Prepare a report on structural changes in cotton during mercerization process.
4. Collect the recipe used for dyeing of cotton with different dyes and prepare a report.
5. Prepare a report on traditional printing methods of India.

b. Micro Projects:

1. Carry out desizing, scouring and bleaching of 5 different fabric sample and compare the total weight loss % and brightness of fabric sample.
2. Carry out dyeing on 5 different fabric qualities with direct dyes (with same concentration) and check the variation in depth of shade.
3. Carry out the pre-treatment of the grey fabric and finally dye them using Direct, Reactive and Vat dyes and check their washing and rubbing fastness.
4. Collect the details of process sequence and machinery used in a nearby Textile processing industry.
5. Collect the details of different types of dyes used by nearby Textile processing industry along with list of other chemicals and their function.
6. Prepare a report on different chemical processing of silk carried out at the industry by visiting nearby silk processing unit and.

c. Other Activities:

1. Seminar Topics:
   - Enzymatic Desizing
   - Modern Machineries for Pretreatment of Textiles.
   - Bleaching of Synthetic and Blend materials.
   - Ammonia mercerization
   - Dyeing of Fabrics made from protein Fibres
   - Modern Rapid dyeing techniques
   - Latest Development in printing methods
   - 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 after treatment of direct dyed goods.
   - Degradation during pre-treatment of textiles
   - Dyeing Machines for batch and continuous production
   - Dyeing Faults in Textile Industries and their remedy.
   - Printing on blend material.

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	15%	15%	15%	25%	20%	20%	20%
CO-2	10%	10%	15%	15%	20%	20%	20%
CO-3	15%	15%	10%	10%	10%	10%	20%
CO-4	30%	30%	30%	25%	25%	30%	20%
CO-5	30%	30%	30%	25%	25%	20%	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 (Cl) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Pre-Treatment of Textiles	10	CO1, CO2	15	4	4	7
Unit-2.0 Bleaching	9	CO1, CO2	15	4	5	6
Unit-3.0 Mercerization	7	CO4	10	3	2	5
Unit-4.0 Dyeing	11	CO4	15	4	5	6
Unit-5.0 Printing	11	CO5	15	5	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.	Desizing of the given grey cotton fabrics by using acid /enzyme	CO1, CO2	50	40	10
2.	Scouring of the given cotton fabric	CO1, CO2	50	40	10
3.	Scouring of Wool fibre	CO1, CO2	50	40	10
4.	Bleaching of Cotton fabric using sodium hypochlorite.	CO1, CO2	50	40	10
5.	Bleaching of Cotton fabric using Hydrogen peroxide.	CO1, CO2	50	40	10
6.	Bleaching of synthetic blends.	CO1, CO2	50	40	10
7.	Dyeing of the given fabric sample by using direct dyes.	CO4	50	40	10
8.	Dyeing of the given fabric sample by using reactive dyes.	CO4	50	40	10
9.	Dyeing of the given fabric sample by using vat dyes.	CO4	50	40	10
10.	Dyeing of the given Wool fabric sample by using Acid dyes.	CO4	50	40	10
11.	Dyeing of the given silk fabric sample by using Basic dyes.	CO4	50	40	10
12.	Dyeing of the given fabric sample by using Sulphur dyes.	CO4	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Practice of block printing on paper and fabrics (cotton, silk)	CO5	50	40	10
14.	Practice of Screen printing on fabrics (cotton, silk)	CO5	50	40	10
15.	Practice of Transfer printing on paper and fabrics (cotton, silk)	CO5	50	40	10
16.	Mercerization of cotton fabric using sodium hydroxide.	CO3	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 mi, 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	7,8,9,10,11,12
4	Dye bath	Dye bath with stirring/shaking motion with 6 or 12 pots General Material = Cr-Nİ 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	7,8,9,10,11,12
5	Laboratory Rota dyer	Capacity 250ml 6 or 12 pots Digital, Programmable Material: Cr-Nİ Stainless Steel Power Supply=220 V, 50 Hz	7,8,9,10,11,12
6	Laboratory Open Bath beaker dyeing machine	Laboratory open bath beaker dyeing machine capacity 250ml (12 or24 pots), Digital, Programmable Material: Cr-Nİ Stainless Steel Power Supply=220 V, 50 Hz	7,8,9,10,11,12

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
7	Printing screen	screen size 12 x 12 inch	14
8	rubber squeeze	Rubber squeeze for screen printing	14
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	7, 8, 9
10	Curing chamber	Air/Steam curing Material: SS Maximum working width: 300mm to 1200mm Dwell time: 45 sec to12 min Saturated steaming: 104 Degree C Thermo Fixing: 210 Degree C (optional)	All
11	Padding mangle	Roller size Ø110 × 350mm Roller material Rubber (Thickness 15mm) Roller speed 0.5~20m/min. Roller hardness 70° Shore Air cylinder pressure: 0~7kgf/cm2 Trust cylinder: Diaphragm type	1,2,3,4,5,6,16
12	Washing Fastness tester	As per ISO and AATCC standard	7,8,9

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.	Cellulosics dyeing	John Shore	Published by Society of Dyers and Colourists (1981) ISBN: 9789813146754
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
7.	Textile Preparation and Dyeing	Choudhury, A. K. R.	CRC Press; 1st edition (9 January 2006) ISBN: 9781578084043

(b) Online Educational Resources:

1. https://nptel.ac.in/courses/116102016
2. https://nptel.ac.in/courses/116102052
3. www.textilelearner.blogspot.in/2011/07/dyeing-process-different-types-of-dye
4. www.teonline.com/knowledge-centre/dyeing-fiber
5. https://www.youtube.com/watch?v=-3U9I2IxB8Q
6. www.textileleamer.blogspot.com/printing-method-method-of-printing
7. https://www.youtube.com/watch?v=8LZefBE-JPw
8. https://www.youtube.com/watch?v=YbRGa806tD4
9. https://www.youtube.com/watch?v=7ak27yP5Vdk

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. Principles of Textile Printing; Asim Kumar Roy Choudhury; CRC press 2022, ISBN 9781138478305
3. Environmental Aspects of Textile Dyeing; R.M. Christie; CRC Press; 1st edition (6 June 2007); ISBN: 978-1420044454
4. https://textiletuts.com/types-of-dyeing-machines/
5. Lab Manuals

******

A) Course Code : **2428303(T2428303/P2428303/S2428303)**

B) Course Title : Textile Testing

C) Pre-requisite Course(s) : Textile Fibres, Yarn Manufacture-I

D) Rationale :

Textile testing is essential for textile engineers to appreciate the importance of testing and to develop skills to test the textiles as per standards using advance testing methods. Quality of yarn depends on the fiber properties, fiber parameters and quality of fabric on yarn properties and parameters, and their quality control and testing. Therefore, students are also equipped with the methods to analyse the testing results statistically. This course is developed in the way by which fundamental information will help the diploma engineers to apply the basic concepts of fiber and yarn testing to solve broad problems in textile manufacturing. Therefore, knowledge of fiber and yarn testing is essential for controlling yarn and fabric manufacturing process. After learning this course, students would be able to measure property of textile material and analyze the result for specific end use or next process. Also they can pinpoint the any deficiency in the process using the result of testing and take remedial measures to ensure the quality. This course is therefore a key course for textile engineers.

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 Apply basic principles of fibre and yarn testing in selection of raw materials, process control and quality assurance.

CO-2 Select correct sampling technique and identification method for given fiber.

CO-3 Evaluate textiles sample based on moisture relationship.

CO-4 Test different types of textile fibers and yarn using the relevant instrument.

CO-5 Use the yarn count measuring instrument to determine linear density of a given yarn.

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	2	1	1	2		
CO-2	3	2	1	2	1	1	2		
CO-3	3	3	1	2	-	1	1		
CO-4	3	3	1	2	-	1	1		
CO-5	3	3	1	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	**2428303**	Textile Testing	03	-	04	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.

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	**2428303**	Textile Testing	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 theses 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: T2428303

