

Curriculum of Diploma Programme

in

Fashion & Clothing Technology



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

**State Board of Technical Education
(SBTE), Bihar**

Semester –VI

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				
2451601	PCC	Clothing Production Machinery, Equipment & Industrial Safety	03	-	04	02	09	06
2451603	PEC	Programme Elective* – Any One	03	-	04	02	09	06
2400604	OEC	Open Elective**/ COE Any One (Advanced- Any One)	03	-	04	02	09	06
2451605	PSI	Major Project (Common for all programmes)	-	-	08	04	12	06
2400505	NRC	Entrepreneurship Development & Start-ups (Common for All Programmes)	-	-	04	02	06	03
2451606	PCC	Computer Aided Design in Fashion and Clothing	-	-	04	02	06	03
Total			09	-	28	14	51	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)
- *: Advanced Apparel, Fashion portfolio, Fashion styling, Garment Exports & Documentation, Special purpose clothing, Visual Merchandising, Apparel Merchandising, Smart Textiles
- ** : 3D printing and design/ AI/ Drone Technology/ Electric Vehicle/ Industrial Automation/ IOT/ Robotics/Transformer Manufacturing and Repairing/Optical Fiber and 5G Communication
- 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 –VI 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)	
2451601	PCC	Clothing Production Machinery, Equipment & Industrial Safety	30	70	20	30	20	30	200
2451603	PEC	Programme Elective* – Any One	30	70	20	30	20	30	200
2400604	OEC	Open Elective**/ COE Any One (Advanced- Any One)	30	70	20	30	20	30	200
2451605	PSI	Major Project (Common for all programmes)	-	-	20	30	50	100	200
2400505	NRC	Entrepreneurship Development & Start-ups (Common for All Programmes)	-	-	20	30	20	30	100
2451606	PCC	Computer Aided Design in Fashion and Clothing	-	-	20	30	20	30	100
Total			90	210	120	180	150	250	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.

*: Advanced Apparel, Fashion portfolio, Fashion styling, Garment Exports & Documentation, Special purpose clothing, Visual Merchandising, Apparel Merchandising, Smart Textiles

** : 3D printing and design/ AI/ Drone Technology/ Electric Vehicle/ Industrial Automation/ IOT/ Robotics/Transformer Manufacturing and Repairing/Optical Fiber and 5G Communication

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** : 2451601 (T2451601/P2451601/S2451601)
- B) **Course Title** : Clothing Production Machinery, Equipment & Industrial Safety
- C) **Pre- requisite Course(s)** : Resource Management in Garment Manufacturing, Fabric Construction, Knitted and Non-woven fabric Construction
- D) **Rationale** :
The Garment manufacturing process requires numerous processes, machineries & equipment for their manufacture. This course introduces these machineries & equipment with uses, their assemblies & parts in detail. Students will learn the sequence of different steps of processes in the apparel industry and perform operations on different sewing machine settings which will help them to work effectively in industry for production of garments. Students will also learn about various process wise safety measures to avoid probable damages.
- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the accomplishment of following course outcomes by the learners. For this, the learners are expected to perform various activities related to three learning domains (Cognitive, Psychomotor and Affective) in classroom/ laboratory/ workshop/ field/ industry.

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

- CO-1** Identify steps of production process in apparel industry.
- CO-2** Develop marker plan to spread the layer for mass production.
- CO-3** Cut the garment components accurately using relevant cutting tool.
- CO-4** Use a relevant sewing machine and work aids to stitch specified garment.
- CO-5** Apply fusing and pressing equipment to finish the garment.
- CO-6** Implement safety measures in the garment manufacturing industry.

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	-	3	3	3	3	3		
CO-2	3	2	3	3	3	3	3		
CO-3	3	3	3	3	3	3	3		
CO-4	3	3	3	3	3	3	3		
CO-5	3	-	3	3	3	3	3		
CO-6	3	3	3	3	3	3	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)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2451601	Clothing Production Machinery, Equipment & Industrial Safety	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)	
2451601	Clothing Production Machinery, Equipment & Industrial Safety	30	70	20	30	20	30	200

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: T2451601**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Enlist salient features of apparel manufacturing industry.</p> <p><i>TSO 1b.</i> Draw process flow chart for specified apparel industry</p> <p><i>TSO 1c.</i> Describe functions of different departments in apparel industry.</p> <p><i>TSO 1d.</i> State uses of different samples in apparel industry.</p>	<p>Unit-1.0 Introduction to Apparel Manufacturing</p> <p>1.1 Salient features of Apparel industry.</p> <p>1.2 Process flow in apparel industry.</p> <p>1.3 Pre- Production, Production and Post- Production Process in Garment Industry</p> <p>1.4 Functions in cutting, sewing and finishing departments.</p> <p>1.5 Types of samples in apparel industry.</p>	CO1
<p><i>TSO 2a.</i> Justify objectives of marker planning.</p> <p><i>TSO 2b.</i> Describe computerized marker planning</p> <p><i>TSO 2c.</i> Use formula to calculate efficiency of marker plan</p> <p><i>TSO 2d.</i> Illustrate equal and stepped spreads</p> <p><i>TSO 2e.</i> Enlist requirements of spreading process.</p> <p><i>TSO 2f.</i> Describe automatic spreading.</p>	<p>Unit-2.0 Marker making and Spreading</p> <p>2.1. Marker Planning- Definition, objectives and types of markers</p> <p>2.2. Methods of marker planning- manual, computerized.</p> <p>2.3. Evaluation of marker planning efficiency, factors affecting marker efficiency</p> <p>2.4. Forms of spreading- equal, stepped</p> <p>2.5. Requirements of spreading</p> <p>2.6. Methods of spreading- manual, traveling m/c</p>	CO2
<p><i>TSO 3a.</i> Derive/ Justify requirements of quality cutting process.</p> <p><i>TSO 3b.</i> Classify the cutting given cutting tool</p> <p><i>TSO 3c.</i> Compare straight knife m/c with round knife cutting m/c.</p> <p><i>TSO 3d.</i> Describe band knife cutting m/c</p> <p><i>TSO 3e.</i> State use of notcher and drill</p> <p><i>TSO 3f.</i> Explain concept of laser cutting.</p> <p><i>TSO 3g.</i> Suggest remedy for identified cutting defects.</p>	<p>Unit-3.0 Cutting of Garment Components</p> <p>3.1 Cutting- definition , requirements of quality cutting</p> <p>3.2 Classification of cutting tools – portable, stationery, specialized.</p> <p>3.3 Portable cutting m/cs- construction and working of straight knife m/c, round knife m/c</p> <p>3.4 Stationery cutting m/cs- construction and working of band knife m/c, die cutting m/c</p> <p>3.5 Specialized cutting m/cs- construction and working of notchers, drills.</p> <p>3.6 Advance cutting m/cs- computer controlled knives, laser cutting, ultrasonic cutting, water jet cutting</p> <p>3.7 Defects in cutting & their remedies</p>	CO3
<p><i>TSO 4a.</i> Define TKT no in sewing threads</p> <p><i>TSO 4b.</i> Classify the given sewing needles.</p> <p><i>TSO 4c.</i> Explain stitch formation in SNLS m/c</p> <p><i>TSO 4d.</i> Explain differential feed mechanism in over lock m/c.</p>	<p>Unit-4.0 Sewing Machines and Work Aids</p> <p>4.1 Sewing threads – construction and types, Ticket number</p> <p>4.2 Sewing needles – parts and functions, needle classification, needle numbering systems.</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 4e.</i> Depict threading in button stitch m/c by a neat diagram.</p> <p><i>TSO 4f.</i> State advantages of using work aids & attachments in apparel manufacturing.</p>	<p>4.3 Single needle lockstitch (SNLS) m/c- parts, threading, feed mechanism, stitch formation, tension settings, common defects and remedies</p> <p>4.4 Over lock and flat lock m/c- parts, threading, feed mechanism, stitch formation, tension settings, common defects and remedies.</p> <p>4.5 Button hole and button stitch m/cs- threading and other settings.</p> <p>4.6 Work aids and attachments- guides, modified and specialized presser foot (edge stitch, top stitch, half zipper foot, gathering foot etc.)</p>	
<p><i>TSO 5a.</i> Select suitable resin for fusing to the given after treatment of apparel.</p> <p><i>TSO 5b.</i> Describe conveyor belt fusing m/c.</p> <p><i>TSO 5c.</i> Give requirements of quality apparel pressing.</p> <p><i>TSO 5d.</i> Describe vacuum steam press table.</p> <p><i>TSO 5e.</i> Suggest the remedy for identified defects.</p>	<p>Unit-5.0 Fusing and Pressing</p> <p>5.1 Fusing- Objectives & Requirements , Types - Fabrics used and Resins, Methods of application of resin , Requirements-Time, Temperature, Pressure</p> <p>5.2 Fusing machines- electric iron, movable flat beds, conveyor fusing machine.</p> <p>5.3 Pressing- requirements of pressing, Under, Moulding, Top Pressing),Types (Dry, Steam, High Pressure Steam), Accessories (Ironing Board, Sleeve Board, Bucks)</p> <p>5.4 Equipment- (Mechanical, vacuum press, steam air mixture, Steam tunnel)</p> <p>5.5 Defects & remedies in fusing and pressing.</p>	CO5
<p><i>TSO 6a</i> Suggest type of extinguishers used based on. Fire types</p> <p><i>TSO 6b</i> Justify need of metallic gloves in cutting department.</p> <p><i>TSO 6c</i> Identify the check points in preventive maintenance of specified sewing m/cs.</p> <p><i>TSO 6d</i> Justify need for metal detector prior to apparel packaging.</p>	<p>Unit 6.0 Safety Measures in Garment Industry</p> <p>6.1 Stores- fire hazards- types of fire, type of fire extinguishers, fire fighter's equipment.</p> <p>6.2 Cutting – use of metallic gloves in cutting, elimination of static charge in synthetics</p> <p>6.3 Sewing – fire prevention, staining prevention, preventive and corrective maintenance of m/cs</p> <p>6.4 Finishing- use of metal detector, eco-friendly packaging.</p>	CO6

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451601

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant CO Number(s)
<p><i>LSO 1.1.</i> Identify the garment components</p> <p><i>LSO 1.2.</i> Prepare patterns for each component</p> <p><i>LSO 1.3.</i> Arrange all needed components for 2 garments</p> <p><i>LSO 1.4.</i> Prepare marker plan with minimum length skillfully.</p>	1.	Prepare marker plan for men's wear for given fabric width. (1/4 th scale)	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant CO Number(s)
<p><i>LSO 2.1</i> Identify the garment components</p> <p><i>LSO 2.2</i> Prepare patterns for each component</p> <p><i>LSO 2.3</i> Arrange all needed components for 2 garmentsre marker plan with minimum length skillfully.</p>	2.	Prepare marker plan for women's wear for given fabric width. (1/4 th scale)	CO2
<p><i>LSO 3.1.</i> Cut the given fabric in equal length as per marking length.</p> <p><i>LSO 3.2.</i> Align all plies skillfully</p>	3.	Form layer of given fabric using equal spread method (manual) for given marking length.	CO2
<p><i>LSO 4.1.</i> Choose round knife cutting m/c with required settings</p> <p><i>LSO 4.2.</i> Use round knife m/c skillfully</p> <p><i>LSO 4.3.</i> Separate the garment components</p>	4.	Cut garment components in lay Using round knife (portable) cutting machine.	CO3
<p><i>LSO 5.1.</i> Choose round knife cutting m/c with required settings</p> <p><i>LSO 5.2.</i> Use round knife m/c skillfully</p> <p><i>LSO 5.3.</i> Separate the garment components.</p>	5.	Cut garment components in lay Using straight knife (portable) cutting machine.	CO3
<p><i>LSO 6.1.</i> Thread the given SNLS m/c</p> <p><i>LSO 6.2.</i> Select the suitable needle as per fabric</p> <p><i>LSO 6.3.</i> Select suitable stitch length.</p>	6.	Demonstrate threading, selection and setting of needles using single needle lockstitch machine.	CO4
<p><i>LSO 7.1.</i> Select suitable stitch length.</p> <p><i>LSO 7.2.</i> Use sewing m/c skillfully.</p> <p><i>LSO 7.3.</i> Develop the seam line properly.</p>	7.	Demonstrate different SPI and other settings using single needle lockstitch machine.	CO4
<p><i>LSO 8.1.</i> Choose suitable work aid.</p> <p><i>LSO 8.2.</i> Set the work aid properly.</p> <p><i>LSO 8.3.</i> Develop the seam line properly.</p>	8.	Develop different seam lines using relevant work-aids.	CO4
<p><i>LSO 9.1.</i> Thread the given over lock m/c.</p> <p><i>LSO 9.2.</i> Select the suitable needle as per fabric.</p> <p><i>LSO 9.3.</i> Select suitable stitch length.</p> <p><i>LSO 9.4.</i> Develop the seam line properly.</p>	9.	Demonstrate threading, selection and setting of needle, different SPI and other settings using 5-needle over lock machine.	CO4
<p><i>LSO 10.1.</i> Select fusing m/c with required settings.</p> <p><i>LSO 10.2.</i> Fuse collar properly.</p> <p><i>LSO 10.3.</i> Stitch the fused collar skillfully.</p>	10.	Prepare collar using fusing machine.	CO5
<p><i>LSO 11.1.</i> Set the vacuum steam press properly.</p> <p><i>LSO 11.2.</i> Use the m/c to press given garment skillfully.</p>	11.	Finish given garment using vacuum steam press.	CO5
<p><i>LSO 12.1</i> Select the fire extinguisher properly.</p> <p><i>LSO 12.2</i> Use the fire extinguisher skillfully.</p>	12	Use relevant fire extinguisher in simulated fire situation.	CO6

L) Suggested Term Work and Self Learning: S2451601

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:

- i. Each student should collect 10 different types of needles and sewing threads used in garment manufacturing and prepare a catalogue with description and application.
- ii. Each batch of students should visit 3 to 4 different garment factories and draw the process sequences. They will collect information about the names, specifications and manufacturer's names of machines and tools used in the process. They will prepare a report.
- iii. Each student should select 2 sewing machines from minimum 4 manufacturers and compare the features.
- iv. Each student should search for minimum 10 work aids and attachments and prepare a report about its features/ uses.
- v. Prepare booklet of showing various ornamented design and express cam order and relevant needle order for each design.

c. Other Activities:

1. Self-Learning Topics:

- Automatic spreading machines.
- UBT SNLS machines.
- Selection of relevant resin in fusible interlining.
- Advance pressing machines.

