Curriculum of Diploma Programme

in

Garment Technology

Department of Science, Technology and Technical Education (DSTTE), Govt. of Bihar

State Board of Technical Education
(SBTE), Bihar

Semester – I

Teaching & Learning Scheme

Course Codes	Category of course	Course Titles	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				
2452101	**PCC**	**Textile Science** (GT, CACDDM)	02	01	-	02	05	04
2452102	**PCC**	**Garment Design Fundamentals**	03	-	04	02	09	06
2400103C	**ASC**	**Applied Chemistry -C** (TE, CACDDM, GT, FCT)	03	-	04	02	09	06
2452104	**PCC**	**Fundamentals of Garment Technology**	03	-	04	02	09	06
2400105D	**ASC**	**Applied Mathematics -D** (CACDDM, FCT, TE, GT, FPP)	02	01	-	02	05	04
2400006	**NRC**	**Environmental Education and Sustainable Development** (Common for All Programmes)	01	-	01	01	03	02
2452107	**NRC**	**Basics of Liberal Art** (Non-Exam Course) (FTS, GT, TE, MIE)	01	-	-	-	01	01
2400108	**NRC**	**Essence of Indian Knowledge System and Tradition** (Common for All Programmes)	01	-	-	-	01	01
Total			**16**	**2**	**13**	**11**	**42**	**30**

Note: Prefix will be added to Course Code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

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 - I
Assessment Scheme

Course Codes	Category of course	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)	
2452101	**PCC**	**Textile Science** (GT, CACDDM)	30	70	20	30	-	-	150
2452102	**PCC**	**Garment Design Fundamentals**	30	70	20	30	20	30	200
2400103C	**ASC**	**Applied Chemistry -C** (TE, CACDDM, GT, FCT)	30	70	20	30	20	30	200
2452104	**PCC**	**Fundamentals of Garment Technology**	30	70	20	30	20	30	200
2400105D	**ASC**	**Applied Mathematics -D** (CACDDM, FCT, TE, GT, FPP)	30	70	20	30	-	-	150
2400006	**NRC**	**Environmental Education and Sustainable Development** (Common for All Programmes)	15	-	10	-	10	15	50
2452107		**Basic Practices of Liberal Art** (Non-exam course) (FTS, GT, TE)	25	-	-	-	-	-	25
2400108	**NRC**	**Essence of Indian Knowledge System and Tradition** (Common for All Programmes)	25	-	-	-	-	-	25
Total			**215**	**350**	**110**	**150**	**70**	**105**	**1000**

Note: Prefix will be added to Course Code if applicable (T for Theory Paper, P for Practical Paper and S for Term Work)

Legend:

PTA: Progressive Theory Assessment in 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 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 : 2452101 (T2452101 / S2452101)

B) Course Title : Textile Science (GT, CACDDM)

C) Pre- requisite Course(s) :

D) Rationale :

Rapid changes and progress in the textile industry have led to the advancement in the fabrics selected for manufacturing garments. Manufacturing fibre and textiles for apparel, household, and industrial use is a great business opportunity. This course provides in-depth knowledge of different fibres, yarns and fabrics available in the market, their manufacturing processes and their properties as well as develop requisite competency and skills in dyeing, printing and its operations, materials, equipment and processes. This course will provide a comprehensive foundation for students undertaking the course in Garment Technology.

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 classroom/ laboratory/ workshop/ field/ industry.

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

CO-1 Select suitable type of textile fibre for various applications.

CO-2 Suggest suitable yarns and fabrics for various uses.

CO-3 Identify fabrics based on the type of yarns, weaves and manufacturing processes.

CO-4 Select the appropriate dyeing process for different fibres, yarns and fabrics.

CO-5 Use various printing styles for different 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	2	-	-	3	-	2		
CO-2	3	2	-	-	3	-	2		
CO-3	3	2	-	-	3	-	2		
CO-4	3	2	-	-	3	-	2		
CO-5	3	-	-	-	3	-	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:

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				
2452101	Textile Science	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)

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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:

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)	
2452101	Textile Science	30	70	20	30	-	-	150

Legend:

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

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Note:

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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: T2452101

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the different terms related to textiles. TSO 1b. Differentiate between types of yarns. TSO 1c. Differentiate between types of fabrics. TSO 1d. Classify the different type of garments. TSO 1e. Explain the importance of textile science in our life.	**Unit-1.0 Fundamentals of Textile** CO 1 1.1 Textile, Textile Science CO 2 1.2 Fibres, Filaments CO 3 1.3 Yarns: spun yarns, filament yarns CO 4 1.4 Sewing threads CO 5 1.5 Fabrics: woven, knitted, non-woven CO 6 1.6 Garment. CO 7 1.7 Importance of textile science in our life.	**CO1, CO2**
TSO 2a. Explain the term 'Textile Fibre'. TSO 2b. Classify different types of textile fibres. TSO 2c. Describe the properties of the given fibre. TSO 2d. Identify the given fibre on basis of the feeling and burning	**Unit-2.0 Textile Fibres** 2.1 Textile fibres, Classification of fibres, General fibre properties. 2.2 Sources of different fibres, physical & chemical properties, their suitability in garment of following textile fibres: Cotton, Silk, Wool, Polyester, Viscose rayon, Acrylic, Nylon. 2.3 Identification of important textile fibres: Feeling and burning test	**CO1**
TSO 3a. Explain the term 'yarn'. TSO 3b. Describe the process involved in conversion of the given fibres into yarn. TSO 3c. Suggest suitable yarn for the given application with justification. TSO 3d. Explain the use of yarn twist and yarn count.	**Unit-3.0 Yarns** 3.1 Conversion of fibres into yarn. 3.2 Types of yarn, their properties and suitability for the garment. 3.3 Yarn Twist, Yarn count	**CO2, CO3**
TSO 4a. Identify various woven fabrics and their uses. TSO 4b. Explain the statred weaving and related terminologies. TSO 4c. Explain basic loom operations. TSO 4d. Classify various types of weaves and their application. TSO 4e. Draft peg plans of various weaves.	**Unit-4.0 Conversion of Yarn into Fabric** 4.1 Fabric formation- weaving, knitting, non-woven 4.2 End use of fabrics produced by these methods 4.3 Woven fabric: Warp and weft yarn, loom, loom mechanism and function of its various parts 4.4 Woven design fundamentals: classification of woven structure, methods of weave representation, weave repeat, basic elements of woven design, types of draft plan and peg plans of weaves 4.5 Basic weaves and its modification (Plain weave, Twill weave, Satin and sateen weaves), decorative weaves.	**CO3**
TSO 5a. Explain the given wet-processing of textile materials. TSO 5b. Classify the various types of dyes. TSO 5c. Describe the given dyeing techniques. TSO 5d. Explain the working of the given dyeing machineries. TSO 5e. Select suitable dyeing process for the given fibre, yarn, and fabric with justification. TSO 5f. Explain the given method of printing.	**Unit-5.0 Chemical Processing of Textile** 5.1 Wet-processing treatments: Singeing, de-sizing, scouring, bleaching, mercerization. 5.2 Dyeing: Dyes & its classification, Principles & Properties of dyes, Application of natural and Synthetic dyes on different fibres and their blends	**CO4, CO5**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5g. Explain the given style of printing. TSO 5h. Describe the given type of Textile finish. TSO 5i. Differentiate between types of mechanical and chemical finishes. TSO 5j. Recommend a chemical processing method for the specific job order with justification.	5.3 Different dyeing techniques, dyeing machinery, Defects in dyeing and their remedies. 5.4 Textile Printing: dyeing and printing, Methods of Printing such as Block Printing, Stencil Printing, Screen Printing, and Roller printing. Styles of Printing: Direct style of Printing, Resist style of Printing, Tie & dye, Batik Printing, Discharge style of Printing. 5.5 Finishing of fabrics: Principle of finishing of natural, man-made fibres and blended fabrics. Wash-n-wear, crease-resistant anti-shrink, water-repellent, rot and mildew proofing, flame-proofing finishes, etc.	

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: S2452101 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. Use internet resources to collect different types of textiles and prepare a collage. Prepare a report.
ii. Prepare a library research assignment on different types of fibres. Present it before the class.
iii. Prepare a summary of envirnmental sustainable processes for conversion of yarn into fabric.
iv. List entrepreneurship and self-employment opportunities in the area of chemical processing of textile.

b. Micro Projects:

i. Collect different types of yarns from different resources and make a comparative chart.
ii. Download 5 videos on Fibres and Yarns, watch them and write a report to detail out the steps involved.
iii. Prepare a document for sustainable practices in textile sciences. Convert it into a street play and conduct few street shows for social awareness. Video shoot it and make it viral.

c. Other Activities:

i. Seminar Topics:
- Durable textiles with sensor.
- Technological advancements in textile manufacturing.

ii. Visits:
- Visit nearby textile, garment, printing industry. Prepare report of visit.
- Visit an industry and chart the process flow for manufacturing of fabric and chemical processing of textile.

iii. Self- learning topics:

- Natural Fibres.
- New spinning system
- Organic dyeing
- Organic printing of textiles.

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%	15%	-	-	-	-
CO-2	10%	20%	10%	25%	-	-	-
CO-3	15%	20%	15%	25%	33%	-	-
CO-4	30%	20%	30%	25%	33%	-	-
CO-5	30%	20%	30%	25%	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 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	COs Number (s)	Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Textile Sciences	8	CO1	12	4	5	3
Unit-2.0 Textile Fibres	8	CO2	12	4	5	3
Unit-3.0 Yarns	8	CO3	12	4	5	3
Unit-4.0 Conversion of yarn into fabric	12	CO4	17	5	6	6
Unit-5.0 Chemical Processing of Textile	12	CO5	17	5	7	5
Total	**48**	**-**	**70**	**22**	**28**	**20**

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, 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: (Not Applicable)

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Textile Science	Gohl and Vilensky	CBS ISBN: 9788123910383
2.	Principles of Textile Testing	Booth J. E.	Athithi Books ISBN: 9789388327473
3.	Textile Science A Practical Manual	Dr. Deepali Rastogi Dr. Chanchal Dr. Sheetal Chopra Dr. Chitra Arora	Elite Publishing ISBN:9788188901678
4.	Textiles Science	Rastogi Deepali (Author), Chopra Sheetal	Orient Blackswan Private Limited ISBN:9789386392664

(b) Online Educational Resources:

1. https://www.youtube.com/watch?v=ystM8evK6HE
2. https://www.youtube.com/watch?v=PDuiSnBYCQc
3. https://www.youtube.com/watch?v=CNDtsSWDIS0
4. https://www.arts.ac.uk/subjects/textiles-and-materials/short-courses/fashion-textiles/introduction-to-textiles-online-short-course-lcf

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: -

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A) Course Code : **2452102 (T2452102 / P2452102 /S2452102)**

B) Course Title : Garment Design Fundamentals

C) Pre-requisite Course(s) :

D) Rationale :

This course is designed to develop artistic aptitude in students to sustain themselves in the field of garment dress design. It helps in developing the basic foundation that is essential for garment design and dress making. The course also forms the basis for drawing garments on proportionate human figures. It emphasizes the basic silhouettes. Different type of human figures enables the designers to design appropriate garments. Application of principles of design will be useful to the students in garment designing. In addition, the knowledge of different types of figures enables the designers to design costumes as per figure types. The focus of the course is on development of skills in the student to apply principles of design in garments for different types of human figures using appropriate elements of design in industry.