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the objectives of textile testing. *TSO 1b.* Summarize the standardization of testing. *TSO 1c.* Explain the importance of textile testing in quality control. *TSO 1d.* Justify the necessity of sampling. *TSO 1e.* Differentiate among various sampling methods. *TSO 1f.* Select the relevant sampling method for testing of given fibre, yarn and fabric. *TSO 1g.* Perform sampling of fibers and yarn and fabric. *TSO 1h.* Identify errors in testing, its causes and remedies. *TSO 1i.* Describe the procedure for identifying the fibres in the given textile materials. *TSO 1j.* Identify given fiber using relevant methods.	**Unit-1.0 Basics of Textile Testing** 1.1 Textile testing: Objectives, Reasons for textile testing, standardization of testing, Standard atmospheric condition. 1.2 Importance of textile testing in quality control. 1.3 Sampling: Sample, Population, Sample Size, Aim of Sampling, Types of samples, factors governing sampling methods. 1.4 Fibre Sampling Methods: Bulk zoning technique, core sampling for wool, 1.5 Fibre sampling from sliver, roving and yarn: random draw method, squaring and cut square method. 1.6 Yarn Sampling Methods. 1.7 Fabric Sampling Methods for testing of fabric properties. 1.8 Errors in testing- types of errors, its causes and remedies. 1.9 Introduction to testing standards- ASTM, BS, IS, ISO, SDC etc. 1.10 Importance of fiber identification. 1.11 Fibre Identification methods: Feeling test, Burning test, Chemical test (solubility test and, swelling test), microscopic test for cotton, wool, silk, flax, viscose, polyester, nylon, acrylic and polypropylene, etc.	**CO1, CO2**
TSO 2a. Explain the importance of moisture to textile materials. *TSO 2b.* Describe the given terms used for moisture related properties of textiles. *TSO 2c.* Describe method of measuring ambient conditions in a given atmosphere. *TSO 2d.* Determine the humidity by a given method. *TSO 2e.* Explain the factors affecting the regain of textile materials. *TSO 2f.* Explain the effect of moisture on properties of textiles. *TSO 2g.* Explain the effects of relative humidity on efficiency of given manufacturing process. *TSO 2h.* Describe measurement of moisture content and regain in textile materials by given method.	**Unit-2.0 Moisture Relations and Testing** 2.1 Moisture and its importance to textile materials. 2.2 Humidity, absolute humidity and relative humidity; Moisture content and moisture regain, standard regain, commercial regain, standard regain of a blend; relationship between moisture content and moisture regain. 2.3 Standard atmospheric conditions for testing of textile materials: Standard atmosphere and standard testing atmosphere. 2.4 Determination of the humidity: Wet-and-dry bulb hygrometer, Hair hygrometer 2.5 Regain –Humidity Relations of textiles (Hysteresis), absorption and desorption curve. 2.6 Factors affecting the regain of textile materials 2.7 Effects of regain on fibre properties. 2.8 Effect of humidity on processing of material.	**CO1, CO2, CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.9 Oven dry weight and correct invoice weight. 2.10 Measurement of moisture regain and moisture content by: Oven dry method (Conditioning oven), Electrical resistance method (Shirley moisture meter).	
TSO 3a. Differentiate among the different types of trash in cotton. *TSO 3b.* Describe the procedure to determine trash content in cotton by trash analyzer. *TSO 3c.* Describe cotton grading method used in a given country. *TSO 3d.* Interpret fiber quality by computing fiber quality index (FQI). *TSO 3e.* Explain the significance of different fibre length in yarn manufacturing. *TSO 3f.* Describe the given method for determination of fibre length. *TSO 3g.* Describe fiber fineness and its technical significance in yarn manufacturing. *TSO 3h.* Explain the given method of fibre fineness measurement. *TSO 3i.* Describe the role of fibre maturity in yarn manufacturing. *TSO 3j.* Explain Maturity ratio and Maturity count *TSO 3k.* Describe the given method of measurement of fibre maturity. *TSO 3l.* Describe the given terms used in tensile testing measurements. *TSO 3m.* Explain principle of CRL, CRE and CRT type tensile testing machine. *TSO 3n.* Explain with sketches the method of measuring the Tensile strength of fibre by given method and instrument. *TSO 3o.* Differentiate in the the working principle of High-Volume Instrument (HVI) and AFIS.	**Unit-3.0 Fibre Testing** 3.1 **Trash Content and Grading of cotton fibre**: Significance and classification of trash, Determination of trash content, Cotton grading: American, Egyptian and Indian cotton grading. Fiber Quality Index (FQI). 3.2 **Fibre length:** Technical significance of fibre length; Staple length of cotton, effective length, mean length, upper quartile length, span length, uniformity ratio, uniformity index; Methods of Measuring fibre length by Hand stapling method, Comb sorter and Digital Fibrograph. 3.3 **Fibre Fineness: I**mportance of fibre fineness, Micronaire, Tex, decitex and Denier; Measurement of fiber fineness by (a) Gravimetric method (cut and weight), (b) Airflow principle-Measurement by tester based on airflow principle. 3.4 **Fibre maturity:** Importance of fibre maturity in Cotton, Factors affecting maturity of cotton. Maturity ratio and Maturity count, Determination of maturity by (a) Caustic soda (Alkaline) Swelling Method, (b) Polarized light method (c) Cauticaire method, and (d)Differential dyeing method; Neps and their measurement (template method). 3.5 **Fibre strength**: Load, Breaking load, Stress, mass stress, Tenacity or specific strength, Breaking length, Strain, Extension, Breaking extension, The load-elongation curve, The stress-strain curve, The initial Young's modulus, Yield point, Work of rupture, Work factor, Elastic recovery, Time and elastic properties. Factors influencing tensile properties of textiles and strength test results. Principle of CRL, CRE, CRT type tensile testing machine. Methods of measuring the strength of fibres: (a) Single fibre strength testing, (b) Bundle (group) fibre strength testing: Pressley Strength tester and Stelometer. 3.6 **Advancement in Testing Equipment:** (i) High Volume Instrument (HVI) (ii) Advanced Fibre Information System (AFIS) (iii) Universal testing machine (UTM)	**CO1, CO2, CO4**
TSO 4a. Explain the features of the given yarn numbering systems. *TSO 4b.* Use Wrap Reel for Determination of yarn length. *TSO 4c.* Calculate count of the given type of yarn using relevant yarn numbering system for the given situation.	**Unit-4.0 Yarn Testing** *4.1* **Yarn Counts (Linear density**): Definition, yarn numbering system – Direct, Indirect and universal system with examples. Conversion from one system to another system. *4.2* Measurement of Length of yarn using Warp Reel. *4.3* Testing of yarn count: (i) Yarn in package form	**CO1, CO4, CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4d. Calculate yarn diameter based on the given data.	(ASTMD-1907-89); (ii) Yarn in short length i.e. Yarn removed from fabric (or piece of cloth)- (IS-3442-98). *4.4* Instruments used for count determination: Analytical Balance, Knowles Balance, Quadrant Balance, Beesley yarn count Balance. *4.5* Relation between yarn count and yarn diameter.	
TSO 5a. Explain the importance of statistic in textile testing. *TSO 5b.* Explain the specified terminologies related to statistics. *TSO 5c.* Prepare frequency distribution table from the given data. *TSO 5d.* Prepare graphical charts for given frequency distribution. *TSO 5e.* Calculate measures of central tendency- mean median, mode and quartile. *TSO 5f.* Calculate mean deviation, standard deviation. c.v. %, Variance. *TSO 5g.* Describe the effect of change in values of Mean deviation, standard deviation, c.v. %, variance on parameters of textile processes.	**Unit-5.0 The Elements of Statistics** *5.1* Importance of Statistics in testing. *5.2* Definition of terms used in statistics such as sample, sampling, sample size, population, histogram, frequency polygon, frequency polygon, frequency, curve, and frequency distribution. *5.3* Measure of Central Tendency : Arithmetic Mean, Median and Mode. The relationship between methods of location. *5.4* The Measurement of Dispersion or scatter-Range : mean range, percentage mean range, inter-quartile range, mean deviation, percentage mean deviation, standard deviation, co-efficient of variation, variation, variance and standard deviation. *5.5* Numerical Problems.	**CO1, CO2, CO3, CO4, CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2428303

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Analyze trash content in cotton using Trash analyzer (ASTM D- 2812-95).	1.	Determination of trash content in cotton using Trash analyzer.	CO1, CO2
LSO 2.1. Identify the textile fibre using burning test and chemical solubility test.	2.	Identification of Textile material	CO1, CO2
LSO 3.1. Identify the textile fibre using microscope. *LSO 3.2.* Calculate the mean width of fibres.	3.	Identification of fibres by longitudinal and cross-sectional view using optical microscope.	CO1, CO2
LSO4.1 Estimate percentage of Mixture of fibres in the given textile materials.	4.	Quantitative Analysis and Estimation of Mixture of fibres.	CO1, CO2
LSO 5.1. Determine moisture regain and moisture content of textile material using given instrument. *LSO 5.2.* Determine relative humidity using hygrometer.	5.	Determination of Moisture Regain, Moisture Content and legal weights.	CO1, CO2, CO3
LSO 6.1. Use Comb sorter for measurement of fiber length / fibre length parameters using comb sorter	6.	Determination of fibre length by Baer Sorter Method (IS: 233 Part-I to VI 1978).	CO1, CO2, CO4
LSO 7.1. Determine fibre length parameters of a given sample using digital Fibrograph.	7.	Determination of fibre length parameters using digital Fibrograph.	CO1, CO2, CO4
LSO 8.1. Use Air flow instrument to determine fibre fineness of given sample.	8.	Determination of fibre fineness by Air-flow method (ASTM D-1448-97, BS3181: 1968).	CO1, CO2, CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 9.1. Determine fibre maturity using caustic soda method and polarized light (Microscope) Method. *LSO 9.2.* Calculate percentage of mature fiber, maturity ratio and maturity coefficient of cotton fibre.	9.	Determination of maturity of cotton, calculate percentage of mature fiber, maturity ratio and maturity coefficient of cotton fibre. (IS 236-1968. ASTM-D-1442-93, BS-3085-1968)	CO1, CO2, CO4
LSO 10.1 Determine single fibre strength using given instrument.	10.	Determination of single fibre strength	CO1, CO2, CO4
LSO 11.1 Use Stelometer for measurement of bundle strength of fibers.	11.	Determination of Bundle fibre strength	CO1, CO2, CO4
LSO 12.1 Use High Volume Instrument (HVI) to determine fibre parameters.	12.	Determination of fibre parameters by using High Volume Instrument (HVI).	CO1, CO2, CO4
LSO 13.1 Use Advanced Fibre Information System (AFIS) to determine fibre parameters.	13.	Determination of fibre parameters using Advanced Fibre Information System (AFIS).	CO1, CO2, CO4
LSO 14.1 Use UTM to determine fibre strength of a given sample.	14.	Determination of fibre strength using Universal testing machine (UTM).	CO1, CO2, CO4
LSO 15.1. Use Wrap Reel to measure yarn length. *LSO 15.2.* Use Weighing balance to measure weight of yarn. *LSO 15.3.* Determine Yarn Count. *LSO 15.4.* Calculate MD, PMD, SD and C.V. % of yarn.	15.	Determination of Yarn Count.	CO1, CO4, CO5
LSO 16.1. Use Wrap Reel to measure yarn length. *LSO 16.2.* Determine Yarn Count using Beesley Balance by removing yarn from given fabric sample. *LSO 16.3.* Calculate MD, PMD, SD and C.V. % of yarn.	16.	Determination of Yarn Count of a fabric by Beesley Balance.	CO1, CO4, CO5
LSO 17.1. Use Wrap Reel to measure yarn length. *LSO 17.2.* Determine Yarn Count using Quadrant Balance. *LSO 17.3.* Calculate MD, PMD, SD and C.V. % of yarn. *LSO 17.4.* Use Quadrant Balance to measure weight of fabric sample.	17.	Determination of Yarn Count and fabric weight using Quadrant Balance.	CO1, CO4, CO5

L) Suggested Term Work and Self Learning: S2428303 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.