2. Visits: Visit nearby garment industry. Prepare report of visit with special m/cs used, material used, finishing techniques, mass production and cost of garment manufacturing.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	-	-
CO-2	15%	15%	15%	25%	-	20%	20%
CO-3	15%	15%	15%	25%	33%	10%	20%
CO-4	25%	25%	25%	25%	33%	15%	20%
CO-5	15%	15%	15%	25%	34%	15%	20%
CO-6	15%	15%	15%	-	-	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 (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to Apparel Manufacturing	6	CO1	10	2	4	4
Unit-2.0 Marker making and Spreading	10	CO2	12	2	4	6
Unit-3.0 Cutting of Garment Components	8	CO3	10	2	4	4
Unit-4.0 Sewing m/cs and Work Aids	12	CO4	18	4	6	8
Unit-5.0 Fusing and Pressing	6	CO5	10	2	4	4
Unit-6.0 Safety measures in Garment Industry	6	CO6	10	2	4	4
Total	48	-	70	14	26	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.	Prepare marker plan for men's wear for given fabric width. (1/4 th scale)	CO2	30	60	10
2.	Prepare marker plan for women's wear for given fabric width. (1/4 th scale)	CO2	30	60	10
3.	Form layer of given fabric using equal spread method (manual) for given marking length.	CO2	40	50	10
4.	Cut garment components in lay Using round knife (portable) cutting machine.	CO3	40	50	10
5.	Cut garment components in lay Using straight knife (portable) cutting machine.	CO3	40	50	10
6.	Demonstrate threading, selection and setting of needle using single needle lockstitch machine.	CO4	40	50	10
7.	Demonstrate different SPI and other settings using single needle lockstitch machine.	CO4	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva- Voce (%)
			PRA* (%)	PDA** (%)	
8.	Develop different seam lines using relevant work-aids.	CO4	30	60	10
9.	Demonstrate threading, selection and setting of needle, different SPI and other settings using 5-needle over lock machine.	CO4	30	60	10
10.	Prepare collar using fusing machine.	CO5	40	50	10
11.	Finish given garment using vacuum steam press.	CO5	30	60	10
12.	Use the given fire extinguisher.	CO6	60	30	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.	Pattern drafting equipment	1/4 th scale, trace paper, pencil(HB,2B), brown sheet, scissor	1,2
2.	Round knife cutting machine	Eastman round knife cutting machine(4" diameter)	4
3.	Straight knife cutting machine	Eastman straight knife cutting machine(8" height)	5
4.	Single needle lockstitch machine	Juki single needle lockstitch machine	6, 7, 8, 10
5.	Modified presser feet, binder, folders and guides	Modified presser feet(edge stitch, top stitch, half zipper, gathering), binder, folders and guides	8
6.	Over lock machine	Silverson 5-thread over lock machine	9
7.	Fusing machine	Fusing machine with conveyor belt	10
8.	Vacuum steam press	Phillips steam press and vacuum steam press table (industrial)	11
9.	Fire extinguisher	Fire extinguisher- class A,B & E	12

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	The Technology of clothing Manufacture	Harold Carr & Barbara Latham	Om book Service. England ISBN- 978-1405161985
2.	Stitches & Seams	R. M. Laing & Webster J.	Manchester, England ISBN-9781870812733
3.	Sewing for Apparel Industry	Shaeffer Claire	Prentice Hall, New Jarsey, USA ISBN- 9780131884434
4.	Sewing Lingerie	The Editors	cy De cosse INCORPORATED (1991) ISBN 13: 9780865732605

(b) Online Educational Resources:

- 1) textilelearner.blogspot.com/2015/09/marker-planning-requirements-of-marker
- 2) www.scribd.com/doc/94099552/Spreading-and-Cutting-of-Apparel-Products
- 3) www.youtube.com/watch?v=
- 4) www.youtube.com/watch?v=2681yeSrsM0
- 5) www.youtube.com/watch?v=TfTwK7E_3CQ
- 6) www.youtube.com/watch?v=KII3t0BOIN8

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

(c) Others: -

- A) **Course Code** : 2451603A (T2451603A/P2451603A/S2451603A)
 B) **Course Title** : Advanced Apparel
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Advanced Apparel allows students to hone their sewing and construction skills to a higher level. The Advanced apparel construction technique includes designing, pattern making and sewing, enabling students to create more intricate and professionally finished garments. In the fashion and apparel industry, advanced apparel construction skills are highly valued. Teaching this course ensures that students are equipped with the techniques and knowledge needed to meet the demands of the industry and compete effectively in the job market. Advanced apparel construction involves pushing the boundaries of traditional techniques, encouraging students to think creatively and innovate in their designs. This fosters the development of unique and original garments, which is essential in a competitive industry.

- 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** Design various garments according to the needs of the client.
CO-2 Develop various garments using principles of dart manipulation, added fullness and contouring.
CO-3 Use the Pattern Grading System for construction of various garments.
CO-4 Design solutions for the fit problems of various garments.
CO-5 Estimate the cost of the constructed garments using the lay marking, material and trimmings used.

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

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

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

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

G) Teaching & Learning Scheme:

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				
2451603A	Advanced Apparel	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)	
2451603A	Advanced Apparel	30	70	20	30	20	30	200

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: T2451603A**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Outline the importance of paper patterns in garment construction of the given sample.</p> <p><i>TSO 1b.</i> Enlist types of paper patterns used in the given garment construction.</p> <p><i>TSO 1c.</i> Explain the application Style line, Principle of Added Fullness and Contouring for the given garment construction.</p> <p><i>TSO 1d.</i> Select neckline, sleeve and collar variations for relevant pattern of the given garment.</p>	<p>Unit – 1.0 Women’s Bodice Blocks</p> <p>1.1 Principles of Pattern Making</p> <p>1.1.1 Types of Paper Patterns</p> <p>1.1.2 Types of Dart Manipulation Techniques</p> <ul style="list-style-type: none"> • Single Dart Series • Double Dart Series <p>1.1.3 Draft and prepare Bodice paper patterns with the following principles</p> <p>a. Style Lines (Armhole, Princess Line and Empire Line)</p> <p>b. Principle of Added Fullness (Equal, Unequal and One-sided fullness)</p> <p>c. Principle of Contouring (Corset, Katori blouse)</p> <p>1.2 Draft and prepare the following paper pattern library with</p> <ul style="list-style-type: none"> • Neckline variations (Off-shoulder dress, Boat neck, Cowl and Halter) • Sleeve variation (Kimono, Raglan) • Collar variation (Flat, Standing and Rolled) 	<p>CO1, CO2, CO3</p>
<p><i>TSO 2a.</i> Explain Pattern Making techniques used for the given women’s lower garments with variation.</p> <p><i>TSO 2b.</i> Develop paper patterns for different component(s) for the given skirt (Flared, Fitted, Pencil, Fishtail, Gored, With Basque, Gathers, Ruffles, Tiers and Pleats)</p>	<p>Unit -2.0 Women’s Lower Garments Blocks</p> <p>2.1 Drafting using Principles of Pattern Making.</p> <ul style="list-style-type: none"> • Skirts (Flared, Fitted, Pencil, Fishtail, Gored, With Basque, Gathers, Ruffles, Tiers and Pleats- any one) • Trousers (Shorts, Culotte, Bermuda, Full length, Pleated waistline, Flare-any one) 	<p>CO1, CO2, CO3</p>
<p><i>TSO 3a.</i> Explain Grading techniques used in Apparel Manufacturing.</p> <p><i>TSO 3b.</i> Outline the importance of Pattern Grading Techniques.</p> <p><i>TSO 3c.</i> Use relevant type of Pattern Grading Technique for the given garment.</p> <p><i>TSO 3d.</i> Apply relevant Enlargement and Reduction technique(s) for the given garment.</p>	<p>Unit -3.0 Grading System</p> <p>3.1 Pattern Grading Techniques</p> <ul style="list-style-type: none"> • Introduction of Pattern Grading Techniques • Importance of Pattern Grading Techniques in Apparel Manufacturing <p>3.2 Types of Pattern Grading Techniques.</p> <p>a. Slash and Spread Method</p> <p>b. Pivot Method</p>	<p>CO1, CO2, CO3</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	3.3 Grade the following patterns- Enlargement and Reduction for Bodice Block, Sleeve Block, Skirt Block, Trouser Block	
<p><i>TSO 4a.</i> Explain Good Fit in the given garment.</p> <p><i>TSO 4b.</i> Identify various fitting problems of the given women's garments.</p> <p><i>TSO 4c.</i> Analyze the causes of various fitting problems of the given women's garments.</p> <p><i>TSO 4d.</i> Rectify identified fitting problems using the Slash and spread method in the given garment.</p>	<p>Unit -4.0 Garment Fit: Problems and Remedial Actions</p> <p>4.1 Fitting problems associated with women's garments</p> <p>4.2 Remedial actions for the following figure abnormalities using Slash and spread in Erect figure, stopping figure, Corpulent figure, Square shoulder, sloping shoulder, Pigeon Chest, Hollow chest, bow knees, knock knees, Smile lines, Frown lines, Gaping necklines</p>	CO4
<p><i>TSO 5a.</i> Select suitable 3D Printer (FDM) and software for the given application with justification.</p> <p><i>TSO 5b.</i> Create the pattern of the given garment.</p> <p><i>TSO 5c.</i> Apply appropriate finishing technique (s) to the given garment.</p> <p><i>TSO 5d.</i> Identify the fitting problem(s) in the given garment.</p> <p><i>TSO 5e.</i> Rectify fitting problem(s) in the given garment.</p>	<p>Unit -5.0 Advanced Garment construction</p> <p>5.1 Draft paper pattern of</p> <ul style="list-style-type: none"> • Salwar and Kurti (Indian wear) • One Piece (Western Wear) <p>5.2 Pattern Chart and Design Specification Sheet (anyone)</p>	CO1, CO2, CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603A