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 appropriate tools and materials to draw sketches for dress designing.
CO-2 Use appropriate elements of design for dress designing.
CO-3 Draw human figure in proportionality for garment design.
CO-4 Design appropriate garment using principles and elements of design.
CO-5 Design dresses for various types of human figures using principle of elements of design.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	2	-	-	2		
CO-2	3	2	-	2	2	-	-		
CO-3	3	3	-	2	2	-	-		
CO-4	3	3	-	2	-	-	-		
CO-5	3	-	-	3	-	3	2		
CO-6	3	-	-	3	-	3	2		

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

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J) Theory Session Outcomes (TSOs) and Units: T2452102

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO1a. Identify tools and materials used for drawing and sketching. *TSO1b.* Describe the function of different drawing and sketching tools. *TSO1c.* Use tools and materials appropriately for drawing and sketching. *TSO1d.* Identify various elements of garment. *TSO1e.* Explain different types of silhouettes with their features. *TSO1f.* Explain the use of different types of design in Garments.	**Unit-1.0 Drawing and Sketching of Garments.** 1.1. Drawing and sketching tools: Pencil, Pen, Ink pen, Pencil colours, Sketch pen, Felt tip pen, Markers, Polychrome colour, Acrylic colour, Charcoal pencil/chalk, T-square, Set square, French curve. Protector, Scale, Compass, Divider, Water colour. Pastel colour, Brush, Crayon wax etc. 1.2. Drawing and sketching material: Drawing sheets/paper, Drawing book, Drawing board etc. 1.3. Elements of Garment: Necklines & Collars, Sleeves & Cuffs; Skirts & Pockets. 1.4. Silhouette: Concept, Definition, Types of silhouette with their features. 1.5. Types of designs: Structural design, applied design. Reducing and Enlargement of design.	**CO1**
TSO2a. Develop drawings and sketches using appropriate elements of design. *TSO2b.* Prepare colour wheel. *TSO2c.* Explain various colour schemes. *TSO2d.* Develop Tints, Shades and Tones. *TSO2e.* Identify warm and cool colours. *TSO2f.* Explain the use of different types of line. *TSO2g.* Distinguish between shapes and forms. *TSO2h.* Identify various textures for garments.	**Unit-2.0 Elements of Design** 2.1 Line: Concept, Different types, Line movements, Aspects, its physical and psychological effects on human figure. (Horizontal, Vertical, Diagonal, Curve, Zigzag). 2.2 Space: Definition, Cues influencing perception of shape and space, physical and psychological effect. 2.3 Shape and form: Different types, equally sided flat shapes, unequally sided flat shapes, equally sided volume forms, unequally sided forms, some shapes that fit snugly together, shapes not fitting together create other shapes between them, Attributes of shape and form. 2.4 Texture: Concept of texture, Types, Psychological and physical effect of Texture. 2.5 Colour – Concept, psychological and physical effects of colour, Primary, secondary and tertiary colour. Neutral colour. Dimension of colour – Hue, Value & Intensity, Tints, Shades and tones, Colour wheel, Warm and Cool colour. Colour scheme – Neutral, Analogous, Monochromatic, Complementary, Double complementary, Split complementary, Double split complementary, Triad colour scheme. Selecting colours, Using of colours, Qualities of colour.	**CO2**
TSO3a. Explain basic human proportions *TSO3b.* Describe eight head theory of male, female and child. *TSO3c.* Compare human proportion of male, female and child. *TSO3d.* Prepare a personalized fashion croquis for men's wear, women's wear and children's wear range development.	**Unit-3.0 Human Figure Proportions and Stylization** 3.1 Basic Human proportions, eight head theory of male and female, child. 3.2 Comparative analysis of Male, Female and child ideal proportions. 3.3 Preparing a personalized fashion croquis for Men's wear, women's wear and children's wear range development.	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4a. Incorporate the elements of point, line, form, colour and texture in designing of garments. *TSO 4b.* Use concepts of Repetition, Gradation, Transition, Radiation, Rhythm, Emphasis and Balance in designing of dresses. *TSO 4c.* Explain the physical and psychological effect of Harmony (Unity), Balance, Emphasis, Proportion (scale) -Rhythm- Effects of Rhythm. Different ways of achieving rhythm and repetition in garments. *TSO 4d.* Explain the effect of Parallelism, Sequence, Alternation, Gradation, Transition, Radiation, Concentricity and Contrast for creation of new designs of clothes. *TSO 4e.* Modify the garments using principles of Develop drawings using principles of design. *TSO 4f.* Distinguish between formal and informal balance. *TSO 4g.* Create harmony, balance, emphasis, proportion and rhythm by different means. *TSO 4h.* Apply the principles of designs in clothing to modify the look of the garment: *TSO 4i.* Use the concepts of large top slim bottom; slim top large bottom for dress designing. *TSO 4j.* Create an angular/sharp look through Colour, Line, Point and texture. *TSO 4k.* Create a Tubular/flat look through Colour, Line, Point and texture. *TSO 4l.* Create a Curvy look through Colour, Line, Point and texture. Accentuate various zones of the body through Colour, Line, Point and texture.	**Unit-4.0 Elements and Principles of Designs in Clothing** 4.1 Identifying and incorporating the element of line, form, colour and texture in the design of garments. 4.2 Concept, effects (physical & psychological) of Harmony (Unity), Balance, Emphasis, Proportion (scale) -Rhythm- Effects of Rhythm. Different ways of achieving rhythm, Repetition, effects of repetition. 4.3 Effect of Parallelism, Sequence, Alternation, Gradation, Transition, Radiation, Concentricity, Contrast, Identifying and Incorporating the element of 'point' in garments. 4.4 Principles of designs in clothing to modify the look of the garment: Concept of large top slim bottom; slim top large bottom, angular/sharp look through Colour, Line, Point and texture., Tubular/flat look through Colour, Line, Point and texture, Curvy look through Colour, Line, Point and texture, zones of the body through Colour, Line, Point and texture.	**CO4**
TSO5a. Identify different type of human figures. *TSO5b.* Design dress for different type of human Figures- Shoulders, Chest. *TSO5c.* Design dress for different type of human - Chest, Hips, Abdomen. *TSO5d.* Design dress for different type of human Waist, Back, Neck. *TSO5e.* Design dress for different type of human - Face, Nose, Chin, Jaw. *TSO5f.* Design dress for different type of human - Forehead, Features and glasses.	**Unit-5.0 Pattern Design & Flattering Different Types of Figures** 5.1 Pattern and dress design for : The Stout figure and the thin figure, Narrow shoulder and Broad shoulder, Round figure, Large Bust, Flat chest, Large Hip, Large waist & Hips, Large abdomen, Long Waist, slender figure, Short Waist, Sway Back, Long Neck, Short or thick neck, Large face, Small face, Square or broad face, Round face, Narrow Pointed face, Retrousse, Nose, Prominent Nose, Prominent Chin & Jaw, Receding Chin & Small Jaw, Prominent forehead, Low forehead, Sharp angular feature, Large features. Glasses.	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2452102

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO1.a Prepare given types of drawing by hand	1	Free hand and Memory drawing.	CO1
LSO2.a Prepare a sheet of Calligraphy writing by hand (All alphabets).	2	Gothic letters and Roman letters.	CO1
LSO3.a Draw given elements of garment.	3	Elements of Garment	CO1
LSO4.a Draw different types of Silhouettes.	4	Types of Silhouettes.	CO1
LSO5.a Reduce and enlarge of given design.	5	Reducing and Enlargement of design.	CO1
LSO6.a Draw effects of different types of lines on the garment.	6	Types of lines.	CO2
LSO7.a Prepare the sheet showing following equal sided flat shapes by hand -Square, Circle, Equilateral Triangle, Pentagon, Hexagon, Octagon.	7	Equal-sided flat shapes	CO2
LSO8a. Draw the following Unequal sided flat shapes -Rectangle, Parallelogram, Heart, Diamond, Teardrop, Marquis, Ogive, Star, Paisley, Club, Spade, Pear, Kidney.	8	Unequal sided flat shapes	CO2
LSO9.a Draw the following Equal sided three - dimensional forms: Sphere, Cube. *LSO9.a* Draw the following Unequal sided three-dimensional forms: Cylinder, Cone, Pyramid, Box, Bell, Dome, Ovoid, Barrel, Hourglass Trumpet.	9	Three dimensional forms	CO2
LSO10.a Draw the following Textures- Rough texture, Smooth texture and Transparent texture.	10	Types of Textures	CO2
LSO11.a Create colour wheel, tints, shades and tones	11	Colour wheel, Tints and shades.	CO2
LSO12.a Reduce and Enlarge the given design.	12	Reduction and Enlargement of design.	CO2
LSO13.a Draw Structural and Applied design for garment	13	Structural and Applied design	CO2
LSO14.a Draw the effect of Balance in clothing in the following areas - line path, space, space & shape, value, texture, pattern.	14	Principles of design: Balance	CO4
LSO15.a Draw the effect of Emphasis in clothing in relation to the elements of design-line thickness, shape, form, space, light, texture, pattern.	15	Emphasis in elements of design.	CO4
LSO16.a Draw the effect of Rhythm in clothing and its relationship with elements of design *LSO16.b* Rhythm in line – Wavy, Zigzag, Single, Swirled, Jagged. *LSO16.c* Rhythm in shape – Saw tooth, Diamond, Undulating. Rhythm in pattern	16	Rhythm in elements of design.	CO4
LSO17.a Draw the effect of Radiation in clothing in relation to elements of design - line & space,	17	Radiation in elements of design.	CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
shape & space, Pattern, Radiation from an axis.			
LSO18.a Draw the effect of Transition in clothing in relation to elements of design -line, space, shape & space, texture, shape & texture.	18	Transition in elements of design.	CO4
LSO19.a Draw the effect of Gradation in clothing in relation to elements of design-Gradation in line, space, shape, space & shape, texture, pattern.	19	Effect of Gradation	CO4
LSO20.a Draw the effect of Repetition in clothing in relation to elements of design -line, space, shape, pattern, texture.	20	Effect of Repetition.	CO4
LSO21.a Sketch proportionate human figures of male, female and child	21	Human Figures	CO5

L) Suggested Term Work and Self Learning: S2452102 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. Draw sketches of dress for male and children's wears.
2. Decorate the sketch of dresses/garments using elements of design.
3. Draw different anatomy of human body.
4. Collect appropriate garment design based on principle and elements of design for female wear.

b. Micro Projects:

1. **Eight head croquis**: Create template of eight head croquis of female with different poses.
2. **Ten head croquis**: Create template of ten head croquis of female with different poses.
3. **Twelve head croquis**: Create template of twelve head croquis of female with different poses.
4. **Sustainable environment:** Draw poster for providing message about Sustainable environment/green technology.
5. Draw square motif of 1" x 1" inch (approx.) use this motif in different orientations and represent each of the followings:
   - In black outline create an overall pattern surface.
   - In black outline create a border of 1 ½" width.
6. Observe and analyze any selected area and identify the elements of design (point, line, shape and texture) present in it.
7. Select a colourful picture from a magazine and find out the colour scheme present in it.
8. Sketch any 1 object four times and apply 4 different colour schemes to each of them.
9. Observe and analyze the selected natural forms and identify the principles of design (balance, rhythm, emphasis and contrast) present in them.

c. Other Activities:

1. Seminar Topics
   - Modern dress for different human figures based on principle and elements of design
   - Indian Ethnic cloth design

2. Visits:

- Visit to nearby boutiques and prepare a report.
- Visit to nearby Fashion institute

3. Self-Learning Topics:
   - Application of Principle of designs in dress designing
   - Use of Various Shape form in dress designing

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%	15%	-	-	20%	20%
CO-2	10%	20%	10%	25%	-	10%	20%
CO-3	15%	20%	15%	25%	33%	15%	20%
CO-4	30%	20%	30%	25%	33%	15%	20%
CO-5	30%	20%	30%	25%	34%	40%	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 percentages 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 Drawing and Sketching of Garments	8	CO1	14	4	4	6
Unit-2.0 Elements of Design	12	CO2	14	4	4	6
Unit-3.0 Human Figure Proportions and Stylization	6	CO3	14	4	4	6
Unit-4.0 Elements and Principles of Designs in Clothing	10	CO4	14	4	4	6
Unit-5.0 Pattern Design & Flattering different types of Figures	12	CO5	14	4	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	Free hand and Memory drawing.	CO1	50	40	10
2	Gothic letters and Roman letters.	CO1	50	40	10
3	Elements of Garment	CO1	50	40	10
4	Types of Silhouettes.	CO1	50	40	10
5	Reducing and Enlargement of design.	CO1	50	40	10
6	Types of lines.	CO2	50	40	10
7	Equal-sided flat shapes	CO2	50	40	10
8	Unequal sided flat shapes	CO2	50	40	10
9	Three dimensional forms	CO2	50	40	10
10	Types of Textures	CO2	50	40	10
11	Colour wheel, Tints and shades.	CO2	50	40	10
12	Reduction and Enlargement of design.	CO2	50	40	10
13	Structural and Applied design	CO2	50	40	10
14	Principles of design: Balance	CO4	50	40	10
15	Emphasis in elements of design.	CO4	50	40	10
16	Rhythm in elements of design.	CO4	50	40	10
17	Radiation in elements of design.	CO4	50	40	10
18	Transition in elements of design.	CO4	50	40	10
19	Effect of Gradation	CO4	50	40	10
20	Effect of Repetition.	CO4	50	40	10
21	Human Figures	CO5	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practical. Rubrics need to beprepared 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.	Drawing Board	Standard size	All
2.	Paint, Paint Brush, Water colour, Scale	Standard sizes	All
3.	Chart Paper, Drawing Sheet, Scrap Book	Standard sizes	All

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Visual design in dress	Marian L Devis	PEARSON, USA. 21 February 1996 • ISBN-: 9780131121294 • ISBN-: 9780131121294
2.	Individuality in clothing selection and personal appearance	Mary Kefgan	Prentice Hall PTR,1971, ISBN 13: 9780130358653
3.	Colour and line in dress	Hemstead	Lawrance Prantice Hall,25 March 2012 • ISBN-10: 1258256517 • ISBN-13: 978 1258256517-978
4.	Fashion design illustration- Men	Pattrick JohnIrcland	5-July 1996, B.T. Batsford Ltd. London,07134646235
5.	How you look and dress?	Byrta Carson	Mc graw hill book co.1969 ISBN-13: 978 0070101746-978

(b) Online Educational Resources:

1. http://www.purushu.com/2010/08/elements-of-design-in-fashion.html
2. https://www.proprofs.com/quiz-school/story.php?title=elements-principles-design-1
3. https://archive.org/details/artineverydaylif008800mbp
4. http://williamson.agrilife.org/files/2014/09/principleselements.pdf
5. https://ncert.nic.in/textbook/pdf/lehe201.pdf
6. https://www.subhartidde.com/slms/BFA(F)%20104%20SE%201%20Principles%20of%20Design.pdf
7. https://www.khanacademy.org/humanities/ap-art-history/start-here-apah#elements-of-art-apah
8. http://www.invisionapp.com/design-defined/principles-of-design/
9. http://www.sewguide.com/dress-for-bodyshape/?amp=1

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. M/c calls' Sewing in colour, Hamlyn
2. Art in Everyday Life by Harrient Goldstein, The Macmillan Company, a
3. Lab Manuals

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A) Course Code : 2400103C (T2400103C / P2400103C / S2400103C)

B) Course Title : Applied Chemistry- C (TE, CACDDM, FCT, GT)

C) Pre- requisite Course(s) :

D) Rationale :

Given course is the applied form of Chemistry. It is an application of basic knowledge of chemistry to understand the requirements of the industries related to textile and garments. This course intends to impart technical knowledge along with productive practice to the students of the diploma engineering. Students will learn about the chemical characteristics of materials, such as their reactivity, bonding, and molecular structures, through the chemistry course. With this understanding, students will be able to choose materials intelligently for certain applications and create new materials that fulfil market demands. Diploma engineers have to deal with various chemicals in diverse technical and engineering fields. Dying, bleaching and cleaning fabric in the textile and garment industry and related areas will require engineers to acquire essential knowledge in chemistry to choose appropriate chemicals, dyes, bleaching agents, soap, detergents and enzyme-based detergents which should be economical and eco-friendly. Student will learn about various types of natural and man-made fibres which requires basics of monomers used and polymerization. Basic knowledge of chemistry is essential to treat textile industry effluents containing various types of synthetic dyes, metals, chlorine and other pollutants which has become an environmental concern.

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 classroom/ laboratory/ workshop/ field/ industry.

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

1.1 Solve various engineering problems applying the basic concepts of atomic structure, chemical bonding and solutions.

1.2 Apply the concepts of chemical structure, properties and identification of polymers and fibers in textile and garment industry.

1.3 Apply suitable wastewater treatment techniques in textile industry.

1.4 Use appropriate chemicals such as dyes, bleaching agents, soaps, detergents and enzyme-based detergents in textile and garment industry.

1.5 Use concepts of organic molecules and isomerism to solve various engineering problems.

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	-	-	-	-	-	-		
CO-2	3	-	2	-	2	1	2		
CO-3	3	3	1	2	-	1	-		
CO-4	3	-	-	-	1	-	1		
CO-5	3	-	-	-	-	-	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:

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				
2400103C	Applied Chemistry- C	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:

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)	
2400103C	Applied Chemistry - C	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: T2400103C

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain quantum numbers and their significance briefly. *TSO 1b.* Explain the importance of principles followed in expressing electronic configuration of elements. *TSO 1c.* Explain different types of Chemical Bonding with examples. *TSO 1d.* List different modes of expressing the concentration of solutions-Molarity, Normality, and parts per million. *TSO 1e.* Prepare solution of given concentration. *TSO 1f.* Describe the balancing of chemical equation of redox reaction using ion-electron method.	**Unit-1.0 Atomic Structure, Chemical Bonding, solutions, and Redox Reactions** 1I Fundamental particles- mass and charges of electrons, protons, and neutrons with names of the scientists who discovered these fundamental particles. 1II Atomic number, atomic mass number. 1III Definition of orbit and orbitals, shapes of s and p orbitals, the 1IV Brief concept of quantum numbers and their significance. 1V Introduction to Aufbau's principle, Pauli's exclusion principle and Hund's rule of maximum multiplicity. 1VI Electronic configurations of elements with atomic number up to 20. 1VII Chemical bonding- Ionic or Electrovalent bond, Covalent bond, Coordinate bond, Hydrogen bond. 1VIII Solutions, Solute and Solvent, Modes of expressing concentration of solutions-Molarity, Normality, and parts per million. 1IX General introduction Oxidation and Reduction, Oxidation number, Balancing of Chemical Equations of Redox Reaction by Ion-Electron Method. 1X Indian Chemistry: -Philosophy of atom by Acharya Kanad. (IKS)	**CO1**
TSO 2a. Differentiate between addition and condensation polymerization. *TSO 2b.* Explain molecular arrangement of polymers. *TSO 2c.* Describe primary and secondary properties of fibre. *TSO 2d.* Classify Fibre based on origin. *TSO 2e.* List monomers and chemical reactions involved in the synthesis of Rayon, Nylon-6, Nylon-6,6, Polyester, Polyethylene and Spandex. *TSO 2f.* Explain identification tests of fibres. *TSO 2g.* Identify fibers based on physical and chemical tests.	**Unit-2.0 Fibres and Polymers** 2.1 Definition of Monomer, Polymer-types of polymers: homopolymer and copolymer, Degree of Polymerization, Types of polymerization-addition and condensation polymerization, Polymer arrangement: Crystalline and Amorphous arrangement, Orientation of fibre. 2.2 Definition of the Terms: Textile, Fibre, Textile fibre, Staple, Filament, Yarn and thread. 2.3 Primary and secondary properties of textile fibre. 2.4 Fibre classification by origin: Natural fibres- Plant fibre-cotton, bast fibre-jute and flax, Protein/Animal fibre- wool and silk, Mineral 2.5 Fibre – Asbestos, monomers and chemical reaction involved in the synthesis of man-made fibres: Rayon, Nylon (6 & 6,6), Polyester, Acrylic, Olefins (Polyethylene and Polypropylene) and Elastomeric fibres-spandex, Comparison of natural and man-made fibres.	**CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.6 Identification of fibres- feeling test, burning test, chemical test.	
TSO 3a. Differentiate between hard water and soft water. *TSO 3b.* Estimate the hardness of water using EDTA titration method. *TSO 3c.* Explain the effect of hardness of water in textile industry. *TSO 3d.* Explain the various water softening techniques. *TSO 3e.* Determine the dissolved oxygen (DO) and biological oxygen demand (BOD) of a wastewater sample. *TSO 3f.* Identify given samples as acid, base or neutral. *TSO 3g.* Explain the two parameters BOD and COD to measure water quality and the amount of organic pollutants present in water. *TSO 3h.* Use the Indian standard specification of drinking water.	**Unit-3.0 Water** 3.1 Introduction, Sources of Water, Hardness of water, types of hardness, Degree of Hardness (In terms of CaCO3 equivalent), Unit of Hardness, Quantitative Measurement of Water Hardness by EDTA method. 3.2 Bad effect of hard water in textile industries- scale and sludge formation in boilers, disadvantage of scale formation. 3.3 Water Softening Technique-Soda Lime Process, Zeolites method and cation-anion exchange method. 3.4 Concept of pH and its applications. 3.5 Determination of Dissolved Oxygen, Water Quality Index - Biological Oxygen Demand, Chemical Oxygen Demand, Simple Numerical Problems. 3.6 Indian standard specification of drinking water.	**CO3**
TSO 4a. Differentiate between soap and detergent. *TSO 4b.* Explain the cleansing action of soap. *TSO 4c.* List different types of detergents. *TSO 4d.* Describe the importance of saponification values. *TSO 4e.* Use of different enzyme-based detergents in textile industry. *TSO 4f.* Classify stains and their removal techniques. *TSO 4g.* list different bleaching agents used in textile industry. *TSO 4h.* Describe the use of indigo, phenolphthalein and methyl orange dye in textile industry.	**Unit-4.0 Soap, Detergents and Dyes** 4.1 Cleaning agent: soap- chemical composition, Detergent: chemical composition, types of detergent. Cleansing action of soaps and detergents, difference between soap and detergent. *2.1.* Saponification values- Definition, determination, and significance. *2.2.* Enzyme based detergents: Introduction to enzyme-based detergents and their types: proteases, amylases, lipases, cellulases, mannanases and pectinases, merits of enzyme-based detergents over synthetic detergents, cleansing action of enzyme-based detergents. *2.3.* Stain: Definition of stain, classification, and removal techniques of stains -Protein stain, Tannin stains, Oil – based stains, Dye stains, Combination Stains, Stains require special treatment methods. *2.4.* Bleaching agent: Definition of bleaching agent, classification of bleaches: oxidizing bleaches- halogen and peroxide bleaches (universal bleaching agent) and reducing bleaches, purposes of bleaching, advantages, and disadvantages of bleaching. *2.5.* Dyes: Definition of dye, classification of dyes, Introduction to some dyes: indigo dye, phenolphthalein, methyl orange.	**CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5a. Identify the structures of organic compound based on their classification. *TSO 5b.* Classify structures of organic molecules. *TSO 5c.* Draw structures of organic molecules. *TSO 5d.* Identify different types of structural isomerism in different molecules. *TSO 5e.* Differentiate amongst different organic compounds based on the functional group.	**Unit-5.0 Basics of Organic Chemistry** 5.1 Classification of organic compounds (acyclic or open chain compounds, cyclic or closed chain or ring compounds- aromatic compounds). 5.2 Introduction to Functional groups (alkenes, alkynes, halides, alcohols, aldehydes, ketones, nitriles, ethers, carboxylic acids, esters, amines, amides, nitro compounds). 5.3 Isomerism, structural isomerism (chain, position and functional), stereoisomerism (geometrical and optical isomerism)	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400103C