(i) Prepare a comparative chart for properties, application and price of different fibres and yarn collected from nearby market.

(ii) Prepare table for different varieties of cotton fibre and their properties.

(iii) Prepare a market survey report of various fibers of natural and man-made origin having diff

(iv) erent linear density based on application and price.

(v) Prepare a market survey report of various yarns of natural and man-made origin having different yarn numbers based on application and price.

(vi) Prepare table for norms published by different research organizations for different yarn properties for various types of yarns.

b. Micro Projects:

1. **Testing standards**: Each batch will make a table of standards of important for test procedures of International standards like ASTM, BS etc.
2. Prepare chart for microscopic appearance of different fibres along with photographs using internet.
3. Prepare a sequential method to identify the given fibre using solubility test and burning test.
4. Prepare a display book containing different varieties of cotton along with their physical properties.
5. Prepare a chart for
   (i) Fibre length ratings based on span length and draw comb sorter diagram with analysis and fibrograph diagram.
   (ii) Fibre fineness rating.
   (iii) Maturity co-efficient rating.
6. Prepare report by conducting comparative analysis of trash content of different cotton with different percentage of trash contents from industry.
7. Prepare report by conducting comparative analysis of yarn strength of different yarn samples collected from market and Industry.

c. Other Activities:

1. Seminar Topics:

   - Identification of Textile fibres.
   - Commercially available Digital Fibrograph.
   - Application of High Volume Instrument (HVI).
   - Application of Advanced Fibre Information System (AFIS).

2. Visits: Visit nearby tool room/testing laboratory /Spinning industry with modern testing facilities. Prepare report of visit with special comments of advanced testing instruments and cost.

3. Self-learning topics:

   - Instron Tensile strength testing machine.
   - High Volume Instrument (HVI).
   - Advanced Fibre Information System (AFIS).
   - Universal testing machine (UTM).
   - Features of advanced strength testing like Tensojet and Tensorapid.

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	15%	15%	20%	20%	-	20%	20%
CO-2	10%	15%	10%	20%	-	15%	20%
CO-3	15%	20%	20%	20%	33%	15%	20%
CO-4	30%	20%	25%	20%	33%	30%	20%
CO-5	30%	30%	25%	20%	34%	20%	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 (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Basics of Textile Testing	06	CO1, CO2	10	4	4	2
Unit-2.0 Moisture Relations and Testing	08	CO1, CO2, CO3	12	4	4	4
Unit-3.0 Fibre Testing	18	CO1, CO2, CO4	26	6	11	9
Unit-4.0 Yarn Testing	10	CO1, CO4, CO5	12	3	4	5
Unit-5.0 The Elements of Statistics	06	CO1, CO2, CO3, CO4, CO5	10	3	3	4
Total Marks	**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.	Determination of trash content in cotton using Trash analyzer.	CO1, CO2	30	60	10
2.	Identification of Textile material	CO1, CO2	40	50	10
3.	Identification of fibres by longitudinal and cross-sectional view using optical microscope.	CO1, CO2	30	60	10
4.	Quantitative Analysis and Estimation of Mixture of fibres.	CO1, CO2	30	60	10
5.	Determination of Moisture Regain, Moisture Content and legal weights.	CO1, CO2, CO3	30	60	10
6.	Determination of fibre length by Baer Sorter Method (IS: 233 Part-I to VI 1978).	CO1, CO2, CO4	30	60	10
7.	Determination of fibre length parameters using digital Fibrograph.	CO1, CO2, CO4	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
8.	Determination of fibre fineness by Air-flow method (ASTM D-1448-97, BS3181: 1968).	CO1, CO2, CO4	40	50	10
9.	Determination of maturity of cotton, calculate percentage of mature fiber, maturity ratio and maturity coefficient of cotton fibre. (IS 236-1968. ASTM-D-1442-93, BS-3085-1968)	CO1, CO2, CO4	40	50	10
10.	Determination of single fibre strength	CO1, CO2, CO4	40	50	10
11.	Determination of Bundle fibre strength	CO1, CO2, CO4	30	60	10
12.	Determination of fibre parameters by using High Volume Instrument (HVI).	CO1, CO2, CO4	40	50	10
13.	Determination of fibre parameters using Advanced Fibre Information System (AFIS).	CO1, CO2, CO4	30	60	10
14.	Determination of fibre strength using Universal testing machine (UTM).	CO1, CO2, CO4	40	50	10
15.	Determination of Yarn Count.	CO1, CO4, CO5	30	60	10
16.	Determination of Yarn Count of a fabric by Beesley Balance.	CO1, CO4, CO5	40	50	10
17.	Determination of Yarn Count and fabric weight using Quadrant Balance.	CO1, CO4, CO5	30	60	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.	Electronic balance	Electronic balance, with the scale range of 0.001g to 500g. Pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	All
2.	Precision Digital Balance	Capacity: 0.1mg to 250gm, Protective in-use cover, security bracket, auto internal calibration with built in weight.	All
3.	Trash Analyzer	To determine the % of lint, trash, dust & micro-dust, in a sample, which may be raw cotton, blowroom lap or card sliver, sliver. Sample size maxi. 100 gms. Microcomputer controlled technology enable digital monitor based.	1
4.	Compound light microscope with Camera	Microscope, Equipment is meant for identification of textile fibres by having longitudinal view / cross sectional view of the fibres	3

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
		and to count the number of fibers.	
5.	Polarized light Microscope	Polarized light Microscope	3, 9
6.	Digital Fibre Blend Analyzer	Testing range 0.1%-100%, Specimen range 0.5-3g, Working position 6, Dimension 560×480×765mm	4
7.	Digital Hygrometer	Temperature Measuring Range: -50 + 70 (-58 158), moisture measuring range: 10 %, 99 % RH, Max and min. temperature display and moisture display, accuracy: ± 1, ± 5%.	5
8.	Conditioning Oven/ Chamber	Conditioning Oven 220 V, Double walled structure, SS Cabinet Size-(450×450×450) mm^3 With capability of maintaining digital temperature control up to 100 °C and facility for smooth variation of temperature inside, digital Humidity Control.	5
9.	Moisture tester.	Electric oven inner size 18" * 18" *18"; temperature range 100 to 250 °C with the capacity of 40 lt. moisture tester. Moisture meter, with scale range 1% to 26%	5
11.	Baer sorter	Comb Sorter instrument with accessories Oil grease, glass plate, Needle forcep.	6
12.	Digital Fibrograph	Measuring Principle-optical , Measuring Range-12.0 to 45.0 mm, Measuring Accuracy ± 0.01 mm, Result output -2.5 % SL, 50%, SL & UR %, Front End Langauge Base English, Applicable Standard - ASTM D5332, ISO 2648 & IS 233, Power Supply - Single Phase 220 V AC.	7
13.	Fibre Fineness Tester	Fibre fineness based on airflow principle	8
14.	Micronair Cotton Fineness Meter	Measurement from 2.5 to 7 micronaire index, Test with 2.0 grams sample, Complete with electric vacuum-pump generating the air flow. Non Hygroscopic plug for checking instrument. The use of MICRONAIRE requires an electronic scale with an accuracy of 0.001 g (code 165.704). Reference standards: ISO 2403, ASTM D1448, BS 3181-1.	8
15.	Cotton Fibre Maturity Tester	Polarization degree: < 8, Maturity coefficient M: ±0.03; Lamp: BA15D 15W/6V, In-built selenium light power supply: 56-A Φ45. Power supply: 220V 50Hz, Good stability; The cotton fibre maturity test with LED display; Data can be printed by small thermal printer.	9
16.	Instron Digital Tensile Tester (Interfaced with a PC).	For Single Fibre and yarn Strength/Elongation test. Compressive force up 1000 lbs. The electromechanical universal testing system has a capacity of 5 kg (1125 lb) with a speed range of between 0.5-500 mm/min.	10, 14
17.	Stelometer	To measure Strength of fibre: Table Top Type, Range 2 to 5 Kg, Dimensions: 320mm × 390 mm ×150 mm (± 10% Variation), Approx. Weight 10 Kg.	11
18.	Pressley Tester	Thickness of separator- 3.2mm, Range of breaking strength- 5~20lbf (25N~90N), Coefficient of strength ratio- 0.9~1.1 Standard: ASTM D 1445-95; IS 3675-1966	11
19.	High Volume Instrument (HVI).	HVI FOR VARIOUS PARAMETER OF FIBRE : Length/Strength Module; Color Trash Module; Micronaire Module; Printer & printer table; Balance; Bar Code Reader; Length/strength cabinet; Micronaire, color and trash cabinet; Operating unit; UV Module; NEP Module; Standard calibration materials; The air supplied to the instrument should comply with ISO 8573	12