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Draft the given basic women's bodice block using a 1:4 scale.</p> <p><i>LSO 1.2.</i> Draft the given basic women's bodice block in Full size.</p> <p><i>LSO 1.3.</i> Cut the given basic women's bodice block in Full size.</p>	1.	Draft the given basic women's bodice block.	CO1, CO2, CO3
<p><i>LSO 2.1.</i> Apply the Principle of added fullness to the given basic women's bodice block.</p> <p><i>LSO 2.2.</i> Draft the given basic women's bodice block with added fullness.</p> <p><i>LSO 2.3.</i> Cut the given basic women's bodice block with added fullness.</p>	2.	Draft the given basic women's bodice block, also apply the Principle of added fullness	CO1, CO2, CO3
<p><i>LSO 3.1.</i> Apply the Principle of added fullness to create the given design.</p> <p><i>LSO 3.2.</i> Create paper patterns of the given design using the Principle of added fullness.</p> <p><i>LSO 3.3.</i> Cut paper patterns of the given design using the Principle of added fullness.</p>	3.	Draft variations of added Fullness to the given garment.	CO1, CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 4.1.</i> Apply the Principle of contouring to the given basic women's bodice block.</p> <p><i>LSO 4.2.</i> Draft the given basic women's bodice block with the Principle of contouring.</p> <p><i>LSO 4.3.</i> Cut the given basic women's bodice block with the Principle of contouring.</p>	4.	Develop the given bodice block using contouring guidelines.	CO1, CO2, CO3
<p><i>LSO 5.1.</i> Apply the Principle of added fullness and Countering to create the given design.</p> <p><i>LSO 5.2.</i> Design the given Corset/ Katori, Princess Blouse.</p> <p><i>LSO 5.3.</i> Create paper patterns of the given Corset/ Katori, Princess Blouse.</p> <p><i>LSO 5.4.</i> Cut paper patterns of the given Corset/ Katori, Princess Blouse.</p>	5.	Develop variation(s) of contouring for the given Corset/ Katori, Princess Blouse using the drafting/ draping method.	CO1, CO2, CO3
<p><i>LSO 6.1.</i> Stitch the given Corset/ Katori, Princess Blouse.</p> <p><i>LSO 6.2.</i> Apply professional finishing techniques for the given garment.</p> <p><i>LSO 6.3.</i> Apply professional packaging techniques for the given garment.</p>	6.	Cut and stitch the achieved design (Corset/ Katori, Princess Blouse) providing all the information (Folds, Seam allowance, Grains, and Cutting details on the pattern pieces).	CO1, CO2, CO3
<p><i>LSO 7.1.</i> Apply the Principle of pattern making for the given women's skirt garment.</p> <p><i>LSO 7.2.</i> Create a paper pattern of the given women's skirt garment.</p> <p><i>LSO 7.3.</i> Cut paper patterns of the given women's skirt garment.</p>	7.	Draft the given basic women's Skirt block using a manual flat pattern providing all the information (Folds, Seam allowance, Grains, Cutting details on the pattern pieces).	CO1, CO2, CO3
<p><i>LSO 8.1.</i> Apply the Principle of pattern making for the given women's trouser garment.</p> <p><i>LSO 8.2.</i> Create a paper pattern of the given women's trouser garment.</p> <p><i>LSO 8.3.</i> Cut paper patterns of the women's trouser garment.</p>	8.	Draft the given basic women's trousers block using a manual flat pattern providing all the information (Folds, Seam allowance, Grains, Cutting details on the pattern pieces).	CO1, CO2, CO3
<p><i>LSO 9.1.</i> Stitch Skirt and Trouser along with shirt or blouse.</p> <p><i>LSO 9.2.</i> Apply professional finishing techniques for the given garment.</p> <p><i>LSO 9.3.</i> Apply professional packaging techniques for the given garment</p>	9.	Cut and stitch the given designed Skirt and Trousers with a shirt or blouse providing all the information (Folds, Seam allowance, Grains, and Cutting details on the pattern pieces). (any one).	CO1, CO2, CO3
<p><i>LSO 10.1.</i> Draft the given basic women's bodice block in 1:4 scale.</p> <p><i>LSO 10.2.</i> Grade the given basic women's bodice block.</p> <p><i>LSO 10.3.</i> Prepare a Master Pattern of the given women's bodice block.</p>	10.	Grade the given pattern pieces by using the Pivot Method -Enlargement and Reduction (Bodice Block, Sleeve Block, Skirt Block, Trouser Block)	CO1, CO2, CO3
<p><i>LSO 11.1.</i> Draft the given basic women's bodice block in 1:4 scale.</p>	11.	Grade the given pattern pieces by using the Slash and Spread Method -Enlargement and	CO1, CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p>LSO 11.2. Grade the given basic women's bodice block.</p> <p>LSO 11.3. Prepare a Master Pattern of the given women's bodice block</p>		Reduction (Bodice Block, Sleeve Block, Skirt Block, Trouser Block)	
<p>LSO 12.1. Analyze Good Fit in the given Upper Body Garments.</p> <p>LSO 12.2 Identify various fitting problems of the given women's Upper Body garments.</p> <p>LSO 12.3 Rectify identified fitting problems by the Slash and spread method for the given garment.</p>	12.	Identify the fitting problems associated with the given stitched women's garments and apply remedial actions for the following figure abnormalities in Upper Body garments.	CO4
<p>LSO 13.1 Analyze Good Fit in the given Lower Body garments.</p> <p>LSO 13.2 Identify various fitting problems of the given women's Lower Body garments.</p> <p>LSO 13.3 Rectify identified fitting problems by the Slash and spread method for the given garment.</p>	13.	Analyze fitting problems associated with given stitched women's garments and apply remedial actions for the following figure abnormalities in Lower Body garments.	CO4
<p>LSO 14.1 Prepare paper pattern of the given dress/ gown with neckline and sleeve variation to test fit.</p> <p>LSO 14.2 Write all the information (Folds, Seam allowance, Grains, and Cutting details on the pattern pieces) for the given sample.</p> <p>LSO 14.3 Test the fitting of the given dress/ gown with neckline and sleeve variation.</p>	14.	Achieve the given pattern combining bodice and skirt variation to achieve a dress/ gown with neckline and sleeve variation to test fit.	CO1, CO2, CO3
<p>LSO 15.1 Stitch the given Salwar and Kurti (Indian Wear) / One Piece (Western Wear).</p> <p>LSO 15.2 Apply the professional finishing techniques for the given garment.</p> <p>LSO 15.2 Apply the professional packaging techniques for the given garment.</p>	15.	Stitch the given Salwar and Kurti (Indian Wear) and One Piece (Western Wear). (Design the garment, draft and cut the paper patterns), (Write all the information- Folds, Seam allowance, Grains, Cutting details on the pattern pieces).	CO1, CO2, CO3
<p>LSO 16.1 Prepare appropriate Lay marking as per the fabric print of the given constructed garment.</p> <p>LSO 16.2 Estimate the fabric and material required for the given constructed garment. LSO 16.3 Prepare the cost sheet of the given constructed garment.</p>	16.	Prepare a layout and cost sheet of the given designed and constructed garments.	CO5

* All Laboratory Experiments / Practicals Titles are compulsory.

L) Suggested Term Work and Self-Learning: S2451603A

Some sample suggested assignments, micro-projects and other activities are mentioned here for reference.

a. Assignments: Make a group of 3-4 students and complete the following assignments for the targeted COs.

1. Pattern Reading Assignment: Provide students with a pattern to analyze, identify symbols, and understand pattern markings.
2. Pattern Alteration Assignment: Students should make basic pattern alterations to fit different body shapes and sizes for kid's garments.
3. Garment Finishing and Pressing: Students should press and finish seams, edges, and hems for a professional look (Under pressing and Top pressing).
4. Repurposing Assignment: Students should repurpose an old garment into a new one (simple) to encourage creativity and sustainability.
5. Sewing Project Portfolio: Students should document their sewing projects with photos and descriptions, creating a portfolio to showcase their work(e-Work).
6. Custom Fit Assignment: Students create pattern alteration for a custom-fit garment (Use any famous personality as a client) from scratch from earlier knowledge of designing courses.
7. Finishing Techniques Identification Assignment: Students should visit the brand mall, outlets, stores and boutiques to analyze brand-specific finishing techniques and sizes to compile the visit report.

b. Micro Projects:

1. Make a library collection of women's wear garments constructed using the Principle of contouring.
2. Identify and rectify your friend's fitting problems (any five fitting problems).
3. Make a library collection of women's wear garments constructed using the Principle of added fullness
Make a collection of size charts of women's wear (any five national/ international brands)
4. Make a sample library of Layouts for various types of fabric Print for Basic Bodice (One Directional, Bi-Directional, Stripe or Lines, Cheques or plaids and nursery prints)
5. Prepare a PPT presentation stating elements of the Cost sheet and their importance.
6. Compile a report of various Grading methods and software used in the Apparel Construction Industry.

c. Other Activities: -

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	30%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	30%	15%	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: The specification table represents the reflection of sample representation of assessment of the cognitive domain of the full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit -1.0 Women's Bodice Blocks	8	CO1, CO2	10	3	3	4
Unit -2.0 Women's Lower Garments Blocks	8	CO1, CO2	10	3	2	5
Unit -3.0 Grading System	8	CO3	20	5	6	9
Unit -4.0 Garment Fit: Problems and Remedial Actions	12	CO4	20	4	6	10
Unit -5.0 Advanced Garment Construction	12	CO5	10	5	2	3
Total	48	-	70	20	19	31

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.	Draft a basic women's bodice block.	CO1, CO2, CO3	30	60	10
2.	Draft a basic women's bodice block and apply the Principle of added fullness	CO1, CO2, CO3	40	50	10
3.	Draft variations of added Fullness.	CO1, CO2, CO3	30	60	10
4.	Develop a bodice block using contouring guidelines.	CO1, CO2, CO3	30	60	10
5.	Develop variations of contouring for Corset/ Katori, Princess Blouse using the drafting/ draping method.	CO1, CO2, CO3	30	60	10
6.	Cut and stitch the achieved design (Corset/ Katori, Princess Blouse).	CO1, CO2, CO3	30	60	10
7.	Draft a basic women's Skirt block using a manual flat pattern.	CO1, CO2, CO3	30	60	10
8.	Draft a basic women's trousers block using a manual flat pattern.	CO1, CO2, CO3	40	50	10
9.	Cut and stitch any one designed Skirt and Trousers with a shirt or blouse.	CO1, CO2, CO3	40	50	10
10.	Grade the following pattern pieces by using the Pivot Method (Enlargement and Reduction) Bodice Block Sleeve Block Skirt Block Trouser Block.	CO1, CO2, CO3	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
11.	Grade the following pattern pieces by using the Slash and Spread Method (Enlargement and Reduction) Bodice Block Sleeve Block Skirt Block Trouser Block.	CO1, CO2, CO3	30	60	10
12.	Identify, and analyze fitting problems associated with stitched women's garments and apply remedial actions for the following figure abnormalities in Upper Body garments.	CO4	30	60	10
13.	Identify, analyze fitting problems associated with stitched women's garments and apply remedial actions for the following figure abnormalities in Lower Body garments.	CO4	30	60	10
14.	Achieve a pattern combining bodice and skirt variation to achieve a dress/ gown with neckline and sleeve variation to test fit.	CO1, CO2, CO3	40	50	10
15.	Stitch Salwar and Kurti (Indian Wear) and One Piece (Western Wear).	CO1, CO2, CO3	40	50	10
16.	Prepare a layout and cost sheet of the designed and constructed garments.	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Equipment Name with Broad Specifications	Relevant Experiment/ Practical Number
1	Fiberglass Dress Form: - Female and male, Female size -40, Male size -42. Dress Forms: It is a standardized duplication of a human form. It is cotton-padded, canvas-covered and set on a movable stand. It is used to take measurements, develop patterns and fit garment samples.	All
2	Rulers: - 12"/24" wooden, metal or plastic rulers. It is used for drawing straight lines per measurement. The marking and divisions on the ruler should be clear and accurate. Tailors square/ 'L' Square: - It is a 24"x 144" metal or plastic ruler with two arms that form a 90-degree angle. It is used to find a 45-degree angle mark outside and inside corners and extend the line through corners.	All
3	French Curve: - It is a curved plastic or metal ruler - It is used to draw curved lines of armholes and necklines.	All
4	Pin Holder: - Plastic/Wood material is used to hold pins and needles for easy accessibility and storage.	All
5	Hip Curve: - It is a curved plastic or metal ruler available in different sizes. It is used to draw curved lines.	All
6	Scissors: - It is a cutting tool, having a size of 8" to 12", with two sharply pointed straight blades. Used to cut paper patterns and fabric. Paper-cutting scissors and cloth-cutting	All

S. No.	Equipment Name with Broad Specifications	Relevant Experiment/ Practical Number
	scissors are different.	
7	Notcher: - It is a punching tool that makes 'U' shaped notch marks. It is used to make 'U' shaped notch marks, which indicate seam allowance, central lines, etc. It looks like a single-punch machine.	All
8	Tailors' Chalk: These chalks can be rubbed off easily on the fabric surface. It is available in various colours with fine edges. It is used for marking the lines and design details on fabric.	All
9	Tracing Wheel: - It is a toothed metal wheel with a wooden or plastic handle. It is used to transfer lines from one pattern to another or from the final pattern to the fabric.	All
10	Pins & Pin Holder: - Pins and small stuffed pillows are also required in pattern-making.	All
11	Stiletto: It is a metal rod with a tapering needle point end and a wooden or plastic handle. It is used for punching dart ends on patterns, and marking the placement of pockets, trimmings, bands etc.	All
12	Thin Brown Paper: - These are brown paper rolls or sheets of various sizes and thicknesses. Used for preliminary pattern drafting and the development of patterns.	All
13	Thick Brown Paper: - These are brown paper rolls or sheets of various sizes and thicknesses. Used for preliminary pattern drafting and the development of the final pattern. - Strong and thick ones are used for making patterns that can be used repeatedly.	All
14	Thick Brown Paper: - These are brown paper rolls or sheets of various sizes and thicknesses. Used for preliminary pattern drafting and the development of the final pattern. - Strong and thick ones are used for making patterns that can be used repeatedly.	All
15	Sewing Thread: - A thread is a long strand of material, often composed of several filaments or fibres, used for sewing garments.	6, 9, 15
16	Hand Needle: - A sewing needle, used for hand-sewing, is a long, slender tool with a pointed tip at one end and a hole (or eye) to hold the sewing thread.	6, 9, 15
17	Machine Needle: - A sewing machine needle is a specialized needle used in a sewing machine.	6, 9, 15
18	Iron: - A clothes iron is a small appliance that, when heated, is used to press clothes to remove wrinkles and unwanted creases.	6, 9, 15
19	Iron board: - An ironing board is generally a large, flat piece of board or metal covered with heat-safe padding on which clothing or linens may be ironed safely.	6, 9, 15
20	Single needle lock stitch machine: - A sewing machine is used to sew fabric and materials together with thread.	6, 9, 15
21	Overlock sewing machine: - These are specialized sewing machines. Overlocks form interlocking stitches using one or two needles, and one or two loopers help prevent puckering of the fabric pieces.	6, 9, 15
22	Trims- Any materials or components used in clothing that are not the main fabric are referred to as trims. The trims can be Sewing Thread, decorative machine stitching, Buttons (both functional and decorative element), Rivets, Zipper, Hasps and Slider, Hook and eye closure, all fasteners, Lining, Interlining, Labels, Patches, Motifs, Embroidery, Smocking, Ribbons, Drawstrings, Laces, Tassels, Braid, Rickrack, Appliqués, Ruffles, Fur, Leather, Shoulder pads and Bias binding.	6, 9, 15

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1	Helen J. Armstrong's fashion design.	Pattern making for fashion design	New Delhi, Pearson India Education Services Pvt. Ltd., 2016. ISBN-13: 978-9332518117
2	Reader's Digest Association	Reader's Digest Complete Guide to Sewing: Step by Step	Reader's Digest ISBN 9780276001826
3	Winifred Aldrich	Metric Pattern Cutting for Women's Wear Edition	Wiley-Blackwell; 5th edition ISBN 13 978-1405175678
4	Natalie Bray	Dress Pattern Designing: The Basic Principles of Cut and Fit	UK, Blackwell Publishing, 2008; ISBN-13. 978-1405175678
5	Natalie Bray	More Dress Pattern Designing	Blackwell Science Ltd., London ISBN: 9780632065028
6	Gillian Holman	Pattern Cutting Made Easy	Blackwell Science Ltd., London ISBN: 9781849940733
7	Zarapkar	Zarapkar System of Cutting	Sale Publishers, Bombay ISBN: 9788124301999

(b) Online Educational Resources:

1. Pattern Alteration (Sewing) | PDF | Seam (Sewing) | Human Appearance (scribd.com)
2. <https://www.futurelearn.com/subjects/creative-arts-and-media-courses/fashion>
3. <https://www.classcentral.com/subject/fashion>
4. <https://www.udemy.com/course/analyse-garment-construction-z/>
5. <https://www.coursera.org/courses?query=fashion%20design>

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

(c) Others: -

- A) **Course Code** : 2451603B (T2451603B/P2451603B/S2451603B)
 B) **Course Title** : Fashion Portfolio
 C) **Pre- requisite Course(s)** : Computer Illustration Techniques
 D) **Rationale** :

This course provides the visualization of idea from board to final design. It develops the skill of accessories designing, Theme based designing for the client. It also teaches the presentation technique to give an accurate result.