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Weigh oxalic acid. LSO 1.2. Prepare a solution of oxalic acid.	1.	Preparation of 250ml N/I0 Oxalic acid Solution.	CO1
LSO 2.1. Weigh Sodium Carbonate. LSO 2.2 Prepare a solution of sodium carbonate.	2.	Preparation of 250ml N/10 Sodium Carbonate Solution.	CO1
LSO 3.1. Use of appropriate indicator for acid-base titration. LSO 3.2 Analyze titration curves for weak acid and strong base.	3.	Determination of strength of Sodium Hydroxide Solution by Titrating against Oxalic Acid solution.	CO1
LSO 4.1. Identify given textile fibre using chemicals. LSO 4.2. Distinguish between animal and vegetable fibre.	4.	Identification of textile fibres like cotton, linen, wool, silk, nylon, polyester, and acrylic using chemical tests.	CO2
LSO 5.1. Identify given textile fibre using burning test. LSO 5.2. Distinguish between animal and vegetable fibre.	5.	Identification of textile fibres like cotton, linen, wool, silk nylon, polyester and acrylic by burning test.	CO2
LSO 6.1. Determine the total hardness of given sample of water in terms of CaCO3 by EDTA titration method. LSO 6.2. Draw the structure of complex of metal ions with ethylenediaminetetraacetic acid (EDTA).	6.	Determination of total hardness of water sample in terms of $CaCO_3$ by EDTA titration method using Eriochrome black-T as indicator.	CO3
LSO 7.1. Determine the saponification value of oil. LSO 7.2. Compare saponification values of some given oils.	7.	Determination of saponification value of the given oil/fat.	CO4
LSO 8.1. Perform Baeyer's test LSO 8.2. Perform Bromine Test	8.	Identification of the presence of unsaturation in a given organic compound.	CO5
LSO 9.1. Perform Ceric Ammonium Nitrate test LSO 9.2. Perform Iodoform test	9.	Identification of the presence of alcoholic functional group in a given organic compound.	CO5
LSO 10.1. Perform 2,4-Dinitrophenyl Hydrazine Test LSO 10.2. Perform Fehling's Test LSO 10.3. Perform Tollen's Test	10.	Identification of the presence of aldehyde and ketone functional groups in a given organic compound.	CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 11.1. Determine the pH of the given sample using; pH paper, Universal indicator and pH meter.	11.	Determination of pH-Values of given Solution by using pH paper, Universal Indicator and pH-meter.	CO3
LSO 12.1. Perform Fehling's Test LSO 12.2. Perform Sodium Bicarbonate Test	12.	Identification of the presence of a carboxylic acid functional group in a given organic compound.	CO5
LSO13.1. Describe the principle behind the estimation of the dissolved oxygen in water LSO13.2. Determine the oxygen content of the different aquatic habitats.	13.	Determination of Dissolved Oxygen (DO) in the given Sample of Water.	CO3

L) Suggested Term Work and Self Learning: S2400103C 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 such as

1. Write the exceptional behavior of elements Chromium and copper based on their electronic configuration.
2. Prepare the chart displaying different steps involved in wastewater treatment in textile industries.
3. Prepare the model, showing the difference between covalent and ionic bond.
4. Prepare a report on the impact of waste generated from textile production on the environment.

b. Micro Projects:

1. Prepare a report by analyzing the cleansing capacity of the different soaps in distilled water and tap water.
2. Collect the sample of water from various water bodies nearby and analyze pH, temperature and dissolved oxygen prepare a report on the same.
3. Sterilization of water samples using bleaching powder.
4. Collect and measure the hardness of different water samples from different sources by using the EDTA titration method.
5. Collect the water samples containing bleaching powder from various sources and measure the percentage of available Chlorine in the collected samples.

c. Other Activities:

3.1 Seminar Topics:

- Methods for Wastewater treatment in textile/ garment industry
- Dye used for the given fiber in textile/ garment industry.
- Chemistry of Dyeing
- Application of chemistry in textile/ garment industry
- Application of enzymes in textile/ garment industry
- Cleansing action of soap and detergents

Visits:

- Organize a visit to the nearby garments industry related to printing and embroidery followed by garment production. There they can explore the different sections like store section, embroidery section, pattern making, drafting section, cutting section, stitching, finishing section, workshop etc.

- Organize a visit to nearby traditional dying and synthetic dying shops to comprehend the different stages and types of dyeing.
- Visit textile industries to learn the bleaching process.

3.2 Self-Learning Topics:

- Basic structure of atom
- Basics of organic chemistry
- Cleansing action of soap and detergents
- Wastewater treatment
- Dyes

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%	15%	15%	10%	10%
CO-2	15%	15%	20%	20%	20%	20%	20%
CO-3	30%	25%	20%	20%	20%	25%	25%
CO-4	15%	20%	20%	20%	20%	15%	15%
CO-5	30%	30%	25%	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 percentages 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 Atomic Structure, Chemical Bonding and Solutions	12	CO1	18	6	8	4
Unit-2.0 Fibre and Polymers	7	CO2	10	3	3	4
Unit-3.0 Water	5	CO3	08	3	3	2
Unit-4.0 Soap, Detergents and Dyes	12	CO4	17	5	7	5
Unit-5.0 Basics of Organic Chemistry	12	CO5	17	5	7	5
Total	**48**	**-**	**70**	**22**	**28**	**20**

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.	Preparation of 250ml N/I0 Oxalic acid Solution.	CO1	40	50	10
2.	Preparation of 250ml N/10 Sodium Carbonate Solution.	CO1	40	50	10
3.	Determination of the strength of Sodium Hydroxide Solution by Titrating against Oxalic Acid Solution.	CO1	30	60	10
4.	Identification of textile fibres like cotton, linen, wool, silk, nylon, polyester and acrylic using chemical tests.	CO2	30	60	10
5.	Identification of textile fibres like cotton, linen, wool, silk nylon, polyester and acrylic by burning test.	CO2	30	60	10
6.	Determination of the total hardness of water sample in terms of CaCO3 by EDTA titration method using Eriochrome black-T as indicator.	CO3	30	60	10
7.	Determination of pH-Values of given samples of Solution by using pH paper, Universal Indicator and pH-meter.	CO3	30	60	10
8.	Determination of saponification value of the given oil/fat.	CO5	30	60	10
9.	Identification of the presence of unsaturation in a given organic compound.	CO5	40	50	10
10.	Identification of the presence of alcoholic functional group in a given organic compound.	CO5	40	50	10
11.	Identification of the presence of aldehyde and ketone functional group in a given organic compound.	CO5	40	50	10
12.	Identification of the presence of a carboxylic acid functional group in a given organic compound.	CO5	30	60	10
13.	Determination of Dissolved Oxygen (DO) in the given Sample of Water.	CO3	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, 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.	Electronic Weighing Balance	Type of Laboratory Balance: Analytical, Sensitivity (mg): 1 mg, Maximum Capacity of weighing (grams): 200 g, Shape of PAN: Circular, Power Supply: Single Phase, Display: LED.	1,2,3, 6, 7, 13
2.	Hot plate magnetic stirrer	Hot plate with Magnetic stirrer: Number of stirring Positions:1, Calibration: Automatic Calibration, Magnetic stirrer with a hot plate, Speed Control Accuracy of set speed (+/-) (RPM): 5, Maximum Stirring capacity per position: 3000 ml, Top plate Material: Stainless steel	7
3.	Digital pH meter	Digital pH Meter: Type: Microcontroller Based, Display: LED / LCD / Touch Screen, 3 digits, Calibration: up to 3 points with auto buffer, pH Range (pH): 0.00 to 14.00, +/- 0.05, Power Requirements: 230 V +/- 10, 50 Hz AC, Modes: pH mV- C, Temperature Compensation Type: Automatic, Temperature Compensation Range (Degree C): 0 to 100, Temperature Accuracy (Degree C): +/- 0.3, Resolution (pH): 0.01	8

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Engineering Chemistry	Jain & Jain	Dhanpat Rai Publishing Co.(P) Ltd., New Delhi, 2015, ISBN: 93-521-6000-2
2.	A Textbook of Engineering Chemistry	Dr S. S. Dara & Dr S. S. Umare	S. Chand & Co.(P) Ltd., New Delhi, 2014, ISBN:81-219-0359-9
3.	Textbook of Chemistry for Class XI & XII (Part-I & II)	NCERT	NCERT, New Delhi, 2017-18, Class-XI, ISBN: 81-7450-494-X (part-I), 81-7450-535-O (part-II), Class-XII, ISBN: 81-7450-648-9 (part-I), 81-7450-716-7 (part-II)
4.	A Textbook of Polymer Chemistry	Dr. M. S. Bhatnagar	S. Chand & Co.(P) Ltd., New Delhi, 2012, ISBN: 9788121941129
5.	Textile Science	E.P.G.Gohl & L.D. Vilensky	CBS, 2nd edition, ISBN-13: 978-8123910383
6.	Textile Auxiliaries and Chemicals with Processes & Formulations	Eiri Board	Engineers India Research Institute (1 December 2009), ISBN : 978-8186732939
7.	Applied Chemistry with Lab manual	Anju Rawlley Devdatta V. Saraf	Khanna Book Publishing Co. (P) Ltd. New Delhi, 2021, ISBN- 978-93-91505-44-8.