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment / Practical Number
20.	Advanced Fibre Information System (AFIS).	Advanced Fibre Information System (AFIS).	13
21.	Microcontroller Wrap Reel	Microcontroller Wrap Reel machines to produce skeins of yarn at predetermined length and number of turns for count and strength testing. The reel starts smoothly and increases to normal speed, before reaching the pre-selected measuring length, it slows down the end of measurement and stops at accurate position. Different length and speed can be programmable using keyboard and display. Collapsible swift for easy lea removal. Reel circumference one meter (or) 1.5 yard available.	15
22.	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.	16
23.	Quadrant Balance	Suitable for measuring count of sliver, roving & yarn in Ne	17
24.	GSM Cutter	GSM Cutter for measuring GSM of fabric.	17

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Principles of Textile Testing	Booth, J. E.	CBS publishers and distributors private ltd. 1996.New Delhi India. ISBN 10:81-239-O515-7, 13:9788123905150
2.	Physical Testing of Textiles	Saville, B.P.	Wood head publishing limited -2002 Cambridge England. ISBN :1 85573 367 6 CRC press ISBN: 0-8493-0568-3.
3.	Textile Testing Physical, Chemical and Microscopical	Skinkle, John H.	Chemical Publishing Co Inc (1940) ASIN: B001OMN6VS
4.	Identification of textile fibers	Edited by Max M. Houck	The Textile Institute, Woodhead Publishing Limited, Cambridge, England, ISBN: 978-1-84569-266-7
5.	Testing & Quality Management	Kothari, V.K.	IAFL, New Delhi 1999 ISBN: 819010330X, 9788190103305
6.	Textile Testing and Analysis	Billie J. Collier, Helen H. Epps	PHI Learning, New Delhi,1998 ISBN: 9780134882147, 013488214
7.	Physical Properties of Textile Fibres'	Morton, W.E; Hearle, J.W.	Wood head publishing 2008. ISBN: 978-1-84569-220-9.

(b) Online Educational Resources:

1. https://www.slideshare.net/MizanurRehmanShobuj/important-of-textile-testing
2. https://www.textileschool.com/321/fiber-identification-tests-to-identify-a-fibre/
3. https://study.com/academy/lesson/iso-textile-testing-standards.html
4. https://nptel.ac.in/courses/116102029/14
5. https://nptel.ac.in/courses/116102029/116

6. https://www.uster.com/en/knowledge/textile-know-how/fibre-testing/
7. https://www.scribd.com/doc/15569730/Fibre-Testing
8. https://www.scribd.com/doc/97265301/Fibre-Maturity
9. https://study.com/academy/topic/textile-fibres-fabrics.html
10. http://textilestudycenter.com/yarn-numbering-system/
11. https://nptel.ac.in/courses/116102029/23
12. https://nptel.ac.in/courses/116102029/24
13. https://nptel.ac.in/courses/116102029/42
14. https://nptel.ac.in/courses/116102029/39
15. https://www.slideshare.net/malarmeganathan/fibre-strength-and-fibre-fineness
16. https://nptel.ac.in/courses/116102029/15
17. https://nptel.ac.in/courses/116102029/12
18. https://clothingindustry.blogspot.com/2018/01/types-fiber-length.html
19. http://textilelearner.blogspot.in/2012/05/yarn-numbering-system-yarn-countdirect.html

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. Hand book of Textile Testing-part-1: Testing and grading of textile fibres.
   SP 15-1: Published 1989, Bureau of Indian Standards (BIS)
2. ASTM Standard for Fibre and Yarn Testing.
3. Textile Testing standards- BS, IS, ISO, SDC etc.
4. ISI Handbook of Textile Testing
5. Hand book of Textile Testing & Quality Control, Grover,E.B; Hamby, D.C.
6. Textile testing, by Angappan P. & Gopalakrishnan R. , Valayakkaranoor, Tamil Nadu

******

A) Course Code : 2428304(T2428304/S2428304)

B) Course Title : Man-Made Fibre Technology

C) Pre-requisite Course(s) : Textile Fibres

D) Rationale :

Manmade fiber technology is a part of textile engineering where textile fibers are developed from artificial sources. The demand for manmade fibers is on the rise and they are required in the ever-growing market for apparel, industrial applications, and for functional uses. Global demands for manmade fibres are continuously increasing year by year and innovations continue to generate new products. This subject provides knowledge regarding manmade fiber technology and various manmade fibers, their classification, physical property, and manufacturing process which is very essential for yarn spinning, weaving, and processing also.

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 various activities related to three learning domains (Cognitive, Psychomotor, and Affective) in the classroom/laboratory/workshop/field/industry.

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

CO-1 Identify the importance of the fibre structure useful for the specified applications.

CO-2 Maintain polymerization process technologies efficiently.

CO-3 Use Melt, Wet, and Dry spinning process technologies for fibre formation.

CO-4 Plan production process of a given type of manmade/ synthetic fibres.

CO-5 Apply the knowledge of Tow-to-Top conversion technologies, spin finish application, textured yarn, and development in manmade fibre in relevant textile engineering applications.

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		
CO-2	3	2	-	1	-	1	1		
CO-3	3	3	1	1	2	1	1		
CO-4	3	3	-	1	1	1	1		
CO-5	3	1	1	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	**2428304**	Man-Made Fibre Technology	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	**2428304**	Man Made Fibre Technology	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 checklists & rubrics for these activities.

I) Course Curriculum Detailing:

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: T2428304

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Classify Man-made fibres. *TSO 1b.* Differentiate between Natural, Regenerated, and Synthetic fibre *TSO 1c.* Describe the importance of the fibre structure useful for the specified application. *TSO 1d.* Explain the degree of polymerization (DP). *TSO 1e.* Explain the influences of crystallinity, amorphous and orientation on fibre properties.	**Unit-1.0 Introduction and Structure of Fibres** 1.1 Natural, Regenerated, and Synthetic fibres, Sources of synthetic fibres, Staples Vs. Filaments. 1.2 Main advantages of synthetic fibres, Unique properties of synthetic fibres, Future of synthetic fibres 1.3 Molecular weights, Molecular weight distribution, Degree of polymerization and their importance in fibre formation, Influences of orientation on fibre properties.	CO1
TSO 2a. Identify the different types of polymers. *TSO 2b.* Explain the salient features of the Polymerization process. *TSO 2c.* Differentiate between the polymerization reactions. *TSO 2d.* Describe the characteristics of fiber-forming polymers.	**Unit-2.0 Raw Material and Polymerization** 2.1 Types (classification) of polymer. 2.2 Thermal properties of the polymer: melting point and glass transition temperature. 2.3 Polymerization and formation of polymers, Functionality, Copolymers. 2.4 Polymerization Techniques: Condensation and Addition Polymerization Technique. 2.5 Characteristics of fiber-forming polymers.	CO2
TSO 3a. Explain the role of viscosity of melts and solution in spinning process. *TSO 3b.* Explain with sketches the function of the specified part of given spinning machine. *TSO 3c.* Explain the process flow of material through a given type of fibre spinning process. *TSO 3d.* Distinguish among Melt, Wet, and Dry Spinning. *TSO 3e.* Explain principle of dry jet wet spinning. *TSO 3f.* Explain the function of Stretching or Drawing process.	**Unit-3.0 Man Made Fibre Spinning** 3.1 Viscosity of melts and solutions. 3.2 Principles of spinning process: Melt Spinning, Dry Spinning, and Wet Spinning. 3.3 Melt Spinning: Process and equipment. 3.4 Dry Spinning: Preparation of dope, dry spinning unit and solidification process. 3.5 Wet Spinning: Wet spinning line and solidification process. 3.6 Dry Jet Wet Spinning Process. 3.7 Need for drawing, factors influencing drawability and influence of drawing on the structure. 3.8 Definition – LOY, MOY, POY, HOY and FOY yarns.	CO2, CO3
TSO 4a. Describe given cellulosic polymer-based manmade fibres. TSO 4b. Describe manufacturing process of the given regenerated cellulosic fibre with flow chart. TSO 4c. Use the properties of regenerated cellulosic fibre for a given applications.	**Unit-4.0 <u>Fibre Made from Natural Polymer</u>** 4.1 Introduction of various manmade fibre based on natural polymers. Raw material, Manufacturing process with a flow chart, Properties, and applications of Viscose Rayon, Cupramonium rayon, Acetate rayon, and Lyocell fibres.	CO2, CO3, CO4
TSO 5a. Explain the manufacturing process of a given type of synthetic fibres with flow chart. *TSO 5b.* Explain the importance of the drawing process in synthetic fibres. *TSO 5c.* Use the physical and chemical properties of	**Unit-5.0 <u>Synthetic Fibres:</u>** 5.1 Introduction of various synthetic fibres. 5.2 Raw Material, manufacturing with flow sheet of synthetic fibres such as Polyamide (Nylon 6, Nylon 66), Polyester (Polyethylene terephthalate), Polyolefin (Polyethylene, Polypropylene), Polyacrylonitrile (Acrylic and	CO2, CO3, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
synthetic fibre for a given application. *TSO 5d.* Explain the limitations of synthetic fibers.	Modacrylic) fibres. 5.3 Need for drawing, factors influencing draw ability, and the influence of drawing on the structure. Physical and chemical properties & uses and limitation of synthetic fibres.	
TSO 6a. Explain the principle of process of Tow-to-top conversion methods. *TSO 6b.* Differentiate between given types of Tow to Top conversion method. *TSO 6c.* Explain the merits and demerits of spin finish. *TSO 6d.* Describe the method of applications of Spin finish. *TSO 6e.* Select the method of manufacturing textured yarn for required end use. TSO 6f. Describe the salient features of a given type of high-performance fibers.	**Unit-6.0 Conversion and Developments** 6.1 Tow-to-Top conversion: - Introduction, cut method, stretch-breaking method, and perlock method. 6.2 Spin finish application: need, composition and methods. 6.3 Texturizing Process: Purpose, classification (stretch and bulk yarn), advantages and properties of textured yarn. 6.4 Methods of manufacturing textured yarn such as false twist, friction disc, and Air-jet Texturising. 6.5 Elastomeric fibres (Spandex, Lycra), Chloro fibres, Bi-Component fibres. 6.6 High-Performance fibres such as Carbon fibre, Glass fibre, etc.	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: S2428304 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 different man-made fibres/filaments used in industry. Collect data of manufacturing company and price of the same.
2. Explore library/internet for production technologies being used for production of different fibres and make a report.
3. Collect samples of various man-made fibres and label them with neat sketches.
4. Prepare a PPT regarding production flow chart of the given man-made fibre.
5. Prepare a PPT regarding different conversion technology used in man-made fibre industries.
6. Write the processing parameters of drawing of the given man-made fibre.