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

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

- CO-1 Identify various materials used in presentations of various fashion portfolios.
 CO-2 Apply fashion forecasting for the given modern trend.
 CO-3 Use Fashion Portfolio Development Techniques for various themes.
 CO-4 Use Fashion Portfolio Boards for various fashion brands
 CO-5 Develop Manual/Digital fashion Portfolio for various fashion brands.

- 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	1		
CO-2	3	-	-	2	-	2	1		
CO-3	3	1	1	2	-	2	1		
CO-4	3	2	2	2	-	2	1		
CO-5	3	2	2	2	-	2	1		
CO-6	3	2	2	2	1	1	1		

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

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

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

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				
2451603B	Fashion Portfolio	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)	
2451603B	Fashion Portfolio	30	70	20	30	20	30	200

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: T2451603B

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the Fashion Portfolio in fashion industry.</p> <p><i>TSO 1b.</i> Enlist the elements required for Fashion Portfolio Preparation for the given sample.</p> <p><i>TSO 1c.</i> Outline the Contents of fashion portfolio for the given sample.</p> <p><i>TSO 1d.</i> Classify the type(s) of fashion portfolio.</p> <p><i>TSO 1e.</i> Explain the importance of fashion portfolio for the given sample.</p> <p><i>TSO 1f.</i> Explain the different Portfolio Presentation Skills for the given sample.</p> <p><i>TSO 1g.</i> List the different material(s) used in the given portfolio presentation.</p>	<p>Unit-1.0 Fashion Portfolio Introduction</p> <p>1.1 Definition of Fashion Portfolio. 1.2 Fashion Portfolio Preparation. 1.3 Contents of Portfolio. 1.4 Types of Portfolios. 1.5 Importance of Portfolio. 1.6 Materials Management in Portfolio Presentation.</p>	CO1
<p><i>TSO 2a.</i> Explain the Fashion Forecasting in fashion industry.</p> <p><i>TSO 2b.</i> Outline the purpose of fashion forecasting for developing fashion portfolio.</p> <p><i>TSO 2c.</i> List the fashion forecasting techniques.</p> <p><i>TSO 2d.</i> Enlist the type(s) of Fashion Forecasting.</p> <p><i>TSO 2e.</i> Classify the given type(s) of Fashion Forecasting.</p> <p><i>TSO 2f.</i> State the Role of Human resource as Fashion Forecaster.</p> <p><i>TSO 2g.</i> Explain the colour based fashion forecasting.</p> <p><i>TSO 2h.</i> Explain the trend-based fashion forecasting.</p> <p><i>TSO 2i.</i> Explain the use of online services for forecasting.</p> <p><i>TSO 2j.</i> Apply fashion forecasting for the given modern trend.</p>	<p>Unit-2.0 Fashion Forecasting Introduction</p> <p>2.1 Forecasting Techniques 2.2 Types of Fashion Forecasting 2.3 Classification of Fashion Forecasting 2.4 Role of Fashion Forecaster 2.5 Colour Forecasting 2.6 Trend Forecasting 2.7 Use of online service for forecasting.</p>	CO1, CO2
<p><i>TSO 3a.</i> Explain the given technical details applied for developing fashion portfolio for the given sample.</p> <p><i>TSO 3b.</i> Select the working drawing materials for the given application.</p> <p><i>TSO 3c.</i> Draw the specification sheet with suitable diagrams for the given sample.</p> <p><i>TSO 3d.</i> Explain the detailing of flat sketch with suitable illustration for the given sample.</p> <p><i>TSO 3e.</i> Outline the importance of cost sheet.</p> <p><i>TSO 3f.</i> Outline the trends in Clothing categories for the given men 's/women's'/kids' wear on the basis of styling, price and size ranges.</p> <p><i>TSO 3g.</i> Use the given Fashion Portfolio Development Techniques (boards/logo/cover page /hang tags) for the given theme.</p>	<p>Unit 3.0 Fashion Portfolio Development Techniques</p> <p>3.1 Technical Details 3.2 Working Drawings 3.3 Development of Spec Sheet 3.4 Flat Sketch 3.5 Costing Sheet. 3.6 Clothing categories: styling, price and size ranges for men 's wear. 3.7 Clothing categories: styling, price and size ranges for women 's wear. 3.8 Clothing categories: styling, price and size ranges for kids wear.</p>	CO3, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 4a.</i> Explain the given Fashion Portfolio Board(s).</p> <p><i>TSO 4b.</i> State the importance of the given type of board in fashion portfolio.</p> <p><i>TSO 4c.</i> Differentiate between the given types of boards.</p> <p><i>TSO 4d.</i> State the purpose of Logo for the given brand(s).</p> <p><i>TSO 4e.</i> State the advantages of hang tags for the given brand(s).</p> <p><i>TSO 4f.</i> Develop Manual/Digital fashion Portfolio for the given sample.</p>	<p>Unit 4.0 Fashion Portfolio Boards</p> <p>4.1 Theme Board 4.2 Story Board 4.3 Mood Board 4.4 Client Board 4.5 Colour Board 4.6 Swatch Board 4.7 Accessories Board 4.8 Concept Board 4.9 Development of Logo 4.10. cover page 4.11 Hang tags.</p>	CO3, CO4
<p><i>TSO 5a.</i> Select appropriate theme based on research and surveys.</p> <p><i>TSO 5b.</i> State the parameters for design development, client, material, trend research and exploration according to the given theme.</p> <p><i>TSO 5c.</i> List steps to perform fashion presentation for the given theme.</p> <p><i>TSO 5d.</i> State the process of design sampling.</p> <p><i>TSO 5e.</i> Set different Commercial Applications process parameters to get a sound Manual/Digital fashion Portfolio for the given sample.</p>	<p>Unit-5.0 Manual/Digital Portfolio Development</p> <p>5.1 Area of specialization: 5.1.1 Research and surveys 5.1.2 Design development based on client, material, trend research and exploration. 5.1.3 Fashion Presentation. 5.1.4 Design Sampling. 5.1.5 Commercial Applications.</p>	CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603B

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Identify a suitable logo for front page.</p> <p><i>LSO 1.2.</i> Prepare logo for portfolio cover page.</p>	1.	Design logo and Portfolio Cover page (Computerized/Manual) for the given sample.	CO1, CO2
<p><i>LSO 2.1.</i> Select a suitable font size and font style for the given brand tags.</p> <p><i>LSO 2.2.</i> Select a suitable font size and font style for the given hang tags.</p> <p><i>LSO 2.3.</i> Develop the given brand tags using suitable color combination.</p> <p><i>LSO 2.4.</i> Develop the given hang tags using suitable color combination.</p>	2.	Design and Render Brand Tags and Hang Tags Labels using suitable color combination, font size and font Style (Computerized/Manual)	CO1, CO2
<p><i>LSO 3.1.</i> Design the given product packaging box.</p> <p><i>LSO 3.2.</i> Develop the given 3D Eco-friendly shopping bag.</p>	3	Design and Render Product Packaging Box/ Eco-Friendly Shopping Bag (Three Dimensional)	CO1, CO2
<p><i>LSO 4.1.</i> Select suitable font size and font style for the given price tags.</p> <p><i>LSO 4.2.</i> Select suitable font size and font style for the given Size Tags.</p>	4.	Design and Render Price Tag, Size Tag with Detailing. (Computerized/Manual)	CO1, CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 4.3.</i> Develop the given price tags using suitable color combination.</p> <p><i>LSO 4.4.</i> Develop the given size tags using suitable color combination.</p>			
<p><i>LSO 5.1.</i> Identify the types of themes for the given situation.</p> <p><i>LSO 5.2.</i> Identify the types of boards for the given situation.</p> <p><i>LSO 5.3.</i> Identify the types of design.</p> <p><i>LSO 5.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 5.5.</i> Select the relevant board for the given Stage Event Theme.</p> <p><i>LSO 5.6.</i> Select the relevant design for the given Stage Event Theme.</p> <p><i>LSO 5.7.</i> Render the given Stage Event Theme.</p>	5.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for stage event using:</p> <ul style="list-style-type: none"> • Theme Based Garment Line With Accessories using Design Mixed with Flats with Suitable Page Composition and Backdrop • Suitable Page Composition and Backdrop. • Collage Creation (Manual/ Computerized) Inspiration Board/ Mood Board/ Color and Swatch (Fabric) Board. • Spec Sheet and Cost Sheet for garments in the Collection 	CO2, CO3, CO4
<p><i>LSO 6.1.</i> Identify the given theme for the given situation.</p> <p><i>LSO 6.2.</i> Identify the types of boards for the given situation.</p> <p><i>LSO 6.3.</i> Identify the type(s) of design for the given situation.</p> <p><i>LSO 6.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 6.5.</i> Select the relevant board for the given Ramp wear Theme.</p> <p><i>LSO 6.6.</i> Select the relevant design for the given Ramp wear Theme.</p> <p><i>LSO 6.7.</i> Render the given Ramp wear Theme.</p>	6.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for Ramp Wear using:</p> <ul style="list-style-type: none"> • Theme Based Garment Line With Accessories using Design Mixed with Flats with Suitable Page Composition and Backdrop • Fashionable Technology Theme (The intersection of Design, Science and Technology) • Collage Creation (Manual/ Computerized) Inspiration Board, Mood Board, Color and Swatch (Fabric) Board • Spec Sheet and Cost Sheet for garments in the Collection 	CO2, CO3, CO4
<p><i>LSO 7.1.</i> Identify the given types of themes for the given situation.</p> <p><i>LSO 7.2.</i> Identify the given types of boards.</p> <p><i>LSO 7.3.</i> Identify the types of design.</p> <p><i>LSO 7.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 7.5.</i> Select the relevant board for the given Store/Brand Theme.</p> <p><i>LSO 7.6.</i> Select the relevant design for the given Store/Brand Theme.</p> <p><i>LSO 7.7.</i> Render the given Store/Brand Theme.</p>	7.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for Traditional Handicraft Theme using:</p> <ul style="list-style-type: none"> • Collage Creation (Manual/ Computerized) Inspiration Board, Mood Board, Color and Swatch (Fabric) Board • Theme Based Garment Line With Accessories use Design Mixed with Flats with Suitable Page Composition and Backdrop • Spec Sheet and Cost Sheet for garments in the Collection 	CO2, CO3, CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 8.1.</i> Identify the types of themes for the given situation.</p> <p><i>LSO 8.2.</i> Identify the types of boards for the given situation.</p> <p><i>LSO 8.3.</i> Identify the type(s) of design for the given situation.</p> <p><i>LSO 8.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 8.5.</i> Select the relevant board for the given Accessories Designing Theme.</p> <p><i>LSO 8.6.</i> Select the relevant design for the given Accessories Designing Theme.</p> <p><i>LSO 8.7.</i> Render the given Accessories Designing Theme.</p>	8.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for Indian Heritage Theme using:</p> <ul style="list-style-type: none"> • Design and Render Theme Based Accessories with Suitable Page Composition and Backdrop. • Collage Creation (Manual/ Computerized) Inspiration Board, Mood Board, Color and Swatch (Fabric) Board. • Spec Sheet and Cost Sheet for garments in the Collection 	CO2, CO3, CO4
<p><i>LSO 9.1.</i> Identify the types of themes for the given situation.</p> <p><i>LSO 9.2.</i> Identify the types of boards for the given situation.</p> <p><i>LSO 9.3.</i> Identify the types of design for the given situation.</p> <p><i>LSO 9.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 9.5.</i> Select the relevant board for the given Indian Festival Theme</p> <p><i>LSO 9.6.</i> Select the relevant design for the given Indian Festival Theme</p> <p><i>LSO 9.7.</i> Render the given Indian Festival Theme</p>	9.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for Indian Festival Theme using:</p> <ul style="list-style-type: none"> • Design and Render Theme Based Accessories with Suitable Page Composition and Backdrop. • Collage Creation (Manual/ Computerized) Inspiration Board, Mood Board, Color and Swatch (Fabric) Boards. • Spec Sheet and Cost Sheet for garments in the Collection 	CO4, CO5
<p><i>LSO 10.1.</i> Identify the types of themes for the given situation.</p> <p><i>LSO 10.2.</i> Identify the types of boards for the given situation.</p> <p><i>LSO 10.3.</i> Identify the types of design for the given situation.</p> <p><i>LSO 10.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 10.5.</i> Select the relevant board for the given Sustainability Theme</p> <p><i>LSO 10.6.</i> Select the relevant design for the given Sustainability Theme</p> <p><i>LSO 10.7.</i> Render the given Sustainability Theme</p>	10.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for Traditional Handicraft Theme using:</p> <ul style="list-style-type: none"> • Design and Render Theme Based Accessories with Suitable Page Composition and Backdrop. • Collage Creation (Manual/ Computerized) Inspiration Board, Mood Board, Color and Swatch (Fabric) Boards. • Spec Sheet and Cost Sheet for garments in the Collection 	CO5
<p><i>LSO 11.1.</i> Identify the types of themes for the given situation.</p> <p><i>LSO 11.2.</i> Identify the types of boards for the given situation.</p> <p><i>LSO 11.3.</i> Identify the types of design for the given situation.</p> <p><i>LSO 11.4.</i> Select the relevant theme for the given situation.</p> <p><i>LSO 11.5.</i> Select the relevant board for the given Television show</p> <p><i>LSO 11.6.</i> Select the relevant design for the given Television show</p> <p><i>LSO 11.7.</i> Render the given Television show.</p>	11.	<p>Illustrate Theme Based Garment Line (any three) with Accessories for Television show Theme using:</p> <ul style="list-style-type: none"> • Design and Render Theme Based Accessories with Suitable Page Composition and Backdrop. • Collage Creation (Manual/ Computerized) Inspiration Board, Mood Board, Color and Swatch (Fabric) Boards. Spec Sheet and Cost Sheet for garments in the Collection 	CO5