(b) Online Educational Resources:

1. https://ncert.nic.in/textbook/pdf/kech102.pdf
2. https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Chemical_Compounds/Introduction_to_Chemical_Bonding
3. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Electrochemistry/Redox_Chemistry/Balancing_Redox_reactions
4. https://www.onlinetextileacademy.com/basics-of-textile-fibres/
5. https://www.ancient-origins.net/history-famous-people/indian-sage-acharya-kanad-001399
6. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=31024
7. http://ecoursesonline.iasri.res.in/course/view.php?id=235

8. https://ncert.nic.in/textbook/pdf/lech206.pdf
9. https://www.canada.ca/en/conservation-institute/services/conservation-preservation-publications/canadian-conservation-institute-notes/identification-natural-fibres.html
10. https://www.sctce.ac.in/faculty/facultylogin/Admin/Attachments/Upload/1559025037_1559025037.pdf
11. https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Chemistry_for_Allied_Health_(Soult)/08%3A_Properties_of_Solutions/8.06%3A_The_pH_Concept
12. https://textilelearner.net/soap-and-micelle-in-textile-wet-processing/
13. https://textilelearner.net/stain-removal-techniques-from-clothes/
14. https://archive.epa.gov/water/archive/web/html/vms52.html
15. https://infinitabiotech.com/blog/overview-on-detergent-enzymes/
16. https://www.textileadvisor.com/2022/01/objectives-of-bleaching-process-types.html
17. https://textilelearner.net/different-types-of-dyes-with-chemical-structure/
18. https://ncert.nic.in/ncerts/l/lech205.pdf

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. Learning Packages
2. Lab Manuals
3. Manufacturers' Manual
4. Users' Guide

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A) Course Code : 2452104 (T2452104 / P2452104 /S2452104)

B) Course Title : Fundamentals of Garment Technology

C) Pre- requisite Course(s) :

D) Rationale :

The garment industry is competitive, cost-conscious and labour-intensive. Garments are the value-added products of Textiles. Human resource with sound technical knowledge is critical in order to get quality garments manufactured which can cater needs of local as well as the export market. This course on fundamentals of garment technology is designed to develop knowledge of different processes involved in the manufacturing of garments. After studying this course students will be able to identify the process, and, corelate the importance of input and output material of one process with another in order to produce a quality garment. The knowledge gained through this course will help students to acquire skill sets required for planning the production of a garment and also enable them to take up the courses of advanced garment manufacturing process in coming semester. This course aims not only on development of relevant competency in the area of garment manufacturing but also on the sustainability and social impact of the industry.

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.

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

CO-1 Select the various tools and processes used in garment production as per requirement.

CO-2 Select suitable fabric based on their characteristics for a particular garment.

CO-3 Suggest the various sections required for particular garment manufacturing in the industry.

CO-4 Identify machinery and equipment for a particular section in garment Industry.

CO-5 Modify the product/production layout based on requirement for specific product.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-		2	-	2	2		
CO-2	3	-	-	2	-	2	-		
CO-3	3	-	-	2	-	2	-		
CO-4	3	-	-	2	-	2	2		
CO-5	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:

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				
2452104	Fundamentals of Garment Technology	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:

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)	
2452104	Fundamentals of Garment Technology	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: T2452104

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Identify various processes used in the textile and garment industry. *TSO 1b.* Describe the process flow of the Garment Industry with a sketch *TSO 1c.* Describe the organizational structure of the garment industry. *TSO 1d.* Compare the Import-export capability of various countries w.r.t garment industry. *TSO 1e.* Analyse the challenges and suggest solutions for garment production establishment	**Unit-1.0 Overview of Garment Industry** *1.1.* Textile and Garment Industry, Importance of textile in Garment Manufacturing, Structure of Textiles and Clothing Industry. *1.2.* Global scenario of apparel manufacturing, Indian Prospects. *1.3.* Challenges in apparel production Technology. *1.4.* Role of various organizations, Future trends, Job Opportunities in Garment Industry	**CO1**
TSO 2a. Identify the different types of fibre used in garment manufacturing. *TSO 2b.* Describe the process flow of Yarn formation with a sketch *TSO 2c.* Differentiate between low, moderate and high twist yarn *TSO 2d.* Identify the different type of fabric based on their formation method. *TSO 2e.* Select suitable characteristics required for a fabric to be used for a particular garment.	**Unit-2.0 Raw Material for Garment Manufacturing** *2.1.* Textile Fibers: Classification, Properties and their significance. *2.2.* Yarn formation: Different stages: Blending, opening, picking, carding, drawing, roving, Spinning *2.3.* Twisting of yarn, Types of twist, Effect of twist on fabric, Yarn Specifications *2.4.* Fabric formation: Different Methods of fabric formation, Woven Fabrics, Knitted Fabrics, Matted Fabrics (Felted and Nonwoven), Leather and Furs etc., *2.5.* Fabric Characteristics for Apparel Manufacturing: Style, Hand, Visual, Utility, Durability etc.	**CO2**
TSO 3a. Explain Product development process of garments. *TSO 3b.* Compare the given garments based on their specification. *TSO 3c.* Select the product standard for local and export market based on requirement. *TSO 3d.* Explain the scope of Inventory management, Waste management, Human resource management in garment industry *TSO 3e.* Select the parameters to be inspected for a fabric required for particular garment application. *TSO 3f.* Identify different trims, closures and garment accessories.	**Unit-3.0 Product Development, Production Planning and Selection of Materials** 3.1 Product development in the Garment industry, Product-development models and product-development process, Garment product standards, specifications, quality assurance and product technical package, Measures for Garment product development. 3.2 Production planning and control in the Garment industry: Production planning, Production systems, Supply chain management, Inventory management, Waste management, Human resource management 3.3 Fabric sourcing and selection: Introduction, Fabric sourcing, Fabric inspection. 3.4 Garment accessories, trims, and closures	**CO3**
TSO 4a. Describe method of taking measurement of given body part. *TSO 4b.* Prepare a measurement chart for different sizes of garments for a particular brand. *TSO 4c.* Identify different pattern construction tool.	**Unit-4.0 Garment Design and Production** 4.1 Garment sizing and fit: Geometry of the human form, Body measurements and preparing measurement charts, Sizing and fit systems.	**CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4d. Describe with sketches the basic block of pattern construction. *TSO 4e.* Explain the fabric spreading process for the cutting. *TSO 4f.* Identify different type of basic stitches and seams used in garment. *TSO 4g.* Identify different type of needle used for stitching different type of garment.	4.2 Pattern construction: Introduction, Pattern construction modes, Body, material and design, Pattern construction tools. Marker Planning 4.3 Fabric spreading and cutting: Introduction, cut process planning, Spreading of textile materials, Cutting of textile materials, Final work operations of the cutting process 4.4 Sewing Operation: Introduction, Stitch forming Principle, Stitch classes, Seam types, Seam-neatening, Industrial Sewing Machine types, stitch formation. Sewing needles, Sewing threads, Sewing thread construction, ticket number. Alternative fabric-joining technologies	
TSO 5a. Explain the advantages of the given method of fusing *TSO 5b.* Explain the objective of pressing for garment. *TSO 5c.* Explain the importance of quality control in the garment manufacturing process. *TSO 5d.* Explain the requirement for final inspection in a garment industry. *TSO 5e.* Identify different type of care label used in garment industry. *TSO 5f.* Explain the roles of various components towards garment costing. *TSO 5g.* Calculate the cost of a given garment.	**Unit-5.0 Garment Finishing, Quality Control, Care Labelling and Costing** 5.1 Garment finishing for functionality, advantages & objectives, Fusing, Pressing, 5.2 Quality control in the apparel industry: Preproduction quality control, Defects in assembling, Defects during pressing and finishing, Final Inspection, General requirements for final inspection 5.3 Requirements of care labelling, Definition of care label, Care labelling systems 5.4 Costing need, Components contributing towards Garment costing: fabric cost, trims cost, labour cost, transport cost, over heads	**CO5**

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2452104

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Identify different type of fabric based on their manufacturing method. *LSO 1.2.* Calculate the basic construction parameter of the given sample.	1.	Fabric types	CO2
LSO 2.1. Identify different body parts to be measured for a particular garment. *LSO 2.2.* Take different body measurements.	2.	Body measurements	CO4
LSO 3.1. Identify different parts of basic blocks of a child shirt. *LSO 3.2.* Prepare the basic blocks for a child shirt.	3.	Basic blocks for child shirt	CO4
LSO 4.1. Identify different parts of basic blocks of a child T-shirt. *LSO 4.2.* Prepare the basic blocks for a child T-shirt.	4.	Basic blocks for child T-shirt	CO4
LSO 5.1. Identify different parts of basic blocks of a child bottom. *LSO 5.2.* Prepare the basic blocks for a child T-shirt.	5.	Basic blocks for child bottom	CO4
LSO 6.1. Prepare a marker plan for two shirt, two T-shirt and four bottom of Kids garment of given measurement. *LSO 6.2.* Adjust the setting of blocks in a marker to optimize the marker planning.	6.	Marker Plan for given garment	CO4
LSO 7.1. Arrange the spreading of fabric for given marker lay-up *LSO 7.2.* Modify the setting of blocks in a marker to optimize the marker planning.	7.	Folded marker plan	CO4
LSO 8.1. Calculate the fabric utilization for given garment.	8.	Marker efficiency	CO4
LSO 9.1. Identify the cutting tool. *LSO 9.2.* Use straight knife for cutting layers for the given blocks.	9.	Application of straight knife cutter	CO1
LSO 10.1. Identify the cutting tool. *LSO 10.2.* Use round knife for cutting layers for the given blocks.	10.	Application of round knife cutter.	CO1
LSO 11.1. Identify the different seam type used in garment manufacturing. *LSO 11.2.* Use the stitching machine for joining the fabrics.	11.	Superimposed and lapped seam Formation	CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 12.1. Identify the different Trims used in the garment. *LSO 12.2.* Identify the seam type used for Trim stitching in garment manufacturing.	12.	Attachment of Trims	CO5
LSO 13.1. Identify the different labels used in the garment. *LSO 13.2.* Identify the seam type used for label stitching in garment manufacturing.	13.	Labels for stitched garments	CO5

L) Suggested Term Work and Self Learning: S2452104 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. Visit nearby different garment industry and prepare a report containing flow chart of various processes used and list down the various tools used.
2. Collect the different types of fabric samples used in garment manufacturing and prepare a sample book.
3. Collect the specification of various machine/equipment/tools used in garment manufacturing and prepare a report containing details of their Model no, Company name, Manufacturing Locations and Price.

b. Micro Projects:

1. Collect different garments made from woven, knitted and nonwoven fabrics from local markets or home. Identify the different seams, stitches, and labels used in these garments.
2. Prepare a measurement chart for 50 students for a shirt.
3. Collect the sewing thread samples of different companies and identify the thread composition, twist direction, TPI, Ticket no, and type of package.
4. Collect 5 videos of different types of cutting machine used in the garment Industry and prepare a report.
5. Collect 5 Videos of different stitching machine used to form different seam and stitches and present before the class.

c. Other Activities:

1. Seminar Topics:

    - Modern fabric-cutting tools used in Garment Industries.
    - Modern add-ons for a single needle sewing machine.
    - Alternative fabric-joining technologies.
    - Defects in garment manufacturing.
    - Care labels for export garments.