b. Micro Projects:

1. Collect various samples of manmade fibres, analyze the physical and chemical properties of manmade fibres, and prepare a compiled report.
2. Prepare a compiled report of Melt, Wet, and Dry spinning technology with machine process parameters.
3. Collect various samples of manmade fibres and prepare the process flow chart of detail of the production of manmade fibre.
4. Prepare a compiled report on change in properties of textured yarn.

5. Prepare a compiled report on raw material, structure, properties, and end-use application of different high-performance fibres.
6. Prepare a sample book of different forms of textile materials and eco fibres from the market.
7. Collect information on Eco-friendly manmade fibres and submit a detailed report.

c. Other Activities:

1. Seminar Topics:

   - Manufacturing process of manmade fibre technology.
   - Special properties of high-performance textile fibre.
   - Textured yarn.
   - Lycra fibre.

2. Visits:
   (a) Visit a nearby manmade fibre production industry with modern machinery facilities. Prepare a report of the visit with special comments on modern machinery used, material used, and cost of production.
   (b) Visit to manmade fiber industry and prepare a report with sketches.
   (c) Visit textured yarn production industries and prepare a detailed report of the visit.

3. Self-learning topics:
   - Lyocell fibre.
   - Tencel fibre
   - Polynosic Rayon
   - Manufacturing process of Polyester fibres.
   - Texturising of manmade fibres.
   - Spandex fibre
   - Inorganic fibres.

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	15%	10%	20%	20%	-	-	-
CO-2	10%	20%	10%	20%	-	-	-
CO-3	25%	20%	20%	20%	33%	-	-
CO-4	25%	20%	25%	20%	33%	-	-
CO-5	25%	30%	25%	20%	34%	-	-
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 (Cl) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction and Structure of fibres	04	CO1	08	3	3	2
Unit-2.0 Raw Material and Polymerization	04	CO2	06	2	2	2
Unit-3.0 Man-Made Fibre Spinning	06	CO2, CO3	08	2	4	2
Unit-4.0 Fibre Made from Natural Polymer	10	CO2, CO3, CO4	16	4	6	6
Unit-5.0 Synthetic Fibres	16	CO2, CO3, CO4	22	6	10	6
Unit-6.0 Conversion and Development	8	CO5	10	3	3	4
Total Marks	**48**	--	**70**	**20**	**28**	**22**

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): (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, 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 Sessions, 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.	A Text Book of Fibre Science and Technology	S.P. Mishra	New Age International Publishers, New Delhi, 2000; ISBN: 81-224-1250-5
2.	Manmade fibres	Moncrieff R.W.	Heywood Books, The Butterworth group, England, 1970; ISBN: 0-592-06332-1
3.	Production of Synthetic fibres	Vaidya A.A.	Prentice-Hall of India Private Limited, New Delhi, 1988. ISBN: 0876925786, 9780876925782
4.	Manufactured Fibre Technology	Gupta, V.B. and Kothari,V.K.	Springer (India) Private Limited. ISBN: 978-81-3220789-4
5.	Handbook of Textile fibres Volume-2	Gordon Cook J.	Woodhead Publishing Limited, England, 2006, ISBN-10: 1-85573-484-2
6.	Textiles Fiber to Fabric	Bernard P. Corbman,	McGRAW-HILL International Edition, 1983
7.	Manmade fibres: Production, Processing, structure and applications	Gupta V.B. and Kothari V.K.	Indian Institute of Technology, Delhi,1997, ISBN: 978-94-011-5854-1
8.	Structure and Properties of High-Performance Fibres	Bhat Gajanan	Woodhead Publishing, New Delhi, 2016, ISBN: 9780081005507

(b) Online Educational Resources:

1. http://nptel.ac.in/
2. http://textilelearner.blogspot.in/
3. https://www.fibre2fashion.com/
4. https://textilestudycenter.com/
5. http://www.textileschool.com/
6. http://www.fibresource.com/
7. https://study.com/academy/topic/textile-fibres-fabrics.html
8. https://textilestudycenter.com/textile-books-free-donwload/
9. http://www.cottonsjourney.com/Storyofcotton/page5.asp
10. https://archive.org/details/manmadefibres0000monc/page/n7/mode/2up
11. http://www.textileassociationindia.org/
12. http://www.sitra.org.in/
13. http://www.itamma.org/
14. http://sasmira.com/
15. www.fibersource.com/
16. https://www.youtube.com/watch?v=22VC_8xcyrs
17. https://www.youtube.com/watch?v=bILk39zSgqA
18. https://www.youtube.com/watch?v=cn6K1m7yH0I

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. Man-made Fibres – Reference books of Textile Technology, Edited by Fondazione Acimit. 2004.
2. Synthetic fibres: nylon, polyester, acrylic, polyolefin, Edited by E. Mclntyre, WP, The Textile Institute.
3. Indian Textile Journal.
4. Man-Made Textiles of India (Published by SASMIRA, Mumbai)
5. Lab Manuals

******

A) Course Code : 2418305(T2418305/ P2418305/S2418305)

B) Course Title : Python Programming

(CE, CSE, AIML, ME, ME (Auto)., ELX, ELX (R), MIE, FTS, CRE, CHE, TE, CACDDM, GT, RE)

C) Pre- requisite Course(s) :

D) Rationale :

Python programming has emerged as a popular programming language across wide range of application segments from Scientific to Machine Learning to mobile app development, and so on. Python is a high-level general-purpose programming language.

Because code is automatically compiled to byte code and executed, Python is suitableuse as a scripting language, Web application implementation language, etc.

In Python there are multiple levels of organizational structure: functions, classes, modules, and packages. These assist in organizing code. An excellentand large example is the Python standard library.

The Object-oriented Python provides a consistent way to use objects: in Python it is easy to implement new object types (called classesin object-oriented programming).

This introductory course to learn basic Python programming features which can be used as building blocks to develop different kind of applications using Python 3.

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 various data types and operators in formation of expressions.

CO-2 Write and execute programs using control statements.

CO-3 Perform relevant operations on Sequence data types

CO-4 Create functions in modules

CO-5 Use numpy in writing python programs

CO-6 Handle data files and exceptions.

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/ Developmentof 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	-	1	-	-	-	-		
CO-2	1	2	2	1	-	1	-		
CO-3	1	2	2	1	-	1	-		
CO-4	1	2	2	1	-	1	2		
CO-5	1	2	2	1	-	1	-		
CO-6	1	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				
	2418305	Python programming	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)	
	2418305	Python programming	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: T2418305