L) Suggested Term Work and Self Learning: S2451603B

Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Collect Hand Tags, Size Tag, Price Tag of Different brands and prepare a Report
- ii. Prepare the Detail Curriculum Vitae (CV) for your client.
- iii. Drape a creative Non-wearable garment on Dummy and prepare a stepwise report.

b. Micro Projects:

- i. Prepare a Report on industrial based final design collection.
- ii. Prepare a Report on Current movie costume and accessories.
- iii. Prepare a Report on TV shows/Stage show Costume.
- iv. Prepare a portable Library on trendy Color.
- v. Prepare a portable Library on trendy Texture.
- vi. Prepare a portable Library on well-known Styles
- vii. Prepare a portable Library on Trend Embellishment/Surface Ornamentation.

c. Other Activities:

1. Seminar Topics:

- Fabric Forecasting
- Fiber Forecasting.
- Forecasting Firms and services

2. Visits: Visit nearby fashion studio / Garment industry. Prepare report of visit with special comments on portfolio design development technique used, material used, single component/batch production/mass production.

3. Self-Learning Topics:

- Cut and Stitch Single Garment based on above any one theme.
- Embellish-Cut-Stitch a Garment /Accessories on Selected Handicraft.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	15%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	20%	20%	20%	15%	16%	20%	10%
CO-6	10%	10%	10%	10%	18%	20%	10%
Total Marks	30	70	20	20	10	20	30
			50				

Legend:

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

**.: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The 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 Fashion Portfolio Introduction	8	CO1	10	3	3	4
Unit-2.0 Fashion Forecasting Introduction	8	CO1, CO2	10	3	2	5
Unit-3.0 Fashion Portfolio Development Techniques	8	CO3, CO4	10	5	2	3
Unit-4.0 Fashion Portfolio Boards	12	CO3, CO4	20	5	6	9
Unit-5.0 Manual/Digital Portfolio Development	12	CO4, CO5	20	4	6	10
Total	48	-	70	20	19	31

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.	Front Page Designing	CO1, CO2	30	60	10
2.	Label Creation-Use suitable color combination, font size and font Style.	CO1, CO2	40	50	10
3.	Hand Bag Creation	CO1, CO2	30	60	10
4.	Price Tags a Creation	CO1, CO2	30	60	10
5.	Theme Based Designing -Stage Event	CO2, CO3, CO4	30	60	10
6.	Theme Based Designing Ramp Wear-Fashionable Technology Theme (The intersection of Design, Science and Technology)	CO2, CO3, CO4	30	60	10
7.	Theme Based Designing Store/Brand – Traditional Handicraft Theme	CO2, CO3, CO4	30	60	10
8.	Theme Based Accessories Designing Accessories Designing – Indian Heritage Theme	CO2, CO3, CO4	40	50	10
9.	Theme Based Designing -Indian Festival Theme	CO4, CO5	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
10.	Theme Based Designing – Sustainability Theme	CO5	40	50	10
11.	Theme Based Designing -Television show	CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, 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 Table	Ms steel square pipe 16 gauge, stand with powder coating paint.	All
2.	Stationery Material	Off-white Drawing Sheets	1 -11
3.	Colouring Material	Poster Color, Staddlers, Markers, Ink colors, Water colors, Oil colors etc	1-11
4.	Camera/phone camera	Resolution, pixel size, aperture, and more	1,2,7,8,9,10 and 11

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fashion Portfolio	Author-Anna Kiper	Publisher-Batsford ISBN-13:978-1849940856
2.	Pro Fashion Sketch Pad-Design and Build your Pro Portfolio	Author-Aemiliana Magnus	Publisher-Create space independent publishing platform ISBN-13:978-1719342506
3.	Mens Wear Fashion Illustration Resource book	Author-Irina Ivanova	Publisher-Art Design Project Incorporated ISBN-13-978-0692608647
4.	Childrens Wear Fashion Illustration Resource book	Author-Irina Ivanova	Publisher-Art Design Project Incorporated ISBN-13:978-0692554074
5.	Portfolio Design for Accessories	Author-Behance	Publisher-Fashion Research foundation publishing ISBN- 13: 978-0984117123
6.	Creative fashion Presentations	Author -Polly Guerin	Fairchild Publications ISBN-1563672502

(b) Online Educational Resources:

1. Logo Designing- <https://youtu.be/4MxRhjHmiVWw>
2. Technical Drawing- <https://za.pinterest.com/mmmmbeti/sketches-flats-technicalspecs/>
3. Fashion Portfolio- www.purfe.com.au
4. Handicrafts of India- <https://www.youtube.com/watch?v=4B5iSH7zdUk>
5. Hanmade in India- https://www.youtube.com/watch?v=N_4zZHBB3aE
6. India Craft- <https://www.youtube.com/watch?v=0DZYG37YiFk>
7. Accessory Design Portfolio: Behance

- A) **Course Code** : 2451603C (T2451603C/P2451603C/S2451603C)
 B) **Course Title** : Fashion Styling
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Fashion styling is one of the emerging career options with a rapid growth in fashion and film industry It also focuses on choosing and coordinating outfits for client in photo shoots and selecting appropriate props and accessories to create complete look according to theme, event, trends etc. It emphasizes the art of clothing coordination and set creation as per different client and occasions those responsible for building new fashion trends.

- 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 Outline the evolution of fashion styling and image design.
- CO-2 Classify the various styling categories according to end use.
- CO-3 Make the stylist modular design plan.
- CO-4 Apply styling techniques for various styles.
- CO-5 Identify the styling enhancements for various styles.

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

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

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

G) Teaching & Learning Scheme:

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				
2451603C	Fashion Styling	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)	
2451603C	Fashion Styling	30	70	20	30	20	30	200

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: T2451603C**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
<p><i>TSO 1a.</i> Define Styling Terminology</p> <p><i>TSO 1b.</i> Explain role of fashion media in Styling</p> <p><i>TSO 1c.</i> Differentiate between Image Design and Image Makeover.</p> <p><i>TSO 1d.</i> Outline the evolution of Fashion Styling and Image Design.</p>	<p>UNIT 1.0 Introduction and History for Fashion Styling</p> <p>1.1 – Styling Terminology</p> <p>1.1.1 Costume</p> <p>1.1.2 Contemporary Style</p> <p>1.1.3 Cutting Edge Fashion</p> <p>1.1.4 Collection</p> <p>1.1.5 Fashion Media</p> <p>1.1.6 Image Design</p> <p>1.1.7 Image Makeovers</p> <p>1.1.8 Style Trunk (stylist essential)</p> <p>1.1.9 Styling</p> <p>1.1.10 Stylist</p> <p>1.1.11 Sourcing</p> <p>1.1.12 Trend</p> <p>1.2 History of Fashion Styling and Image Design</p> <p>1.2.1 Rose Berthin</p> <p>1.2.2 Ray Petri</p> <p>1.2.3 Fashion Trend Decades</p>	CO1
<p>TSO2a. Define Advertising Styling.</p> <p>TSO2b Explain Thematic Styling for the given sample.</p> <p>TSO2c. Enlist the type(s) of Fashion Show(s).</p> <p>TSO2d. Differentiate between E-Commerce and Personal Stylist.</p> <p>TSO2e. Enlist the Styling Categories.</p> <p>TSO2f. Identify the suitable styling category for the given sample.</p> <p>TSO2g. Explain the role and Responsibilities of Fashion Stylist and Back Stage Captain.</p>	<p>Unit-2.0 Classification of Styling</p> <p>2.1 Styling Category</p> <p>2.1.1. Advertising (Product)</p> <p>2.1.2. Celebrity (Red Carpet)</p> <p>2.1.3. Dramatic Shoot</p> <p>2.1.4. Editorial Styling (Personal and Product)</p> <p>2.1.5. Runway Styling</p> <p>2.1.6. Fashion Editorial</p> <p>2.1.7. Personal /Bridal Wardrobe</p> <p>2.1.8. Still Life</p> <p>2.1.9. Television/Film</p> <p>2.1.10 Thematic Styling</p> <p>2.1.11. Costume Styling (Movies /web series)</p> <p>2.1.12. Campaign/Look book Styling</p> <p>2.1.13. Commercial Advertising Styling</p> <p>2.2 Role and Responsibilities of Fashion Stylist.</p> <p>2.3 Role of Back Stage Captain.</p>	CO2
<p>TSO3a. Explain the Principle of Clothing Co-ordination</p> <p>TSO3b. Enlist the do's and don'ts of design selection for the given sample.</p>	<p>Unit-3.0 Clothing Co-ordination</p> <p>3.1 Principle of Clothing Co-ordination</p> <p>3.1.1 Style selection –</p> <p>Dos & Don't for Design selection</p>	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
<p>TSO3c. Enlist the advantages of style selection for the given figure type</p> <p>TSO3d. Explain the purpose/use/function of set creation for the given sample.</p> <p>TSO3c. Explain the process of styling modular Plan.</p> <p>TSO3d. Explain the process of Mix and Match on the basis of seasons / Occasion / Garment and Accessories for the given sample.</p>	<p>Tall & Thin, Tall & Stout, Short & Stout, Short & Slim etc.</p> <p>3.1.2 Illusion to overcome defects- Colour, Texture and Line</p> <p>3.1.2 Set Creation- (Purpose, Use, Functions) Detail of Shape wear, Costume, Accessories, Props and background etc.</p> <p>3.1.3 Stylist Modular Dressing plan- Concept of Assemble look with Budget Constraints</p> <p>3.1.4 Mix and Match- Definition of Mix and Match, Types of Seasonal Wear, Types of Occasional Wear, Concept of Garment and Accessories Mix-Match</p>	
<p>TSO4a. Differentiate between the List the types of photography</p> <p>TSO4b. Enlist types of lighting for the give sample.</p> <p>TSO4c. Explain the importance of Public Relations.</p> <p>TSO 4d. State importance of Art Direction in the given styling.</p> <p>TSO4e. Importance of Model Agencies and Bookings.</p> <p>TSO 4f. Differentiate between Vintage Clothing and Street Style.</p> <p>TSO 4g. List the color analysis parameters for the given sample.</p> <p>TSO 4h. Apply the styling technique appropriately for the given sample.</p>	<p>Unit-4.0 Styling Techniques</p> <p>4.1 Types of Photography-</p> <p>4.1.1. Photo Macro graph</p> <p>4.1.2. Photo Micro graph</p> <p>4.1.3. High Speed Photography (Motor Driven Camera)</p> <p>4.1.4. Underwater Photography</p> <p>4.2 Types of Lighting –</p> <p>4.2.1. Rembrandt Lighting</p> <p>4.2.2. Loop Lighting</p> <p>4.2.3. Butterfly Lightning</p> <p>4.2.4. Split Lightning/Paramount Lightning</p> <p>4.3 Working With Public Relations</p> <p>4.4 Art Direction</p> <p>4.5 Model Agencies and Bookings</p> <p>4.6 Vintage Clothing and Street Style</p> <p>4.7 Colour Analysis</p>	CO4
<p>TSO 5a Explain the importance of Accessories in styling.</p> <p>TSO 5b. Explain importance of Props in styling.</p> <p>TSO 5c. Explain Importance of Hairstyle and Make up in Styling.</p>	<p>Unit-5.0 Styling Enhancement Makeover</p> <p>5.1 Accessories –</p> <p>5.1.1. Importance of Accessories</p> <p>5.1.2. Types of Accessories-Men’s, Women’s, Kids</p> <p>5.1.3. Props</p> <p>5.2 Makeup-</p> <p>5.2.1. History of make up</p> <p>5.2.2. Importance of Makeup</p> <p>5.3 Hair style-</p> <p>5.3.1. Ancient History of Hairstyle-Male, Female</p> <p>5.3.2. Importance of Hairstyle</p>	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603C