2. Visits: Visit nearby industry with Garment manufacturing facilities. Prepare a report of visit with special comments on Cutting, stitching, and finishing machines used, material used, garment produced in production, and cost of the produced Garment.
3. Self-Learning Topics:
    - Problems during cutting of multilayer of fabrics and their remedies
    - New developments in Garment Industry.
    - Stitching of Knitted fabrics.
    - Costing calculations for production of a shirt.

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%	15%	20%	-	40%	20%
CO-2	10%	20%	10%	20%	-	10%	20%
CO-3	15%	20%	15%	20%	33%	15%	20%
CO-4	30%	20%	30%	20%	33%	15%	20%
CO-5	30%	20%	30%	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 percentages 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 Overview of Garment Industry	8	CO1	14	4	4	6
Unit-2.0 Raw Material for Garment Manufacturing	8	CO2	14	4	4	6
Unit-3.0 Product development, production planning and selection of materials	8	CO3	14	4	4	6
Unit-4.0 Garment design and production	12	CO4	14	4	4	6
Unit-5.0 Garment finishing, quality control, care labelling and costing	12	CO5	14	4	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.	Fabric types	CO2	50	40	10
2.	Body measurements	CO4	50	40	10
3.	Basic blocks for child shirt	CO4	50	40	10
4.	Basic blocks for child T-shirt	CO4	50	40	10
5.	Basic blocks for child bottom	CO4	50	40	10
6.	Basic blocks for child bottom	CO4	50	40	10
7.	Folded marker plan	CO4	50	40	10
8.	Marker efficiency	CO4	50	40	10
9.	Application of straight knife cutter	CO1	50	40	10
10.	Application of round knife cutter.	CO1	50	40	10
11.	Superimposed and lapped seam Formation	CO4	50	40	10
12.	Attachment of Trims	CO5	50	40	10
13.	Labels for stitched garments	CO5	50	40	10

Legend:
PRA*: Process Assessment
PDA**: Product Assessment

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ ImplementationStrategies 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.	Mannequin	Mannequin of boy, girl, man and women	2,3,4 & 5
2.	Tailoring Tape	Tailoring Tape T – flexible 5 ft	3,4,5,6,7,9
3.	Scales	Scale : Metal 1 meter, Set squares : wooden/plastic, French curves : wooden/plastic,	3,4,5,6,7
4	Marker tool	pattern paper, pins, pencils, Scissors : Heavy duty metallic, Marker Chalk	3,4,5,6,7
5	Cutting Table, drill and knotcher	Cutting table , Fabric drill and knotcher : 220V, 1P, 0.20 HP, drill depth =6”	9,10
6	Cutting Knife	Straight Knife cutting machine round blade cutting machine	9,10
7	Sewing Machine,	Sewing Machine : Max. sewing speed 4,000sti/min Max. stitch length 7mm(normal/reverse feed) Needle bar stroke 35mm Feed dog 3-row Sewing Thread	11, 12

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Garment Manufacturing Technology	Rajkishore Nayak Rajiv Padhye	Woodhead Publishing, 2015, ISBN: 978-1-78242-232-7
2.	Apparel Manufacturing Technology	T. Karthik P. Ganesan D. Gopalakrishnan	CRC Press, Taylor & Francis Ltd, 2017 ISBN: 13: 978-1-4987-6375-2
3.	The Technology of Clothing Manufacture	Harold Carr and Barbara Lathan	Wiley-Blackwell; 4th edition, 2008 ISBN: 13 : 978-1405161985
4.	Garment Technology for Fashion Designer	Gerry Cooklin	Wiley-Blackwell, 2012 ISBN: 978-1-405-19974-2
5.	Quality Characterisation of apparel	Dr Subrata Das	Woodhead Publishing India (P) Ltd 2009; ISBN-13 : 978-81-908001-3-6

(b) Online Educational Resources:

1. https://www.onlineclothingstudy.com/2017/07/garment-manufacturing-process-fabric-to-fashion.html
2. https://in.apparelresources.com/business-news/manufacturing/productivity-apparel-manufacturing-back-basics/
3. https://www.youtube.com/watch?v=sLb59LdvUjg
4. https://www.youtube.com/watch?v=5nUjGNDImIk
5. https://www.youtube.com/watch?v=QaS4sI0n5Qg
6. https://www.juki.co.jp/en/products/industrial/

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. International Journal of Clothing Science and Technology, Emerald Publishing Limited, ISSN: 0955-6222
2. Guide To Basic Garment Assembly For The Fashion Industry; Jayne Smith; Wiley-Blackwell 2013; ISBN-13 : 978-1-405-19888-2
3. Singer Stitching Machine Users' Guide
4. Juki Stitching Machine product brochures
5. Lab Manuals

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A) Course Code : 2400105D (T2400105D / S2400105D)

B) Course Title : Applied Mathematics -D (CACDDM, FCT, TE, GT, FPP)

C) Prerequisite Course(s) : Algebra, Trigonometry, Coordinate Geometry

D) Rationale :

Mathematics is the core course to develop the competencies of most of the technological courses. It provides students with a fundamental understanding of mathematical principles and concepts necessary for solving engineering problems. Textile engineering and allied programs involve dealing with various quantitative aspects, including measurements, material properties, production data, and quality control. Proficiency in basic engineering mathematics enables students to analyze and interpret these quantitative data accurately. Statistical methods are useful to evaluate and optimize textile processes, conduct experiments, analyze experimental data, and make data-driven decisions for process improvement and quality enhancement. The application of basic engineering mathematics in various aspects of textile engineering, including problem-solving, quantitative analysis, design, optimization, and computer-aided tools, makes this course an indispensable subject for aspiring textile engineers. The course provides an insight to analyze engineering problems scientifically using differentiation, trigonometry, coordinate geometry, mensuration, and statistics.

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 classroom/laboratory/workshop/field/ industry.

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

- **CO-1** Demonstrate the ability to solve branch-specific engineering-related problems using applications of differentiation.
- **CO-2** Demonstrate the ability to algebraically analyze basic functions using Trigonometry.
- **CO-3** Solve engineering-related problems based on Straight lines.
- **CO-4** Solve the problems based on measurements of regular close figures and regular solids.
- **CO-5** Apply the concept of statistics to solve engineering-related problems.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Program 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	-	-	-	-	-	-		
CO-2	3	1	1	-	-	-	-		
CO-3	2	1	-	-	-	-	-		
CO-4	3	1	-	-	-	-	1		
CO-5	3	2	-	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:

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				
2400105D	Applied Mathematics - D	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= (1xCIhours) + (0.5xLIhours) + (0.5xNotionalhours)

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:

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)	
2400105D	Applied Mathematics - D	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 of 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: T2400105D

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Apply the working rules and standard forms of differentiation to find the derivative of simple functions. *TSO 1b.* Invoke the concept of the Chain rule to find the derivative of simple functions. *TSO 1c.* Apply the concept and rules of derivative to solve the problems related to the velocity and acceleration of a given simple function. *TSO 1d.* Apply the concept and rules of derivative to solve the problems related to the maxima-minima of a given simple function.	**Unit-1.0 Differentiation and its Applications** 1.1. Concept and Definition of Differentiation. 1.2. Working rules, sum, products, division. 1.3. Chain rules. 1.4. Applications: velocity, acceleration, maxima minima of the given function.	**CO1**
TSO 2a. Apply the concept of compound angle, allied angle, and multiple angles to solve the given simple engineering problems. *TSO 2b.* Apply the concept of Sub-multiple angles to solve the given simple engineering problems. *TSO 2c.* Employ the concept of factorization and de-factorization formulae to solve the given simple engineering problems. *TSO 2d.* Use concepts given in Ancient Indian Mathematics for trigonometry to solve given problems. (IKS)	**Unit-2.0 Trigonometry** 2.1 Trigonometric ratios of compound, allied, multiple, and sub-multiple angles (without proof). 2.2 Factorization and de-factorization formula (without proofs). 2.3 Trigonometry in Indian Knowledge System: The Evolution of Sine Function in India. 2.4 Indian Trigonometry: Basic Indian Trigonometry- Introduction and Terminology (From Ancient Beginnings to Nilakantha). (IKS) 2.5 Trigonometry in Indian Knowledge System: Pythagorean triples in Sulabasutras. (IKS)	**CO2**
TSO 3a. Calculate the angle between the given two straight lines. *TSO 3b.* Formulate an equation of straight lines related to given engineering problems. *TSO 3c.* Identify the perpendicular distance from the given point to the line. *TSO 3d.* Calculate the perpendicular distance between the given two parallel lines. *TSO 3e.* Use the geometry given in Sulabasutras to solve the given problems. (IKS)	**Unit-3.0 Straight line** 3.1 Straight line and slope of a straight line. a. Angle between two lines. b. Condition of parallel and perpendicular lines 3.2 Various forms of straight lines. a. Slope-point form, two-point form b. Slope-intercept form, Intercept-intercept form c. General form d. The perpendicular distance from a point to the line. e. Perpendicular distance between two parallel lines. 3.3 Geometry in Sulabasutras in Indian Knowledge System (construction of the square, circling the square). (Indian Mathematics). (IKS)	**CO3**
TSO 4a. Calculate the area of the given triangle and circle Identify the isomorphic graphs. *TSO 4b.* Determine the area of the given square parallelogram, Rhombus, and Trapezium. *TSO 4c.* Compute the surface area of the given Cuboids, spheres, Cones, and Cylinders. *TSO 4d.* Determine the volume of given Cuboids, Sphere, Cone, and Cylinder.	**Unit-4.0 Mensuration** 4.1 Area of regular Closed figures, Area of Triangle, Square Parallelogram, Rhombus, Trapezium, and Circle. 4.2 Volume of Cuboids, Cone, Cylinder, and Sphere.	**CO4**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5a. Obtain the range and coefficient of range of the given grouped and ungrouped data. *TSO 5b.* Calculate means and standard deviation of discreet and grouped data related to the given simple engineering problems. *TSO 5c.* Define Common causes and Special causes. *TSO 5d.* Define Upper control limit and Lower control limit. *TSO 5e.* Implement control charting to assess process stability. *TSO 5f.* Determine the appropriate type of chart for a given process.	**Unit-5.0 Statistics** 5.1 Range, coefficient of range of discrete and grouped data. 5.2 Mean deviation and standard deviation from the mean of grouped and ungrouped data, weighted means. 5.3 SPC (Statistical Process Control) and significance. 5.4 Histograms and Charts. 5.5 Common causes and Special causes. 5.6 Control limits (Upper control limit and Lower control limit).	**CO5**