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate between Procedure Oriented P and Object Oriented Programming approach with example. *TSO 1b.* Use the concept of Lvalue and Rvalue *TSO 1c.* Write python program using various data types and operators	Unit 1: Fundamentals of Python Programming Syntax 1.1 Introduction to Python Character Set, Python Tokens, Variables, Lvalue and Rvalue Concepts, and the Use of Comments. 1.2Overview of Data Types: • Number Types: Integer, Floating Point, Complex • Boolean Type • Sequence Types: String, List, Tuple • None Type • Mapping Type: Dictionary • Distinction between Mutable and Immutable Data Types 1.3 Understanding Operators: • Arithmetic Operators • Relational Operators • Logical Operators • Assignment Operator • Augmented Assignment Operators • Expressions and Statements • Type Conversion and Input/Output Mechanisms • Precedence of Operators • Expression Evaluation	**CO-1**
TSO 2a. Write Python program using decision making statements *TSO 2b.* Write Python program using loop structure to solve iterative problems	**Unit-2.0 Conditional and Iterative statements** 2.1 Conditional statements: • simple if statement • if- else statemen • if-elif-else statement 2.2 Iterative statements: • while loop • for loop • range function • break and continue statements • nested loops	**CO-2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Perform various operations on string using string operators and methods *TSO 3b.* Perform various operations on List using list operators and methods *TSO 3c.* Perform various operations on tuples using tuples operators and methods *TSO 3d.* Perform various operations on set using set methods *TSO 3e.* Perform various operations on dictionary using dictionary methods	**Unit-3.0 String, List, Tuples, set and Dictionary** 3.1 String: • Indexing • string operations (concatenation, repetition, membership & slicing) • traversing a string using loops • built-in functions. 3.2 Lists: • Introduction • Indexing in list • list operations: concatenation, repetition, membership & slicing, traversing a list, built- in list functions, linear search on list of numbers and counting the frequency of elements in a list 3.3 Tuples: Creating, initializing, accessing elements, tuple assignment, performing operations on tuples, tuple methods and built-in functions, nested tuples 3.4 Set: Creating set, traversing, adding, removing data in set, performing set operations like join, Union intersection, difference 3.5 Dictionary: accessing items in a dictionary using keys, mutability of dictionary: adding a new item, modifying an existing item, built-in dictionary functions.	**CO-3**
TSO 4a. Create and use user defined functions to implement modular programming approach *TSO 4b.* Differentiate variable scope with example. *TSO 4c.* Import and use Python modules, libraries	**Unit-4.0 Python Functions, Modules and packages** 4.1 Functions: types of function (built- in functions, functions defined in module, user defined functions), creating user defined function, arguments and parameters, default parameters, positional parameters, Lambda functions, returning value, scope of a variable: global scope, local scope 4.2 Modules and Packages: Importing module using 'import' Regular Expressions, Exception Handling, PyPI Python Package Index, Pip Python package manager, Importing Libraries and Functions	**CO-4**
TSO 5a. Write simple Python programs using numpy *TSO 5b.* Use Numpy array in python program *TSO 5c.* Use Numpy to solve linear algebra problem.	**Unit-5.0 Numpy** 5.1 Introduction to NumPy 5.2 Installation of NumPy 5.3 NumPy Arrays: • Understanding the NumPy array	**CO-5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	• The fundamental data structure in NumPy. • Creation of arrays using different methods: np.array(), np.zeros(), np.ones(), etc. • Exploring array attributes like shape, size, and dimensions. 5.4 Array Indexing and Slicing: • Accessing elements and subarrays in NumPy arrays using indexing and slicing. • Demonstration of the difference between one-dimensional and multi-dimensional array indexing. 5.5 Array Operations: • Performing element-wise operations on NumPy arrays. • Exploring universal functions (ufuncs) for mathematical operations. 5.6 Linear Algebra with NumPy: • Introduction to linear algebra operations using NumPy. • Matrix multiplication, determinant, inverse, and solving linear equations. 5.7 File input and output with Numpy 5.8 Broadcasting in Numpy	
TSO 6a. Explain different types of Exceptions in python *TSO 6b.* Write Python programs for exception handling in Python *TSO 6c.* Differentiate different modes of file opening. *TSO 6d.* Perform read, Write, Append operations in files	**Unit 6: Exception and File Handling in Python** 6.1 Exception Handling: syntax errors, exceptions, need of exception handling, user-defined exceptions, raising exceptions, handling exceptions, catching exceptions, Try - except - else clause, Try - finally clause, recovering and continuing with finally, built-in exception classes. 6.2 File Handling: text file and binary file, file types, open and close files, reading and writing text files, reading and writing binary files, file access modes	**CO-6**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2418305

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Write, execute and debug simple Python program using Integrated Development and Learning Environment (IDLE) *LSO 1.2.* Write and execute simple 'C' program using variables, arithmetic expressions.	1.	a) Download and Install IDLE. Write and execute Python program to- b) Calculate the Area of a Triangle where its three sides a, b, c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) c) Swap Two Variables d) Solve quadratic equation for real numbers.	**CO-1**
LSO 2.1. Write and execute python programs using conditional statements. *LSO 2.2.* Write and execute python programs using various types of Loop statements	2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	**CO-2**
LSO 3.1. Write and execute Python program to perform various operations on string using string operators and methods	3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	**CO-2, CO-3**
LSO 4.1. Write and execute Python program to perform various operations on List using List operators and methods	4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	**CO-2, CO-3**
LSO 5.1. Write and execute Python program to perform various operations on Tuple using Tuple operators and methods.	5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	**CO-2, CO-3**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 6.1. Write and execute Python program to perform various operations on sets using set methods.	6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	**CO-2, CO-3**
LSO 7.1. Write and execute Python program to perform various operations on Dictionary using Dictionary methods	7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})	**CO-2, CO-3**
LSO 8.1. Write and execute Python program to create user defined functions and call them.	8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate !n/(!r)*!(n-r)) where symbol "**!** " stands for factorial.	**CO-2, CO-4**
LSO 9.1. Write and execute Python program to define a numpy array. *LSO 9.2.* Develop and execute Python program Using various types of Numpy operation.	9.	a) Write a python program to create a Numpy array filled with all zeros b) Write a python program to check whether a Numpy array contains a specified row c) Write a python program to Remove rows in Numpy array that contains non-numeric values d) Write a python program to Find the number of occurrences of a sequence in a NumPy array e) Write a python program to Find the most frequent value in a NumPy array f) Write a python program to Combine a one and a two-dimensional NumPy Array g) Write a python program to Flatten a Matrix in Python using NumPy h) Write a python program to Interchange two axes of an array	**CO-2, CO-5**

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 10.1. Develop and execute Python program to handle various type of exceptions. *LSO 10.2.* Develop and execute Python program to perform file operations.	10.	a) Using exception handling feature such as try…except, try finally- write minimum three programs to handle following types of exceptions. i. Type Error ii. Name Error iii. Index Error iv. Key Error v. Value Error vi. IO Error vii. Zero Division Error b) Write Python program to demonstrate file operations.	**CO-6, CO-1, CO-2,**

Note: in addition to above listed practical, students are suggested to practice all the examples covered by the teacher during theory sessions.

L) Suggested Term Work and Self Learning: S2418305 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. Crete a shop billing system
2. Create income tax calculation system.
3. Develop number guessing game (random integer will be selected by the system and the user has to guess that integer in the minimum number of guesses. Maximum 5 guess allowed.)
4. Assign numbers to alphabet a-z as (1-26). User will input a word. System will convert in to a number by adding all the individual alphabet of that word.
5. Design a basic calculator program that performs arithmetic operations like addition, subtraction, multiplication, and division based on user input.
6. Any other micro-projects suggested by subject faculty on similar line.

(Students may use file and sequence data types to develop above listed applications)

c. Other Activities:

1. Seminar Topics:

- Tkinter widgets in python
- Python date/time module and its applications
- wxPython and its applications

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	10%	10%	15%	16%	16%	10%	16%
CO-2	15%	15%	15%	16%	16%	15%	16%
CO-3	25%	25%	20%	18%	18%	25%	18%
CO-4	15%	15%	15%	16%	16%	15%	16%
CO-5	25%	25%	25%	18%	18%	25%	18%
CO-6	10%	10%	10%	16%	16%	10%	16%
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 Basics of Python Programming syntax	4	CO-1	7	3	2	2
Unit-2.0 Conditional and Iterative statements	6	CO-2	10	3	3	4
Unit-3.0 3.0 String, List, Tuples, set and Dictionary	12	CO-3	18	5	3	10
Unit-4.0 Python Functions, Modules and packages	7	CO-4	10	3	3	4
Unit-5.0 Numpy	12	CO-5	18	4	5	9
Unit-6.0 Exception and File Handling in Python	7	CO-6	7	2	2	3
Total	**48**	**-**	**70**	**20**	**18**	**32**

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.	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	**CO-1**	40	50	10
2.	Write and execute Python program to- a) Check if a Number is Positive, Negative or zero. b) Check whether the given year is a Leap Year. c) Print all Prime Numbers in an Interval. d) Display the multiplication Table based on the given input. e) Print the Fibonacci sequence. f) Find the Factorial of a Number.	**CO-2**	40	50	10
3.	Write and execute Python program to- a) Check whether the string is Palindrome b) Reverse words in a given String in Python c) identify in a strings the name, position and counting of vowels. d) Count the Number of matching characters in a pair of string (set) e) Python program for removing i-th character from a string	**CO-2, CO3**	40	50	10
4.	Write and execute Python program to- a) find largest number in a given list without using max(). b) find the common numbers from two lists. c) create a list of even numbers and another list of odd numbers from a given list. d) To find number of occurrences of given number without using built-in methods.	**CO-2, CO-3**	40	50	10
5.	Write and execute Python program to- a) find the index of an item of a tuple. b) find the length of a tuple. c) to reverse a tuple. d) Write a Python program to sort a list of tuple by its float element. Sample data: [('item1', '12.20'), ('item2', '15.10'), ('item3', '24.5')] Expected Output: [('item3', '24.5'), ('item2', '15.10'), ('item1', '12.20')]	**CO-2, CO-3**	40	50	10
6.	Write and execute Python program to- a) create an intersection of sets. b) create a union of sets. c) create set difference. d) check if two given sets have no elements in common.	**CO-2, CO-3**	40	50	10
7.	Write and execute Python program to- a) Write a Python script to concatenate two dictionaries to create a new one	**CO-2, CO-3**	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	b) Write a Python script to merge two Python dictionaries. c) Write a Python program to combine two dictionary adding values for common keys. d1 = {'a': 100, 'b': 200, 'c':300} d2 = {'a': 300, 'b': 200, 'd':400} Sample output: d({'a': 400, 'b': 400, 'd': 400, 'c': 300})				
8.	Write and execute Python program to- a) Write a Python function for reversing a string and call it. b) Write a Python function for calculating compound interest and call it. c) Write a Python function for calculating the factorial of a number and call it to calculate !n/(!r)*!(n-r)) where symbol "**!** " stands for factorial.	**CO-2, CO-4**	40	50	10
9.	a) Write a python program to create a Numpy array filled with all zeros b) Write a python program to check whether a Numpy array contains a specified row c) Write a python program to Remove rows in Numpy array that contains non-numeric values d) Write a python program to Find the number of occurrences of a sequence in a NumPy array e) Write a python program to Find the most frequent value in a NumPy array f) Write a python program to Combine a one and a two-dimensional NumPy Array g) Write a python program to Flatten a Matrix in Python using NumPy Write a python program to Interchange two axes of an array	**CO-2, CO-5**	40	50	10
h)	Using exception handling feature such as try…except, try finally-write minimum three programs to handle following types of exceptions. viii. TypeError ix. NameError x. IndexError xi. KeyError xii. ValueError xiii. IOError xiv. ZeroDivisionError	**CO-2, CO-6**	40	50	10
i)	Write and execute Python program to- a) Calculate the Area of a Triangle where its three sides a,b,c are given. s=(a+b+c)/2, Area=square root of s(s-a)(s-b)(s-c) (write program without using function) b) Swap Two Variables c) Solve quadratic equation for real numbers.	**CO-1**	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.	Computer system	Processor Intel Core i5, 4 GB RAM, 15 GB free disk space	All
2.	Integrated Development and Learning Environment (IDLE)	S/w to be downloaded for python 3.11.3 or higher	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Computing and Problem-Solving using Python	E. Balagurusamy	McGraw Hill Education (India)Pvt. Ltd.1st Edition /2016
2.	Learning Python Programming	Jeffrey Elkner, Allan B.Downey, Chris Meyers	Samurai Media Limited. 2016
3.	Python Programming	Ashok Namdev Kamthane and Amit Ashok Kamthane	McGraw Hill Education (India) Pvt.Ltd.2020, 2nd Edition
4.	Programming in Python	Dr. Pooja Sharma	BPB Publications 2017