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Identify Indian bridal wedding functions for designing garments for the given sample.</p> <p><i>LSO 1.2.</i> Develop design for the given Indian bridal styling.</p> <p><i>LSO 1.3.</i> Select appropriate hairstyle, accessories, footwear and make-up for the given Indian bride.</p> <p><i>LSO 1.4.</i> Prepare a photo shoot for the given Indian bridal styling.</p>	1.	<p>Indian Bridal Styling-All aspects of Bridal wedding functions like Mendi, Sangeet, Wedding ceremony etc.</p> <ul style="list-style-type: none"> Develop designs for wedding clothes, put together the entire look from hairstyle, make-up, accessories and footwear etc. for the given sample. (any 4) Document the looks through a photo shoot. 	CO1
<p><i>LSO 2.1.</i> Identify western bridal wedding functions for designing garments for the given sample.</p> <p><i>LSO 2.2.</i> Develop designs for the given western bridal styling.</p> <p><i>LSO 2.3.</i> Select appropriate hairstyle, accessories, footwear and make-up for the given western bride.</p> <p><i>LSO 2.4.</i> Prepare a photo shoot for the given western bridal styling.</p>	2.	<p>Western Bridal Styling-All aspects of western Bridal wedding functions.</p> <ul style="list-style-type: none"> Develop design for wedding clothes, put together the entire look from hairstyle, make-up, accessories and footwear etc. for the given sample. (any 4) Document the looks through a photo shoot. 	CO1
<p><i>LSO 3.1.</i> Identify the latest fashion garments for the given Bollywood film/television.</p> <p><i>LSO 3.2.</i> Analysis the latest fashion garments for the given Bollywood film/television.</p> <p><i>LSO 3.3.</i> Identify the latest fashion styles for the given Bollywood film/television.</p> <p><i>LSO 3.4.</i> Analysis the latest fashion styles for the given Bollywood film/television.</p> <p><i>LSO 3.5.</i> Identify the latest fashion silhouettes for the given Bollywood film/television.</p> <p><i>LSO 3.6.</i> Analysis the latest fashion silhouettes for the given Bollywood film/television.</p> <p><i>LSO 3.7.</i> Analysis the latest fashion color prints for the given Bollywood film/television.</p> <p><i>LSO 3.8.</i> Identify and analysis the latest fashion color prints for the given Bollywood film/television.</p> <p><i>LSO 3.9.</i> Identify the latest fashion technical information for the given Bollywood film/television.</p> <p><i>LSO 3.10.</i> Analysis the latest fashion technical information for the given Bollywood film/television.</p>	3.	<p>Bollywood Film/ Television Styling: Analysis the given collection of fashion editorial. (identify the latest fashion garments, accessories, their trends, styles, silhouettes, colour prints and other technical informations).</p>	CO1
<p><i>LSO 4.1.</i> Identify the latest fashion garments for the given Hollywood film/television.</p>	4.	<p>Hollywood Film/ Television Styling: Analysis the given collection of fashion</p>	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 4.2.</i> Analysis the latest fashion garments for the given Hollywood film/television.</p> <p><i>LSO 4.3.</i> Identify the latest fashion trends for the given Hollywood film/television.</p> <p><i>LSO 4.4.</i> Analysis the latest fashion trends for the given Hollywood film/television.</p> <p><i>LSO 4.5.</i> Identify the latest fashion styles for the given Hollywood film/television.</p> <p><i>LSO 4.6.</i> Analysis the latest fashion styles for the given Hollywood film/television.</p> <p><i>LSO 4.7.</i> Identify the latest fashion silhouettes for the given Hollywood film/television.</p> <p><i>LSO 4.8.</i> Analysis the latest fashion silhouettes for the given Hollywood film/television.</p> <p><i>LSO 4.9.</i> Identify the latest fashion color prints for the given Hollywood film/television.</p> <p><i>LSO 4.10.</i> Analysis the latest fashion color prints for the given Hollywood film/television.</p> <p><i>LSO 4.11.</i> Identify the latest fashion technical information for the given Hollywood film/television.</p> <p><i>LSO 4.12.</i> Analysis the latest fashion technical information for the given Hollywood film/television.</p>		editorial on the basis of the latest fashion garments, accessories, their trends, styles, silhouettes, color prints and other technical information.	
<p><i>LSO 5.1.</i> Select appropriate style, silhouette, color, prints suitable for all the examined body shapes for sport player for developing personal styling image.</p> <p><i>LSO 5.2.</i> Develop various boards for fashion styling according to Sport player needs and preferences.</p>	5.	Personal Styling for the given Sports Player: Recognize style, silhouette, colour, prints suitable for all the examined body shapes and prepare various boards fashion styling according to client's needs and preferences.	CO3, CO4, CO5
<p><i>LSO 6.1.</i> Select appropriate style, silhouette, color, prints suitable for all the examined body shapes for the given Indian female politician for developing personal styling image.</p> <p><i>LSO 6.2.</i> Develop various boards for fashion styling according to the given Indian female politician needs and preferences.</p>	6.	Personal Styling for the given Indian female Politician: Recognize style, silhouette, color, prints suitable for all the examined body shapes and prepare various boards fashion styling according to client's needs and preferences.	CO3, CO4, CO5
<p><i>LSO 7.1.</i> Select appropriate style, silhouette, color, prints suitable for all the examined body shapes for the given western male politician for developing personal styling image.</p> <p><i>LSO 7.2.</i> Develop various boards for fashion styling according to the given western male politician needs and preferences.</p>	7.	Personal Styling for the given Western male Politician: Recognize style, silhouette, color, prints suitable for all the examined body shapes and prepare various boards fashion styling according to client's needs and preferences.	CO3, CO4, CO5
<p><i>LSO 8.1.</i> Choose four different looks your client according to his/her singing stage event.</p>	8.	Create Look Book for the given event:	CO3, CO4, CO5
		<ul style="list-style-type: none"> • Styling looks for your client with a combination of garment/accessories/makeup to 	

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 8.2.</i> Choose suitable design garment/accessories/makeup to create look and concept for your client according to his /her Singing Stage Event.</p> <p><i>LSO 8.3.</i> Produce document for his/her looks through a photo shoot.</p>		<p>create look and concept for Singing Stage Event (any 4 looks).</p> <ul style="list-style-type: none"> Document the looks through a photo shoot. 	
<p><i>LSO 9.1.</i> Choose four different looks your client according to his/her Product Campaign.</p> <p><i>LSO 9.2.</i> Choose suitable design garment/accessories/makeup to create look and concept for your client according to his /her Product Campaign Event.</p> <p><i>LSO 9.3.</i> Produce document for his/her looks through a photo shoot.</p>	9.	<p>Create Look Book for the given Product Campaign:</p> <ul style="list-style-type: none"> Styling looks for your client with a combination of garment/accessories/makeup to create look and concept for Product Campaign (any 4 looks). Document the looks through a photo shoot. 	CO3, CO4, CO5
<p><i>LSO 10.1.</i> Identify looks for E-Commerce and Catalog Styling.</p> <p><i>LSO 10.2.</i> Select designs for E-Commerce and Catalog Styling for the given client.</p> <p><i>LSO 10.3.</i> Select appropriate style, silhouette, color, prints suitable for all the examined body shapes for sport player for developing E-Commerce and Catalog Styling.</p>	10.	<p>E-Commerce and Catalog Styling: Identify the look, develop two designs for the given latest E-Commerce and Catalog fashion garments, accessories, their trends, styles, silhouettes, color prints.</p>	CO3, CO4, CO5
<p><i>LSO 11.1.</i> Identify looks for Kids Styling.</p> <p><i>LSO 11.2.</i> Select designs for kids Styling.</p> <p><i>LSO 11.3.</i> Select appropriate style, silhouette, color, prints suitable for all the examined body shapes kids styling.</p>	11.	<p>Kids Styling: Identify the look, develop two designs for the given latest kids brand fashion garments, accessories, their trends, styles, silhouettes, color prints.</p>	CO3, CO4, CO5

L) Suggested Term Work and Self Learning: S2451603C

Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Analyse the traditional sarees styling and submit a report on the trend analysis.
- ii. Analyse the development of denim jeans and submit a report on the styling using denim.
- iii. Collect newspaper articles of fashion stylists and submit a collage highlighting their styles.
- iv. Choose a celebrity and compare the various looks in personal styling and submit a swatch book of the same.

b. Micro Projects:

- Conduct a Shoot to prepare a fashion look book for a specific Brand (renowned /newly launched)/ Design/ Accessories. Study and note down all the different aspects like-design concept, personality, event, source, backdrop, Final touch and end movement requirement for a complete event.

(Any one from the following)

1. Commercial Advertisement/ Native product Advertising
2. Editorial Styling

- 3.Movie/ Theater Styling
- 4.Fashion Show Styling
- 5.Dance/Singing Shows Styling
- 6.Personal Styling-Sports man, Actor etc.
- 7.Suggest Tagline for the Product

c. Other Activities:

1. Seminar Topics:

Body Shape analysis for fashion styling

- Understanding different body shapes and their characteristics.
- Identifying styles, silhouettes, colors and prints that flatter each body shape.
- Practicing body shape analysis on models or classmates.

2.Visits:

Visit a nearby Fashion stylist Studio. Prepare report of visit with special comments of fashion styling technique used, material used and Concept of Assemble look with Budget Constraints.

3.Self-Learning Topics:

- Fashion and Styling
- Trends in fashion.
- Roles and Responsibilities of Fashion Stylist

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	30%	10%	25%	-	10%	20%
CO-3	15%	30%	15%	25%	33%	15%	20%
CO-4	30%	15%	30%	25%	33%	15%	20%
CO-5	30%	10%	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 (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit- 1.0 Introduction and History for fashion styling	8	CO1	10	3	3	4
Unit-2.0 Classification of Styling	12	CO2	20	5	6	9
Unit-3.0 Clothing Co-ordination	12	CO3	20	4	6	10
Unit-4.0 Styling Techniques	8	CO4	10	5	2	3
Unit-5.0 Styling Enhancement Makeover	8	CO5	10	5	2	3
Total	48	-	70	22	19	29

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.	Indian Bridal Styling -All aspects of Bridal wedding functions like Mendi, Sangeet, Wedding ceremony etc. Develop 4 designs for wedding clothes, put together the entire look from hairstyle, make-up, accessories and footwear etc Document the looks through a photo shoot.	CO 2, CO3, CO4, CO5	30	60	10
2.	Western Bridal Styling -All aspects of western Bridal wedding functions. Develop 4 designs for wedding clothes, put together the entire look from hairstyle, make-up, accessories and footwear etc Document the looks through a photo shoot.	CO 2, CO3, CO4, CO5	40	50	10
3.	Bollywood Film/ Television Styling: Analysis the collection of fashion editorial to identify the latest fashion garments, accessories, their trends, styles, silhouettes, color prints and other technical information.	CO 2, CO3, CO4, CO5	30	60	10
4.	Hollywood Film/ Television Styling: Analysis and collection of fashion editorial to identify the latest fashion garments, accessories, their trends, styles, silhouettes, color prints and other technical information.	CO 2, CO3, CO4, CO5	30	60	10
5.	Personal Styling for Sport Player: Recognize style, silhouette, color, prints suitable for all the examined body shapes and prepare various boards fashion styling according to client's needs and preferences.	CO3, CO4, CO5	30	60	10
6.	Personal Styling for Indian female Politician: Recognize style, silhouette, color, prints suitable for all the examined body shapes and prepare various boards fashion styling according to client's needs and preferences.	CO3, CO4, CO5	30	60	10
7.	Personal Styling for Western male Politician: Recognize style, silhouette, color, prints suitable for all the examined body shapes and prepare various boards fashion styling according to client's needs and preferences.	CO3, CO4, CO5	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
8.	Create Look Book: Styling four looks for your client with a combination of garment/accessories/makeup to create look and concept for Singing Stage Event . Document the looks through a photo shoot.	CO3, CO4, CO5	40	50	10
9.	Create Look Book: Styling four looks for your client with a combination of garment/accessories/makeup to create look and concept for Product Campaign . Document the looks through a photo shoot.	CO4, CO5	40	50	10
10.	E-Commerce and Catalog Styling: Identify the look, develop two designs for the latest E-Commerce and Catalog fashion garments, accessories, their trends, styles, silhouettes, color prints.	CO3, CO4, CO5	40	50	10
11.	Kids Styling: Identify the look, develop two designs for the latest kids brand fashion garments, accessories, their trends, styles, silhouettes, color prints.	CO3, CO4, CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, 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 Table	Ms steel square pipe 16 gauge, stand with powder coating paint.	All
2.	Stationery Material	Off-white Drawing Sheets	1 -11
3.	Colouring Material	Poster Color, Staddlers, Markers, Ink colors , Water colors, Oil colors etc	1-11
4.	Camera/phone camera	Resolution, pixel size, aperture, and more	1,2,7,8,9,10 and 11