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

K) Suggested Tutorial and Outcomes:

Outcomes	S. No.	Tutorial Titles	Relevant COs Number(s)
1.1 Apply differentiation to determine the parameters of the fabric to achieve the desired strength. 1.2 Use the concept of differentiation to calculate the parameters of the fabric to achieve the desired shrinkage. 1.3 Calculate desired thermal conductivity of the fabric that needs to be adjusted, using the concept of differentiation. 1.4 Use differentiation to calculate the parameters of the fabric that need to be adjusted to achieve the desired air permeability. 1.5 Apply differentiation to solve given problems based on the Food Industry.	1.	• Application of differentiation for determining desired strength. • Differentiation and its applications for determining desired shrinkage. • Application of differentiation for determining thermal conductivity. • Differentiation and its applications for determining desired air permeability. • Application of differentiation in the Food industry.	CO1
2.1. Measure the angles of two pieces of fabric and calculate the angle at which the seam needs to be sewn to be perfectly straight. *2.2.* Measure the angle of a fabric roll and calculate the angle of the roll. *2.3.* Measure the length of the conveyor belt for a given angle of the frame. *2.4.* Calculate the circumference of the circle by measuring the radius of a piece of fabric.	2.	• Applications of measuring angles. • Applications of measuring length. • Applications of calculating circumferences.	CO2
3.1 Calculate the amount of fabric required to make a garment with specific measurements. 3.2 Calculate the finished length of a fabric after making a certain number of pleats. 3.3 Make a particular style of garment by calculating the total yardage of fabric needed.	3.	• Applications of measuring length. • Applications of finding slope. • Applications of computing perpendicular distance.	CO3

Outcomes	S. No.	Tutorial Titles	Relevant COs Number(s)
3.4 Estimate the number of ems and seams needed to finish a garment. 3.5 Calculate the total yardage of fabric needed to make a particular style of garment.			
4.1 Calculate the area of a fabric piece given the measurements of length and width. 4.2 Calculate the area of a fabric piece given the measurements of length and width. 4.3 Calculate the weight of a cylindrical fabric piece given the measurements of radius, height, and density. 4.4 Calculate the Weight of a cuboid fabric piece given the measurements of length width, height, and density.	4.	• Applications of calculating area. • Applications of calculating weight.	CO4
5.1 Create a frequency distribution table for the number of textile engineering diploma students in a class. 5.2 Create a distribution graph (bar graph) to illustrate the number of textile engineering diploma students in a class. 5.3 Calculate the mean, median, mode, and range of the number of textile engineering diploma students in a class. 5.4 Explain the difference between a population and a sample in the context of textile engineering diploma students in a class. 5.5 Calculate the standard deviation for the number of textile engineering diploma students in a class.	5.	• Applications of frequency distribution. • Applications of mean, median, and mode. • Applications of calculating standard deviation.	CO5

L) Suggested Term Work and Self-Learning: S2400105D 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

1. Use differentiation to determine the rate at which dye is absorbed by the textile material.
2. Use Differential calculus to model and optimize the tensile strength of fabric based on the relationship between fabric composition, weave structure, and tensile strength.
3. Apply Trigonometric functions to create patterns like stripes, checks, or circular designs. Explain the relationship between the function parameters and resulting fabric pattern characteristics.
4. Use Library resources to find various applications of trigonometry in designing food processing equipment.
5. Use Library resources to find various applications of straight lines in fabric inspection to detect distortions or irregularities in woven or knitted fabrics.
6. Prepare a handout and a PDF file on the role of straight lines in assembling and decorating food products such as cakes or Sandwiches.
7. Employ mensuration to calculate fabric weight and Fabric Consumption and prepare a file.

8. Use the concept of mensuration for pattern layout optimization and present the findings.
9. Prepare a write-up on the role of statistical process control in identifying and addressing variations in textile production processes.
10. Prepare a presentation on the role of statistics in the nutritional analysis of food products. Discuss the use of statistical techniques to analyze and interpret data related to nutrient content, dietary intake, and health outcomes.

b. Micro Projects:

1. Prepare charts displaying various standard differential formulas.
2. Explore the use of differential calculus to calculate the velocity and acceleration of a particle.
3. Calculate the rate of change of the temperature and plot its graph.
4. Calculate profit and loss concerning business using graphs.
5. Prepare charts showing the area and volume of various geometrical shapes using mensuration.
6. Draw the graph of the Trigonometric ratio on a chart paper and verify using suitable open-source software.
7. Prepare a model showing the area of different geometrical shapes.
8. Prepare a simulated environment to study the 2D-printing under the influence of coordinate geometry.
9. Prepare a chart consisting of the surface area of cuboids, spheres, cones, and cylinders as their real-life application.
10. Download 5-7 videos based on mean deviation for group data and ungrouped data, watch them, and write a report to detail the mathematical steps involved.
11. Make a short video of duration 5-7 minutes for the use of Laplace transform to calculate the response of a system to an input signal.
12. Download 5-7 videos based on the application of Statistical process control to understand the process of manufacturing products and write a report to detail the mathematical steps involved.
13. Make a short video of duration 10-15 minutes on the engineering application of statistical process control especially in production units in the textile industry.

c. Other Activities:

1. Seminar Topics:
    - Sustainable Textile Manufacturing: Challenges and Opportunities
    - Smart Textiles and Wearable Technology
    - Nanotechnology in Textiles: Advancements and Applications
    - Digital Printing Techniques for Textile Design
    - Innovations in Textile Dyeing and Finishing Processes
    - Advances in Textile Testing and Quality Control
    - Eco-Friendly Textile Fibers: Development and Utilization
    - Trends in Textile Fashion Design and Forecasting
    - Textile Supply Chain Management: Optimization and Logistics
    - Surface Modification Techniques for Textile Material
    - Textile Engineering for Sustainable Apparel Production
    - Future Prospects of 3D Printing in Textile Manufacturing

2. Visits: Visiting the following places would provide students an opportunity to see the application of various branches of mathematics in different fields. This will also help students to comprehend the career opportunities available in the field of mathematics.
    - Visit to a mathematics museum.
    - Visit a mathematics research institute.
    - Visit to a mathematics laboratory.
    - Visit to a Data Science Center.
    - Visit the mathematics department of a college or university.
    - Visit a nearby Textile Industry.
    - Visit to a Space Agency.
    - Visit to a Game Studio.

3. Self-Learning Topics:
    - Applications of differentiation (optimization, rates of change)
    - Statistical inference (confidence intervals, hypothesis testing)
    - Systems of linear equations and their solutions
    - Yarn calculations (count systems, conversions)
    - Fabric calculations (linear density, fabric weight)
    - Statistical analysis of textile data

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%	10%	20%	10%	-	-
CO-2	10%	10%	10%	20%	10%	-	-
CO-3	20%	20%	20%	20%	25%	-	-
CO-4	25%	25%	25%	20%	25%	-	-
CO-5	35%	35%	35%	20%	30%	-	-
Total Marks	**30**	**70**	**20**	**20**	**10**	**-**	**-**
			50				

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The percentages 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 of 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 Differentiation and its Applications	8	CO1	08	2	4	2
Unit-2.0 Trigonometry	8	CO2	08	2	4	2
Unit-3.0 Straight line	10	CO3	14	4	6	4
Unit-4.0 Mensuration	8	CO4	18	6	6	6
Unit-5.0 Statistics	14	CO5	22	6	8	8
Total	**48**	**-**	**70**	**20**	**28**	**22**

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

O) Suggested AssessmentTable for Laboratory (Practical): (Not Applicable)

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Field Trips, Portfolios, 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:

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	High-end computers	Processor Intel Core i7 with Compilers and Programming Languages, RAM 32GB, DDR3/DDR4, HDD 500 GB, OSWindows10	All
2.	Software	Scientific Calculators, Graphing Calculator, SCILAB, GraphEq^2.13, Microsoft Mathematics, GeoGebra, Math3D	1,2,3,4,5
3.	Printer	High-Speed Duplex Printer	4,5
4.	Scanner	Handheld 3D scanner, Accuracy up to 0.1mm, Resolution up to 0.2 mm, Wireless technology with an in-built touchscreen and battery, Extended field of view for capturing both large and small objects	4,5

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Elementary Engineering Mathematics	B. S. Grewal	Khanna Publishers,15th Edition. ISBN: 978-81-7409-257-1
2.	Engineering Mathematics (Third edition)	Croft, Anthony	Pearson Education, New Delhi, 2014. ISBN 978-81-317-2605-1
3.	Calculus and Its Applications	Marvin L. Bittinger David J. Ellenbogen Scott A. Surgent	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
4.	Calculus and Analytic Geometry	G. B. Thomas, R. L. Finney	Addison Wesley, 9th Edition, 1995. ISBN 978-8174906168
5.	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publ., New Delhi,2014, ISBN: 978-0-470-45836-5
6.	Understanding Engineering Mathematics	John Bird	Routledge; First Edition ISBN 978-0415662840
7.	Indian Mathematics Engaging with the World from Ancient to Modern Times	George Gheverghese Joseph	World Scientific Publishing Europe Ltd. 57ISBN 978-17-86340-61-0
8.	A Modern Introduction to Ancient Indian Mathematics	T.S. Bhanumurthy	New Age International Private Limited, 1 January 2008 ISBN- 10. 812242600X, ISBN- 13. 978-8122426007
9.	Mathematics-I	Deepak Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-42-4
10.	Mathematics-II	Garima Singh	Khanna Book Publishing Co. (P) Ltd. ISBN: 978-93-91505-52-3
11.	Sansar Ke Mahan Ganitagya	Gunakar Muley	First Edition, Rajkamal Prakashan, ISBN-10. 8126703571, ISBN-13. 978-8126703579.
12.	Consider Dimension and Replace Pi	M.P. Trivedi and P.Y. Trivedi	Notion Press; 1st edition (2018), ISBN: 978-1644291795

(b) Online Educational Resources:

1. https://ocw.mit.edu/
2. https://tutorial.math.lamar.edu/
3. https://www.khanacademy.org/
4. https://www.feynmanlectures.caltech.edu/
5. https://www.wolframalpha.com/
6. https://www.dplot.com/
7. https://www.geogebra.org/
8. https://www.easycalculation.com/
9. https://www.scilab.org/
10. https://www.desmos.com/
11. https://nptel.ac.in/
12. https://swayam.gov.in/
13. https://ndl.iitkgp.ac.in/
14. https://parakh.aicte-india.org/
15. https://ekumbh.aicte-india.org/
16. https://learnengg.com/LE/Index

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. Online Mathematics Courses.
2. Mathematics Communities and Forums.
3. Mathematics Journals.
4. Mathematics Podcast.
5. Mathematics Tutorials.
6. Mathematics Quizzes.
7. Mathematics Animation.
8. Mathematics Simulations.
9. Mathematics Games.
10. Mathematics Puzzles.
11. Mathematics Brain Teasers.
12. Mathematics Apps.
13. Mathematics Blog.