(b) Online Educational Resources:

1. https://docs.python.org/3/tutorial/
2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/indextm

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

******

A) Course Code : 2400006(T2400006/ P2400006/S2400006)

B) Course Title : Environmental Education and Sustainable Development (Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Every creature depends on nature for their survival. It is therefore, not only essential but also moral responsibility of all of us to keep our environment clean & in a good condition. The global environmental issues such as clean water and sanitation, affordable & clean energy, sustainable cities & communities, etc. are best addresses through sustainable development goals. Environmental education is one of the primary activities to spread the concept of sustainability on a broader scope. In India, environmental education is considered as mandatory for all segment of education including technical education. Every creature depends on nature for their survival. It is therefore, not only essential but also moral responsibility of all of us to keep our environment clean & in a good condition. The concept of sustainable development is closely associated with environmental education to promote developments. Considering importance of environmental education and sustainable development, it became necessary to provide basics of these areas to the engineering graduates. The knowledge gained through this course will help the diploma students to take engineering decisions aligned to ensure sustainability of environment for next generations through proper protection of environment.

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** Explain the importance of ecosystem for the protection of environment
- **CO-2** Use relevant air & water pollution control methods to solve pollution related issues
- **CO-3** Recognize relevant energy sources required for domestic & industrial application
- **CO-4** Analyze the issues of climate change and its impact on sustainability
- **CO-5** Apply engineering solutions/methods/legislations to reduce the activities that are harming the environment.

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/ Developmentof 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		
CO-2	3	2	2	2	2	-	2		
CO-3	3	-	-	-	3	-	2		
CO-4	3	3	-	2	2	-	2		
CO-5	3	-	3	3	2	2	2		

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				
------	**2400006**	Environmental Education and Sustainable Development	01	-	01	01	03	02

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)	
------	**2400006**	Environmental Education and Sustainable Development	15	-	10	-	10	15	50

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: T2400006

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate aquatic & terrestrial ecosystem *TSO 1b.* Explain structure of ecosystem *TSO 1c.* Compare food chain & web chain *TSO 1d.* Describe carbon, nitrogen, Sulphur & phosphorus cycle *TSO 1e.* Explain causes & effect of global warming	**Unit-1.0 Ecosystem** 1.1 Aquatic & Terrestrial ecosystem 1.2 Structure of ecosystem 1.3 Food chain & Food web 1.4 Carbon, Nitrogen, Sulphur & Phosphorous Cycle 1.5 Global warming – Causes & Effects	**CO1**
TSO 2a. Explain environmental pollution & its sources. *TSO 2b.* Assess the causes of water & air pollution in a given area *TSO 2c.* Explain the effects of water & air pollution on human, plant & animal *TSO 2d.* Take appropriate measures to prevent the pollution problems at city /municipal areas *TSO 2e.* Determine the pollution level in the environment at different seasons.	**Unit-2.0 Air & Water Pollution** 2.1 Traditional pollution issues- Air, Water, Noise 2.2 Water pollution 2.2.1 Sources of water pollution 2.2.2 Effects of water pollution 2.2.3 Control of water pollution 2.2.4 Physical & chemical standard of domestic water as per Indian Standard 2.3 Air pollution 2.3.1 Sources of air pollution 2.3.2 Air pollutants 2.3.3 Effects of air pollution on human, plant & animal 2.3.4 Air monitoring system 2.3.5 Air pollution control	**CO2**
TSO 3a. Describe various types renewable sources of energy *TSO 3b.* Explain solar energy & methods of harnessing *TSO 3c.* Explain wind energy and its impact on environment *TSO 3d.* Discuss characteristics of biomass & its digestion process *TSO 3e.* Describe new energy sources & their application	**Unit-3.0 Sustainability & Renewable Sources of Energy** 3.1 Concept of sustainable development 3.2 Renewable sources of energy for sustainable development 3.3 Solar Energy 3.3.1 Features of solar thermal & PV system 3.3.2 Solar pond, Solar water heater, Solar dryer and Solar stills 3.4 Wind Energy	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.4.1 Current status & future prospects of wind energy 3.4.2 Wind energy in India- Advantages and challenges of harnessing wind energy 3.4.3 Environmental benefits & limitations 3.5 Biomass 3.5.1 Types of Biomass energy sources 3.5.2 Energy content in Biomass of different types 3.5.3 Biogas production 3.6 Concept and advantages of hydroponics or aquaponics system to demonstrate soil less cultivation and integration of fish and plant cultivation. 3.7 Water conservation and sustainable development 3.8 New Energy Sources: Hydrogen energy, Ocean energy & Tidal energy	
TSO 4a. Describe impact of climate change on human life *TSO 4b.* Identify the factors contributing to climate change *TSO 4c.* Explain sustainable development goals to transform the world *TSO 4d.* Develop implementation strategies for action plan on climate change	**Unit-4.0 Climate Change and Sustainable Development** 4.1 Impact of Climate change 4.2 Factor contributing to climate change 4.3 Sustainable development Goals (SDGs) 4.4 Action Plan on Climate Change- India	**CO4**
TSO 5a. Identify the elements of a successful management system *TSO 5b.* Explain green building concept & its benefits *TSO 5c.* Apply 5R concept in a given building construction project *TSO 5d.* Explain various environment protection laws *TSO 5e.* Explain carbon foot-print & carbon credit	**Unit-5.0 Environmental legislation and Sustainable Building Practices** 5.1 Environment management system and Planning 5.2 Green Building concept 5.3 Green and sustainable building materials -5R concept 5.4 Environment protection acts, legislation and Laws 5.5 Zero carbon foot-print building for sustainable constriction.	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400006

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Use of Air pollutant analyzer to determine the air pollution level *LSO 1.2.* Collect air samples for pollution level detection	1.	Determination of air pollutants harming local environment	**CO2**
LSO 2.1 Use of Water pollutant analyzer to determine the water pollution LSO 2.2 Collect water samples for pollution level detection	2	Determine the water pollutants harming local environment	**CO2**
LSO 3.1 Prepare report on EIA of a given context and area. LSO 3.2 Collection of stakeholders view on effect on environment about a particular project/activity.	3.	Carry out the Environmental Impact Assessment (EIA) for a given project /activity of development	**CO1** **CO3**
LSO 4.1 Predict of possible factors causing effects of climate change LSO 4.2 Effect of Ice melting on sea water	4.	Assessment of the impact of climate change on local environment	**CO1** **CO4**
LSO 5.1 Elaborate the uses of sustainable building materials, the considering 3R LSO 5.2 Trace of Carbon foot print due to construction of a small building	5.	Demonstration of sustainable building materials in lab/workshop	**CO2** **CO5**
LSO 6.1 Set up sample recycling bins in the laboratory LSO 6.2 Appreciate the importance of recycling and environmental benefits LSO 6.3 Explain the importance of 3 R	6.	Demonstration of the recycling process for the different materials such as paper, plastic etc. for waste management	**CO3**
LSO 7.1 Explain the process of composting LSO 7.2 disseminate the use of composting process to near and dear for soil health and fertility for generating organic food	7	Setting up composting bins in the laboratory to demonstrate the process of composting organic waste	**CO3**
LSO 8.1 Calculate own water footprint for daily activities LSO 8.2 Explain the importance of reducing water consumption and conserve water resources.	8	Calculation of personal water footprint for daily water usage for activities like bathing, cooking and laundry.	**CO3**
LSO 9.1 Explore the alternative / renewable sources of energy in day to day life	9.	Develop bio mass energy in the laboratory	**CO3** **CO4**
LSO 10.1 Explore the alternative / renewable sources of energy in day to day life	10.	Develop solar model in the laboratory	**CO3**
LSO 11.1 Explore the alternative / renewable sources of energy in day to day life	11.	Develop wind turbine model in the laboratory	**CO4**

L) Suggested Term Work and Self Learning: S2400006 Some sample suggested assignments, micro project and other activities are mentioned here for reference.