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fashion Styling	Jo Dingemans	Red Globe Press Publishing, ISBN-13:978-0333770924
2.	Fashion Stylist	Gillian Armour	Create Space Publishing, ISBN-13:9781450588102

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
3.	The professional Wardrobe Stylist	Gillian Armour	Create Space Publishing, ISBN-13:9781480140233
4.	How to do color Analysis	Gillian Armour	Create Space Publishing, ISBN-13:9781461028116
5.	Stylist-The interprets of Fashion	Shannon Burns	Rizzoli Publishing, ISBN-13:978-0847829248
6.	Fashion Stylists Handbook	Danielle Griffiths	Laurence King Publishing, ISBN-13:9781780678559

(b) Online Educational Resources:

1. Fashion Styling-<https://austrianstyleinstitute.com.au/what-an-editorial-stylist-does-and-how-to-become-one/>
2. Personal Stylist-https://en.wikipedia.org/wiki/Personal_stylist
3. Celebrity Stylist-<http://www.whowhatwear.com/celebrity-style-lessons/slide14>
4. Props and Set Styling- <https://www.styledepartment.co.uk/prop-and-set-styling/>
5. Catalogue styling- <https://issuu.com/blog/catalogs-and-lookbooks>
6. <https://youtu.be/XL8fIbEJ6EY>
7. <https://www.caseypaulstyling.co.uk>
8. <http://youtu.be/1jyEiD0dGi8>
9. https://issuu.com/docs/cizraclugston/docs/fashion_stylist_research_pdf

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

- A) **Course Code** : 2451603D (T2451603D/P2451603D/S2451603D)
 B) **Course Title** : Garment Export and Documentation
 C) **Pre- requisite Course(s)** : Fashion buying and Merchandising
 D) **Rationale** :

Garments are exported within different countries. The students need to be aware of different registration, licence, procedures, and formats regarding export documentation. Different processes and the agencies involved in it need to be known. This subject orients the student to carry out those processes and prepare documents for Garment export.

- 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 know Procedure for Export merchandising and export documentation required for exporting garment.

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

- CO-1** Identify various distribution networks for export.
CO-2 Apply various export legal norms pertaining to registration and licensing to register the firm for garment export merchandising.
CO-3 Prepare various documents required for garment export merchandising procedures.
CO-4 Calculate the price for exports.
CO-5 Prepare various documents for pre-shipment and post-shipment procedure of merchandises.

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	1	1	1	2		
CO-2	3	2	2	1	1	1	2		
CO-3	3	2	1	2	1	1	1		
CO-4	3	2	2	2	1	2	2		
CO-5	3	1	3	1	1	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				
2451603D	Garment Export and Documentation	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)	
2451603D	Garment Export and Documentation	30	70	20	30	20	30	200

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: T2451603D**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain export merchandising.</p> <p><i>TSO 1b.</i> Identify types of Export.</p> <p><i>TSO 1c.</i> Select the export strategy for the given garment.</p> <p><i>TSO 1d.</i> Developing an export organization.</p> <p><i>TSO 1e.</i> Identify the distribution network for export of the given garment.</p> <p><i>TSO 1f.</i> State the advantages and disadvantages of exporting.</p> <p><i>TSO 1g.</i> Write the steps of garment export order execution.</p> <p><i>TSO 1h.</i> Role of merchandiser of the given export garment.</p> <p><i>TSO 1i.</i> Explain the types of garments sampling.</p> <p><i>TSO 1j.</i> Identify the garment sampling for the given export.</p> <p><i>TSO 1k.</i> List the type of person taking pre-production for the given export.</p> <p><i>TSO 1l.</i> Explain the sources of accessories and material required for garment production.</p>	<p>Unit-1.0 Garment Export Merchandising and Sourcing</p> <p>1.1 Export Definition and types</p> <p>1.2 Export strategy</p> <p>1.3 Export organization structure</p> <p>1.4 Exporting garment</p> <p>1.5 Export advantages and disadvantages.</p> <p>1.6 Garment export order execution</p> <p>1.7 Roles and functions of merchandiser of export garment.</p> <p>1.8 Garment Sampling and its types for export</p> <p>1.9 Reproduction meeting</p> <p>1.10 Sourcing of accessories and materials required for exporting garments.</p>	CO1
<p><i>TSO 2a.</i> Explain the scope of garment export in India.</p> <p><i>TSO 2b.</i> Identify the role of Indian government to promote garment export in India.</p> <p><i>TSO 2c.</i> Write out a step-by-step procedure to start a garment export business.</p> <p><i>TSO 2d.</i> Identify the prerequisite to create an export plan for the given garment.</p> <p><i>TSO 2e.</i> Apply the procedure to set up a production unit for the given garment.</p> <p><i>TSO 2f.</i> Explain various mandatory licenses for export business.</p> <p><i>TSO 2g.</i> Identify the approach to get an export order for the given garment.</p> <p><i>TSO 2h.</i> Use the export registration cum membership certificate, step-by-step procedure.</p> <p><i>TSO 2i.</i> Apply processing on export order.</p>	<p>Unit-2.0 Registration process of Garment Exporting Firm.</p> <p>2.1 Scope of export in India.</p> <p>2.2 Role of the Indian government to promote Garment export in India.</p> <p>2.3 Plan To start an export business.</p> <p>2.4 Steps to start export business, and licencing for export business</p> <p>2.5 Processing an export order</p>	CO1, CO2

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 3a.</i> Explain garment export procedure and documentation required for the given export.</p> <p><i>TSO 3b.</i> Identify the documents required for export of garment.</p> <p><i>TSO 3c.</i> Compare the documents required for exporting of the given garment merchandise.</p> <p><i>TSO 3d.</i> Explain invoice for exporting of the given garment merchandise.</p> <p><i>TSO 3e.</i> Identify the types of invoice(s) for government export.</p> <p><i>TSO 3f.</i> Explain letter of credit.</p> <p><i>TSO 3g.</i> Identify the types of letter of credit for exporting</p> <p><i>TSO 3h.</i> Explain the bill of lading and shipping bill.</p> <p><i>TSO 3i.</i> Use the list of export documents for the given garment export.</p>	<p>Unit-3.0 Foreign Trade Documents</p> <p>3.1 Need rational and types of documents related to Garment export.</p> <p>3.2 Invoice containing HSN code, packaging notes and list, certificate of origin.</p> <p>3.3 Certificate related to shipment, shipping bill, certificate of measurement.</p> <p>3.4 Bill of landing, Airways bill, document related to payment, letter of credit, bill of exchange, letter of hypothecation, bank certificate for payment.</p> <p>3.5 Documents related to inspection certificate of inspection- COGSP and other forms.</p>	<p>CO3, CO4</p>
<p><i>TSO 4a.</i> Explain garment pricing calculation.</p> <p><i>TSO 4b.</i> Identify the garment costing for the given export order.</p> <p><i>TSO 4c.</i> Use of costing functions to find out standard export order costing.</p> <p><i>TSO 4d.</i> Explain the term FOB, C&A and CIF used to calculate garment cost.</p> <p><i>TSO 4e.</i> Explain the role of GST in garment export.</p>	<p>Unit-4.0 Export Pricing</p> <p>4.1 Garment costing, quick and final cost.</p> <p>4.2 Export pricing Skimming and penetration.</p> <p>4.3 Pricing concept-Ex works</p> <p>4.4 FOB, cost, and freight (C & F)</p> <p>4.5 Cost insurance freight (CIF), Delivery duty unpaid (DDU), Delivery duty paid(DDP)</p> <p>4.6 Goods and service tax (GST)</p>	<p>CO3, CO4</p>
<p><i>TSO 5a.</i> Explain the shipping documents required for government export.</p> <p><i>TSO 5b.</i> Identify the type(s) of shipping document format for the given export.</p> <p><i>TSO 5c.</i> Preparing the shipping document for the given garment export.</p> <p><i>TSO 5d.</i> Explain the pre-shipment procedure for the given garment export.</p> <p><i>TSO 5e.</i> Identify the pre-shipment procedure for the given garment export</p> <p><i>TSO 5f.</i> Prepare the documents required for the given pre-shipment.</p> <p><i>TSO 5g.</i> Explain the post-shipment procedure for garment export.</p> <p><i>TSO 5h.</i> Identify the post-shipment procedure for government export.</p> <p><i>TSO 5i.</i> Prepare the document required for post-shipment.</p> <p><i>TSO 5j.</i> Explain shipping agents.</p>	<p>Unit-5.0 Shipment and Custom</p> <p>5.1 Pre-shipment inspection and quality control, Foreign exchange formalities pre-shipment,</p> <p>5.2 Shipment documents, shipping of goods and Port procedure, custom clearance, warehousing charges.</p> <p>5.3 Post shipment formalities and procedure.</p> <p>5.4 Claim duty drawback and other benefits.</p> <p>5.5 Role of Clearing and forwarding agent.</p>	<p>CO5</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<i>TSO 5k.</i> Identify the role of clearing and forwarding agent for the given export.		

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603D

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Identify the sample for garment export business.</p> <p><i>LSO 1.2.</i> Select an appropriate sample for export.</p> <p><i>LSO 1.3.</i> Plan export strategy.</p> <p><i>LSO 1.4.</i> Prepare export order execution plan.</p> <p><i>LSO 1.5.</i> Develop a sample garment as per export order.</p>	1.	Develop a sample garment for export of the given garment merchandise.	CO1
<p><i>LSO 2.1.</i> Identify the role of Indian apparel export council.</p> <p><i>LSO 2.2.</i> Select the export garment firm.</p> <p><i>LSO 2.3.</i> Develop the garment export business.</p>	2.	Survey on role of Apparel export promotional council for foreign trade for export of the given garment merchandise.	CO1
<p><i>LSO 3.1.</i> Identify the registration process for export business.</p> <p><i>LSO 3.2.</i> Select the documents required for registration process of export business.</p> <p><i>LSO 3.3.</i> Use the document to get the export license.</p>	3.	Write down the procedure for getting the export license preparation for export of the given garment merchandise.	CO1
<p><i>LSO 4.1.</i> Identify the 11 standard shipping documents for export that you need to understand in order to be successful.</p> <p><i>LSO 4.2.</i> Identify documents required for exporting.</p> <p><i>LSO 4.3.</i> Select document required for exporting.</p> <p><i>LSO 4.4.</i> Prepare the documents for garment export.</p>	4.	Prepare a document for registration process of export business licensing for export of the given garment merchandise.	CO2
<p><i>LSO 5.1.</i> Identify the elements of bill of entry, Landing, Invoice documents for export of the given garment merchandize.</p> <p><i>LSO 5.2.</i> Select document detailing required for bill of entry, Landing and Invoice for export of the given garment merchandize.</p> <p><i>LSO 5.3.</i> Prepare the bill of entry, Landing and Invoices for export of the given garment merchandize.</p>	5.	<p>For export of the given garment merchandise Prepare the documents (use HSN code) for Garment products</p> <ul style="list-style-type: none"> ● Proforma Invoice ● Commercial Invoice ● Packing List ● Certificates of Origin ● Certificate of Free Sale ● Shipper's Letter of Instruction ● Inland Bill of Lading ● Ocean Bill of Lading ● Air Waybill ● Dangerous Goods Forms ● Bank Draft 	CO3, CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 6.1.</i> Identify the contents of cost sheet.</p> <p><i>LSO 6.2.</i> Select the appropriate elements of the given garment export.</p> <p><i>LSO 6.3.</i> Prepare a cost sheet for the given garment export.</p> <p><i>LSO 6.4.</i> Prepare the cost sheet document using the term FOB, C&A and CIF to calculate garment cost.</p>	6.	Make a document of cost sheet for your export garment form.	CO3, CO4, CO5
<p><i>LSO 7.1.</i> Identify the documents for exporting different types of government.</p> <p><i>LSO 7.2.</i> Select the government type for exporting.</p> <p><i>LSO 7.3.</i> Prepare the documents for exporting the given garments.</p>	7.	Prepare at least two documents for export pricing for various type of garment.	CO3, CO4, CO5
<p><i>LSO 8.1.</i> Identified GST for different type of garment export.</p> <p><i>LSO 8.2.</i> Select the GST percentage for type(s) of the given garment export.</p> <p><i>LSO 8.3.</i> Use the GST percentage for different types of garment export.</p>	8.	Prepare a garment cost sheet using GST.	CO3, CO4, CO5
<p><i>LSO 9.1.</i> Identify pre-shipment documents for garment export.</p> <p><i>LSO 9.2.</i> Select the pre-shipment document as per rules of different country for the given garment export.</p> <p><i>LSO 9.3.</i> Use the free shipment document for the given government export.</p>	9.	Prepare the document for pre-shipment procedure	CO4, CO5
<p><i>LSO 10.1.</i> Identify post-shipment documents for garment export.</p> <p><i>LSO 10.2.</i> Select the post-shipment document as per rules of different country for the given garment export.</p> <p><i>LSO 10.3.</i> Use the post shipment document for government export.</p>	10.	Prepare the varies documents for post shipment procedure	CO5
<p><i>LSO 11.1.</i> Identify the role of forwarding and clearing agent.</p> <p><i>LSO 11.2.</i> Select the documents required for forwarding and clearing agent.</p> <p><i>LSO 11.3.</i> Use the document from clearing and forwarding agent for exporting of the given garment.</p>	11.	Write a report on the role of clearing and forwarding agent.	CO5

L) Suggested Term Work and Self Learning: S2451603D

Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Prepare a report on role of the Indian government to promote Garment export.
- ii. Make a presentation on garment export in India for last 3 years.
- iii. Prepare all types of documents required to export ready-made garments to the UK.

b. Micro Projects:

1. Visit your nearby export house and prepare a report on the visit.
2. Make a report on different type of HSN code used for garment export.
3. Makeup presentation on clearing and forwarding agent.

c. Other Activities:

1. Seminar Topics:

- Recent promotional activities by export promotional council of India.
- New policies and procedure implemented by international export trade council.