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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/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	3	-	-	-	2	-	2		
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:

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:

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.* Explain 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 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	**CO3**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	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

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
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	20%	-	15%	-	-	20%	20%
CO-2	10%	-	10%	-	-	10%	20%
CO-3	15%	-	15%	-	-	15%	20%
CO-4	25%	-	30%	-	-	15%	20%
CO-5	30%	-	30%	-	-	40%	20%
Total Marks	**15**	**-**	**10**	**-**	**-**	**10**	**15**
			10				

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

Note:
- The percentages 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
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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
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:

(b) 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:

1. www.nptel.iitm.ac.in
2. www.khanacademy

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A) Course Code **: 2452107 (T2452107)**

B) Course Title **:** Basics of Liberal Art (Non-Exam Course) (FTS, GT, TE, MIE)

C) Pre- requisite Course(s) **:**

D) Rationale **:**

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

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

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

CO-1 Demonstrate knowledge of key concepts and theories in literature, history, philosophy, and social sciences.

CO-2 Apply critical thinking skills to evaluate and assess information from diverse sources.

CO-3 Use creative thinking to perform disruptive engineering tasks.

F) Suggested Course Articulation Matrix (CAM):

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	**PO-2** Problem Analysis	**PO-3** Design/ Development of Solutions	**PO-4** Engineering Tools	**PO-5** Engineering Practices for Society, Sustainability and Environment	**PO-6** Project Management	**PO-7** Life Long Learning	**PSO-1**	**PSO-2**
CO-1	-	-	-	-	3	1	3		
CO-2	-	-	1	-	3	1	3		
CO-3	-	-	1	-	3	1	3		

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

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

G) Teaching & Learning Scheme:

Course code	Course Title	Scheme of Study (Hours/Week)				
		Classroom Instruction (CI)		Notional Hours (TW+ SL)	Total Hours (CI+TW)	Total Credits (C)
		L	T			
2452107	Basics of Liberal Art	01	-	-	01	01

Legend:

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

LI: Laboratory Instruction (Includes experiments/practical performances /problem-based experiences in laboratory, workshop,

field or other locations using different instructional/Implementation strategies)

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

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

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

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

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

H) Assessment Scheme:

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)	
2452107	Basics of Liberal Art	25	-	-	-	-	-	25

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

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

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Define the concept of liberal arts and its significance. *TSO 1b.* Identify the different disciplines encompassed by liberal arts. *TSO 1c.* Describe the historical development and evolution of liberal arts.	**Unit-1.0 Introduction to Liberal Arts** 1.1. Definition and significance of liberal arts 1.2. Historical development and evolution of liberal arts 1.3. Overview of interdisciplinary approaches in liberal arts 1.4. Liberal arts education and its benefit	**CO1**
TSO 2a. Analyze information and arguments is essential for success in liberal arts. *TSO 2b.* Analyze assumptions and identify biases *TSO 2c.* Draw logical conclusions from the evidence.	**Unit-2.0 Critical Thinking** 2.1 The Role of Critical Thinking in Liberal Arts Education 2.2 Arguments in Liberal Arts Disciplines, Information Assumptions, biases 2.3 Critical Thinking and Interpretation, logical conclusions from the evidence 2.4 Media Literacy and Critical Thinking in the Digital Age	**CO1, CO2**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 3a. Devise original ideas and interpretations in give situation *TSO 3b.* Use new and unconventional approaches to problem-solving. *TSO 3c.* Use both primary and secondary sources effectively.	**Unit-3.0 Creativity** 3.1 Creative Thinking Skills in Education 3.2 Primary and Secondary Sources in Research for Academic Studies 3.3 Critical Thinking in Research: A Focus on Higher Education 3.4 Innovative Approaches to Analysis in Different Academic Fields 3.5 Collaborative Research in Academic Settings 3.6 Feel free to let me know if you would like further information or if you have any other specific requests! 3.7 FDM based 3D printing process details. 3.8 Conduct research, Sources of information. 3.9 Primary and secondary data sources.	**CO1, CO3**

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

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

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

b. Micro Projects:

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

c. Other Activities:

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

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

L) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

M) Suggested Learning Resources:

(a) Books:

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

(b) Online Educational Resources:

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

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

(c) Others:

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

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A) Course Code : **2400108 (T2400108)**

B) Course Title : Essence of Indian Knowledge System and Tradition
(Common for all Programmes)

C) Pre- requisite Course(s) :

D) Rationale :

This course will survey the basic structure and operative dimensions of Indian knowledge system. With the new education policy-NEP 2020 focusing on Indian Knowledge Systems (IKS) and Traditions of India. This course introduces the learners to the rich and varied knowledge traditions of India from antiquity to the present. This also helps the learner to know and understand their own systems and traditions which are imperative for any real development and progress. Also, it helps the learner to think independently and originally adopting Indian frameworks and models for solving the problems related to world of work where the student is supposed to perform.

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

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

CO-1 Identify the rich heritage and legacy residing in our Indian Knowledge systems.

CO-2 Correlate the technological & philosophical concepts of IKS with engineering domain specific problems and local problems for finding out possible solutions.

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

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

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

G) Teaching & Learning Scheme:

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				
2400108	Essence of Indian Knowledge System and Tradition	01	-	-	-	01	01

Legend:

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

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

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

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

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

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

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

H) Assessment Scheme:

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)	
2400108	Essence of Indian Knowledge System and Tradition	25	-	-	-	-	-	25

Legend:

PTA: Progressive Theory Assessment in 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 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: T2400108

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Explain the architecture of the Ancient Indian Knowledge Systems. *TSO 1b.* List the salient features of IKS. *TSO 1c.* Comprehend the given IKS model. *TSO 1d.* Identify the role and relevance of the given IKS model in contemporary society.	**Unit-1.0 Introduction to Indian Knowledge Systems** 1.1 Overview of IKS 1.2 Organization of IKS – □□□□□□□-□□□□□□□□□□□□□ 1.3 Conception and Constitution of Knowledge in Indian Tradition 1.4 The Oral Tradition 1.5 Models and Strategies of IKS	**CO1**
TSO 2a. Enlist the importance of Veda, Vedanga, Visaya, Siksaka. *TSO 2b.* Describe the given IKS domain. *TSO 2c.* Identify elements of mentioned IKS domains that are relevant to Technical Education System. *TSO 2d.* Correlate the elements of mentioned IKS domains with given engineering domain.	**Unit-2.0 Overview of IKS Domains and Relevance in Current Technical Education System.** 2.1 The Vedas as the basis of IKS 2.2 Overview of all the six Vedāṅgas 2.3 Relevance of following IKS domains in present Technical Education System: • Arthashastra (Indian economics and political systems) • Ganita and Jyamiti (Indian Mathematics, Astronomy and Geometry • Rasayana (Indian Chemical Sciences) • Ayurveda (Indian Biological Sciences / Diet & Nutrition) • Jyotish Vidya (Observational astronomy and calendar systems) • Prakriti Vidya (Indian system of Terrestrial/ Material Sciences/ Ecology and Atmospheric Sciences) • Vastu Vidya (Indian system of Aesthetics- Iconography and built-environment /Architecture) • Nyaya Shastra (Indian systems of Social Ethics, Logic and Law) • Shilpa and Natya Shastra (Indian Classical Arts: Performing and Fine Arts) • Sankhya and Yoga Darshna (Indian psychology, Yoga and consciousness studies) • Vrikshayurveda (Plant Science / Sustainable agriculture/food preservation methods)	**CO1, CO2**

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

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

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

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

b. Micro Projects:

1. Write a report on any IKS domain highlighting the correlation with one domain specific engineering course.

c. Other Activities:

1. Seminar Topics: discuss any one IKS domain in details a highlighting the eminent works in the area.

2. Visits:

- Visit any nearby ancient temple and corelate the geomatical, Shilpa and Vaastu on IKS dimensions specified in each domain.

3. Self-Learning Topics:

- Sustainable practices adopted in ancient India that can be applied for current engineering situations.

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	-	-	-	-	-	-	-
CO-2	100%	-	-	-	-	-	-
Total Marks	**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 percentages 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 AssessmentTable for Laboratory (Practical): (Not Applicable)

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

Q) List of Major Laboratory Equipment, Tools and Software: (Not Applicable)

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Indian Knowledge System: Concepts and Applications	Archak, K.B. (2012).	Kaveri Books, New Delhi
2.	Introduction to Indian Knowledge System: Concepts and Applications	Mahadevan, B. Bhat, Vinayak Rajat Nagendra Pavana R.N.	PHI, ISBN: 9789391818203
3.	Glimpse into Kautilya's Arthashastra	Ramachandrudu P. (2010)	Sanskrit Academy, Hyderabad
4.	"Introduction" in Studies in Epics and Purāṇas, (Eds.)	KM Munshi and N Chandrashekara Aiyer	Bhartiya Vidya Bhavan

(c) Online Educational Resources:

1. http://bhavana.org.in
2. www.academia.edu/23254393/Science_in_Ancient_India_-_an_educational_module
3. www.academia.edu/23305766/Technology_in_Ancient_India_-_Michel_Danino
4. www.hamsi.org.nz/http://insaindia.res.in/journals/ijhs.php
5. www.niscair.res.in/sciencecommunication/ResearchJournals/rejour/ijtk/ijtk0.asp
6. www-history.mcs.st-andrews.ac.uk/Indexes/Indians.html

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(d) others:

1. Swami Harshananda. "A bird's eye view of vedas". R K Math. Bangalore.,http:// rkmathbangalore. org/Books/ABirdsEyeViewOfTheVedas.pdf.
2. Sanskrit Prosody, https://en.wikipedia.org/wiki/Sanskrit_prosody.
3. Vartak, P.V. (1995). "Veda and Jyotish," Part II, Chapter 2, in Issues in Veda and Astrology, H Pandya (Ed.), pp 65 – 73.
4. Sundaram, A.V. (1995). "Astrology: Its usefulness and Limitations in ModernTimes", Part II, Chapter 9, in Issues in Veda and Astrology, H Pandya (Ed.), pp 129 – 135.
5. Archak, K.B. (2012), "The Vedāṅga Literature", Chapter VIII in Essentials of Vedic Literature, Kaveri Books, New Delhi, pp 330 – 391.
6. Vasant Lad (1996), "Ayurveda: A Brief Introduction and Guide", (whole article).

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