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

1. Conduct a waste audit in your polytechnic. Categorize waste into different types such as plastic, paper, organic. Quantify the amount of each waste.

b. Micro Projects:

- Conduct of EIA of a project/activity such as construction of roads in the local area. Prepare a report on:

  (a) Environmental issues in your city
  (b) SDGs and environment related acts/laws applicable in your state and in India.
  (c) Current-status & future-prospects of Wind Energy
  (d) New energy sources

- Prepare a model of rain water harvesting system to demonstrate how rainwater can be collected and stored for various purposes such as irrigation and toilet flushing.

- Students may be asked in group to set up a small solar panel to compare the energy output under different lighting condition and angles to understand the concept of solar energy and its potential applications.

c. Other Activities:

1. Seminar Topics:
   - Climate change issue and problems
   - Sustainable development- Global practices
   - Factor affecting sustainability in India

2. Visits:
   Visit Pollution control Board of your city. Prepare report of visit with special comments of initiatives taken for protecting environment and ensuring sustainable development of the city.

   Organize a field trip to a nearby park for the students. Students can be observed different species of the plants, animals and insects. They may be asked to prepare report on importance of biodiversity conservation.

3. Self-learning topics:

   - Sustainable Development Goals
   - Climate change.
   - Pollution issues
   - Laws and legislation of environmental protection

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	-	-	15%	-	-	20%	20%
CO-2	-	-	10%	25%	-	10%	20%
CO-3	-	-	15%	25%	33%	15%	20%
CO-4	-	-	30%	25%	33%	15%	20%
CO-5	-	-	30%	-	-	40%	20%
Total Marks	-	-	**10**	**10**	**05**	**10**	**15**
			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):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine the Air and water pollutants harming local environment	**CO1**	30	60	10
2.	Determine the water pollutants harming local environment	**CO1**	40	50	10
3.	Carry out the Assessment of Environmental Impact (EIA) for a given project /activity of development	**CO1 CO3**	30	60	10
4.	Assess the impact of climate change on local environment	**CO1 CO4**	30	60	10
5.	Demonstrate sustainable building materials in lab/workshop	**CO2 CO5**	30	60	10
6.	Demonstrate the recycling process for the different materials such as paper, plastic etc. for waste management	**CO3**	50	40	10
7.	Setting up composting bins in the laboratory to demonstrate the process of composting organic waste	**CO3**	50	40	10
8.	Calculation of personal water footprint for daily water usage for activities like bathing, cooking and laundry.	**CO3**	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
9.	Develop bio mass energy in the laboratory	**CO3 CO4**	30	60	10
10.	Develop solar model in the laboratory	**CO3**	30	60	10
11.	Develop Wind turbine model in the laboratory	**CO4**	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.	Air analyzer	Air Quality Meter Product Type: Measuring Instrument Analysis Time: 2 sec to 8-hour 59 min. 59 sec Automation Grade: Automatic	1
2.	Water Analyzer	Multi-Parameter Water Testing Meter Digital LCD Multi-Function Water Quality Monitor PH/EC/TDS/Salt/S. G/CF/ORP	2
3.	Sustainable Building Materials	As per availability in the market	2,5
4.	Solar energy Panel – KT	Solar Panel Kit 5 LEDs, 2 ON/Off Switch, Wire, 2 Crocodile Clip	7
5.	Bio mass/energy installation -kit	The Bio-energy Science Kit is a great way to find out how a direct ethanol fuel cell works.	6
6.	Wind power energy -Kit	4M wind turbine kit, to demonstrate power of wind and convert it into electricity by building your own turbine.	8
7.	Ice melting demo kit	Simple bowls of different sizes	--

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Ecology and Control of the Natural Environment	Izrael, Y.A.	Kluwer Academic Publisher eBook ISBN: 978-94-011-3390-6
2.	Renewable Energy Sources and Emerging Technologies	Kothari, D.P. Singal, K.C., Ranjan, Rakesh	PHI Learning, New Delhi, 2009 ISBN-13 - 978-8120344709
3.	Green Technologies and Environmental Sustainability	Singh, Ritu, Kumar, Sanjeev	Springer International Publishing, 2017 eBook ISBN 978-3-319-50654-8
4.	Coping with Natural Hazards: Indian Context	K. S. Valadia	Orient Longman ISBN-10: 8125027351 ISBN-13: 978-8125027355
5.	Introduction to Engineering and Environment	Edward S. Rubin	Mc Graw Hill Publications ISBN-10: 0071181857 ISBN-13: 978-0071181853
6.	Environmental Science	Subrat Roy	Khanna Book Publishing Co. (P) Ltd. ISBN-978: 93-91505-65-3

(b) Online Educational Resources:

1. http://www1.eere.energy.gov/wind/wind_animation.html
2. http://www.nrel.gov/learning/re_solar.html
3. http://www.nrel.gov/learning/re_biomass.html
4. http://www.mnre.gov.in/schemes/grid-connected/biomass-powercogen/
5. http://www.epa.gov/climatestudents/
6. http://www.climatecentral.org
7. http://www.envis.nic.in/
8. https://www.overshootday.org/
9. http://www.footprintcalculator.org/
10. https://www.carbonfootprint.com/calculator.aspx

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) www.nptel.iitm.ac.in
b) www.khanacademy

******

A) Course Code : 2428306(P2428306/S2428306)

B) Course Title : Summer Internship -I (Common For all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

Diploma students are required to give exposure of their own diploma programme related industrial hardware, software and practices, just after completing one semester, so that they can correlate this industrial exposure with the concept being taught in the branch specific specialized engineering courses in forthcoming semesters. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the 'Whole to Part' approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the diploma programme – and then teaching the related concepts ('Part') of the same in subsequent semesters. In this way before actually being exposed to academic input specific to diploma programmes, the students need to be sent to the nearby/local industries and also may be advised to explore information related to their programme of study using different sources related to potential employment opportunities of both wage and self-employment, job function, job position, nearby relevant industries and so on.

The summer internship will provide the direction to the students and also help in mind mapping to plan their futuristic course of action, after passing the diploma. This would also bridge the gap between their virtual imagination about the outcome of the programme and real happenings related to the diploma programme.

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** Comprehend the practices of identified industry or world of work related to diploma engineering programme of study.
- **CO-2** Map real equipment, processes, product, management, operations etc. to the course of study through various glimpses of input, process and output in different type of industries.
- **CO-3** Identify the probable enterprises /startups for futuristic planning and self-growth.
- **CO-4** Identify the probable job function and job position in their relevant programme of study.

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		
CO-2	3	-	-	1	-	-	1		
CO-3	3	-	-	-	1	-	2		
CO-4	3	-	-	-	1	-	2		

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				
	2428306	Summer Internship -I	-	-	02	02	04	02

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)	
	2428306	Summer Internship -I	-	-	10	15	10	15	50

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) **Suggested Instructional/Implementation Strategies:** Mentors/ Coordinators/ Teachers need to plan and implement the summer internship in their respective programme as per the outcome expected from the programme. However in general, summer internship would help in exploring and exposing the student to the below mentioned dimensions of the world of work. These dimensions can further be explored in depth as per the need and advancement in respective programmes in later stages. Mentors/Coordinators/ Teachers need to map the academic contents of the programme of study with the activities of this industrial exposure and are advised to follow the whole to part approach to make the students aware about the potential industry's expected outcomes & setup ('Whole') from the specific diploma programme and then teaching the related concepts ('Part') of the same in subsequent semesters.

- Industrial Layout
- Organizational Structure
- Corporate Communications
- Strategic, Rolling and Developmental plans
- Maintenance Procedures
- Inventory Control and Management System
- Purchase and Store Procedures
- Major Machinery, Tools, Equipment, Devices, Software, Control System etc.
- Product Development, Manufacturing, Packaging and Delivery
- Project Management
- Operation and Maintenance
- Warehouse Management
- Assembly Line
- Quality Assurance and Testing Cell
- Process/ Software Development/ Fabrication/ Construction Work Management
- Testing and Quality Assurance Practices
- Total quality management
- Calliberation and Certification practices
- Safety Practices
- Industrial Acts
- Industrial Grievances
- Behavioural Aspects
- Conduction of Meetings and Discussions
- Sales and Marketing Strategies
- Forecasting and Target Setting
- Production Planning and Control
- Storage Retrieved and Material handling Practices
- Automation and Control Facilities
- Enterprise Resource Planning (ERP)
- Supply Chain
- Customer Satisfaction Strategies
- Finance and Accounts
- Research and Development
- Promotion and Capacity Building Schemes
- Reduce, Reuse and Recycling Efforts and Policies
- Recognitions and Rewards
- After Sale Services

- Promotional Avenues
- Social Corporate responsibilities

J) Assessment of Summer Internship -I

S. No.	Criteria of Assessment	% of Weightage
1.	Maintaining the log book after having exposure to different types of industry/ world of work	15
2.	Preparing the list of job functions and job positions of relevant programme	20
3.	Identify the probable enterprise/ startup for futuristic planning	15
4.	Report writing of summer internship as per the prescribed format	30
5.	Presentation of Report	20
Total		**100**

Note: S. no. 1 to 3 shall be considered for progressive assessment. While S. No. 4 & 5 shall be considered for end term assessment

******