2. Visits: Visit nearby export house/ garment expo and observe and write down the following ..

- Examine the documents used for export of garment.
- Check the different sample garment.
- Inspection and quality check report of merchandiser for exporting of garment.
- Pre-shipment procedure for exporting the garment.

3. Self-Learning Topics:

- Prepare a scrapbook for different the types of documents use in import and export procedure.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid-Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	15%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	30%	30%	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 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 Garment Export Merchandising and Sourcing	8	CO1	12	4	4	4
Unit-2.0 Registration process of Garment Exporting Firm.	6	CO1, CO2	8	4	4	0
Unit-3.0 Foreign Trade Documents	16	CO3, CO4	24	4	8	12
Unit-4.0 Export pricing	8	CO3, CO4	12	4	4	4
Unit-5.0 Shipment and Custom	10	CO4, CO5	14	4	4	6
Total	48	-	70	20	24	26

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Develop a sample garment for export.	CO1	30	60	10
2.	Survey on role of Appral export promotional council for foreign trade.	CO1	40	50	10
3.	Write down the procedure for getting the export license preparation.	CO1	30	60	10
4.	Prepare a document for registration process of export business licensing.	CO2	30	60	10
5.	Prepare the documents as (use HSN code) for Garment products <ul style="list-style-type: none"> ● Proforma Invoice ● Commercial Invoice ● Packing List ● Certificates of Origin ● Certificate of Free Sale 	CO3,	20	70	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	<ul style="list-style-type: none"> Shipper's Letter of Instruction Inland Bill of Lading Ocean Bill of Lading Air Waybill Dangerous Goods Forms Bank Draft 				
6.	Make a document of cost sheet for your export garment form.	CO3, CO4,	30	60	10
7.	Prepare at least two documents for export pricing for various type of garment.	CO3, CO4,	30	60	10
8.	Prepare a garment cost sheet using GST.	CO3, CO4,	40	50	10
9.	Prepare the document for pre shipment procedure	CO4, CO5	30	60	10
10.	Prepare the varies documents for post shipment procedure	CO4, CO5	30	60	10
11.	Write a report on the role of clearing and forwarding agent.	CO4, CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, 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.	High-end computers	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Projector	Epson EB-X49 XGA Projector Brightness: 3600lm with HDMI Port (Optional Wi-Fi) (V11H982040) (Brand name is used for product Specification details)	All

APH Publishing Corporation (1 January 2009)

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Export Import Procedures and Documentations	Neelam Arora	Himalaya pub ISBN: 978-93-5142-503-8
2.	Export Import Procedures and Documentations	Madurima Lall/Sultan Ahmad	Sultan Chand & Sons ISBN: 81-951043-6-9
3.	Garment Export Industry of India	P. P. Deshpande	APH Publishing Corporation (1 January 2009) ISBN 10: 8131304647, ISBN 13: 978-8131304648
4.	Apparel and Textile Exports	Pradeep Joshi	CBS Publishers & Distributors ISBN: 9788123913247, 9788123913247

(b) Online Educational Resources:

1. <https://garmentsmerchandising.com/flow-chart-of-garments-export-process/https://www.fibre2fashion.com/industry-article/4469/garment-merchandising-and-export-procedures>
2. <https://textileapex.com/14-key-responsibilities-of-a-garments-merchandiser/>
3. <https://textilelearner.net/role-of-merchandiser-in-garment-industry/>
4. <https://smallbusiness.chron.com/export-merchandising-16068.html>
5. <https://www.onlineclothingstudy.com/2013/10/garment-export-house-departments-and.html?m=1#:~:text=A%20garment%20export%20house%20procures,garments%20to%20the%20destination%20countries.>
6. <https://www.linkedin.com/pulse/top-10-roles-production-merchandiser-#:~:text=An%20export%2Fproduction%20merchandiser's%20role,within%20the%20time%20frame%20specified.>
7. <https://textilelearner.net/step-by-step-execution-of-garment-export-order/>
8. <https://www.linkedin.com/pulse/most-important-guide-garment-export-all-information-one-place->
9. <https://textilemerchandising.com/garments-costing-for-export-order/>

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:

Export Import Procedures : Documentation and Logistics -C. Rama Gopal
 Customs Import Export Procedures
 RCMC Guideline

- A) **Course Code** : 2451603E (T2451603E/P2451603E/S2451603E)
 B) **Course Title** : Special Purpose Clothing
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Special Purpose Clothing course aims to equip students with the knowledge and skills necessary to design and create garments tailored for specific activities or environments. By exploring the unique requirements of various industries and pursuits, such as healthcare, sports, and protective wear, students will learn to conceptualize and execute specialized clothing designs. Through hands-on projects and case studies, students will gain an understanding of the materials, technologies, and ergonomics involved in producing functional and comfortable special purpose clothing. The course will also emphasize sustainability and ethical considerations in the production of special purpose garments, fostering a holistic approach to design and manufacturing. Ultimately, graduates of this course will be well-prepared to meet the diverse needs of consumers and industries through innovative and purpose-driven clothing solutions.

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

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

- CO-1** Identify the various types of clothing required for various wears (protective wear, sportswear, health care)
CO-2 Outline the various technological advancements in special purpose clothing with respect to various purposes.
CO-3 Apply principles of design in accordance to the physical/organizational ergonomics, incorporate industry standards and sketch patterns for the various subject based special purpose clothing.
CO-4 Choose suitable pattern making techniques for developing the paper patterns required to make the garments.
CO-5 Stitch well finished garments with relevant trims and technology for various special purpose clothing

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

Course Outcomes (COs)	Programme Outcomes(POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	1	1	-	-	-	1		
CO-2	3	1	1	-	-	-	1		
CO-3	3	3	2	2	3	3	3		
CO-4	3	3	3	3	2	2	2		
CO-5	3	3	3	3	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				
2451603E	Special Purpose Clothing	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)	
2451603E	Special Purpose Clothing	30	70	20	30	20	30	200

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 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: T2451603E**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the significance of special purpose clothing in the context of the fashion industry.</p> <p><i>TSO 1b.</i> Identify key historical developments and trends that have influenced the evolution of the given special purpose clothing.</p> <p><i>TSO 1c.</i> Analyze the role of the given special purpose clothing in addressing specific needs and challenges in specific sector(s).</p> <p><i>TSO 1d.</i> Classify the given types of special purpose clothing based on their intended use and functionality (performance wear, protective clothing, medical apparel, and uniforms).</p> <p><i>TSO 1e.</i> Evaluate the unique design and construction requirements for each type of special purpose clothing.</p> <p><i>TSO 1f.</i> Compare and contrast the materials, features, and performance characteristics of the given type(s) of special purpose clothing.</p>	<p>Unit -1.0 Introduction & overview of Special Purpose Clothing</p> <p>1.1 - Definition and significance.</p> <p>1.2 Historical Context</p> <p>1.3 Evolution in the Fashion Industry.</p> <p>1.4 Different Special Purposes.</p>	CO1
<p><i>TSO 2a.</i> Identify the fabric(s) suitable for different the given special purposes, considering factors such as durability, breathability, and moisture-wicking properties.</p> <p><i>TSO 2b.</i> Identify the fibers, weaves/ structure/ pattern of the textiles used in making the given type(s) of clothing.</p> <p><i>TSO 2c.</i> Evaluate the impact of technological advancements, such as smart textiles and sustainable materials, on the design and production of the given special purpose clothing.</p> <p><i>TSO 2d.</i> Outline the principles of fabric selection and technology to create innovative and functional designs for the given specific purposes.</p>	<p>Unit-2.0 Fabric Selection and Technology</p> <p>2.1 Fabrics suitable for various purposes</p> <ul style="list-style-type: none"> - Performance wear - Protective clothing - Medical and healthcare apparel - Uniforms and workwear <p>2.2 Technological advancements in special purpose textiles for all the above-mentioned fabrics.</p>	CO1, CO2
<p><i>TSO 3a.</i> Apply principles of design, including balance, proportion, and symmetry, to</p>	<p>Unit-3.0 Design Principles for Special Purpose Clothing (Performance wear, Protective</p>	CO3, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>create the given aesthetically pleasing the given special purpose clothing sample.</p> <p><i>TSO 3b.</i> Integrate ergonomic considerations into the design process to optimize comfort, mobility, and performance for the given sample.</p> <p><i>TSO 3c.</i> Identify an understanding of industry standards and regulations governing the design and production of the given special purpose clothing.</p>	<p>clothing, Medical and healthcare apparel, Uniforms and workwear)</p> <p>3.1 Balancing aesthetics and functionality 3.2 Ergonomics in design. 3.3 Incorporating industry standards.</p>	
<p><i>TSO 4a.</i> Identify advanced pattern making techniques to create custom-fit designs for the given special purpose clothing.</p> <p><i>TSO 4b.</i> Evaluate proficiency in the given garment construction methods suitable for different types of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>TSO 4c.</i> Explain principles of fit, function, and durability into the construction of the given special purpose garments.</p>	<p>Unit-4.0 Pattern Making and Garment Construction (Performance wear, Protective clothing, Medical and healthcare apparel, Uniforms and workwear)</p> <p>4.1 Tailoring techniques for different purposes 4.2 Body movement and comfort</p>	CO3, CO4
<p><i>TSO 5a.</i> Select industries producing the given special purpose clothing.</p> <p><i>TSO 5b.</i> Analyze the given case studies of successful special purpose clothing designs, identifying key elements of their success and innovation.</p> <p><i>TSO 5c.</i> Evaluate current trends and emerging technologies in the field of the given special purpose fashion, and their potential impact on future design practices.</p> <p><i>TSO 5d.</i> Outline findings from case studies and industry trends to inform the development of original design concepts for the given special purpose clothing.</p> <p><i>TSO 5e.</i> Identify relevant safety and industry standards governing the design, production, and labeling of special purpose clothing.</p> <p><i>TSO 5f.</i> Explain ethical considerations related to the use of materials, production processes, and labor practices in the given special purpose clothing industry.</p> <p><i>TSO 5g.</i> Outline strategies for ensuring compliance with regulations and standards while maintaining design integrity and innovation in the given sample.</p>	<p>Unit-5.0 Case Studies and Industry Trends</p> <p>5.1 Successful examples and stories. 5.2 Current trends in special purpose fashion. 5.3 Regulations and Standards 5.4 Compliance with safety and industry standards. 5.5 Ethical considerations in special purpose clothing production.</p>	CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603E

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Apply principles of design, including balance, proportion, and symmetry, to create the given aesthetically pleasing special purpose clothing.</p> <p><i>LSO 1.2.</i> Identify the fabric and trims to make the given garment.</p> <p><i>LSO 1.3.</i> Draw the fashion sketch of the given garment.</p> <p><i>LSO 1.4.</i> Draw the technical sketch in front and back view of the given garment.</p> <p><i>LSO 1.5.</i> Develop the pattern template in 1:4 scale of the given garment.</p> <p><i>LSO 1.6.</i> Prepare the specification sheet for the given sample.</p> <p><i>LSO 1.7.</i> Estimate the required fabric by marking the lay plan on paper in 1:4 scale for the given sample.</p> <p><i>LSO 1.8.</i> Prepare the cost sheet for the given sample.</p>	1.*	Design special Purpose clothing for subject based performance wear also develop the technical document including Flat sketch, Specification table, Drawing of the draft, Lay plan, and Cost sheet.	CO1, CO2, CO3
<p><i>LSO 2.1.</i> Apply principles of design, including balance, proportion, and symmetry, to create the given aesthetically pleasing special purpose clothing.</p> <p><i>LSO 2.2.</i> Identify the fabric and trims to make the given garment.</p> <p><i>LSO 2.3.</i> Draw the fashion sketch for the given sample.</p> <p><i>LSO 2.4.</i> Draw the technical sketch in front and back view for the given sample.</p> <p><i>LSO 2.5.</i> Develop the pattern template in 1:4 scale for the given sample.</p> <p><i>LSO 2.6.</i> Prepare the specification sheet for the given sample.</p> <p><i>LSO 2.7.</i> Estimate the required fabric by marking the lay plan on paper in 1:4 scale for the given sample.</p> <p><i>LSO 2.8.</i> Prepare the cost sheet for the given sample.</p>	2.*	Design special Purpose Clothing for subject based protective clothing also develop the technical document including Flat sketch, Specification table, Drawing of the draft, Lay plan, and Cost sheet.	CO1, CO2, CO3
<p><i>LSO 3.1.</i> Apply principles of design, including balance, proportion, and symmetry, to create the given aesthetically pleasing special purpose clothing.</p> <p><i>LSO 3.2.</i> Identify the fabric and trims to make the given garment.</p> <p><i>LSO 3.3.</i> Draw the fashion sketch for the given garment.</p> <p><i>LSO 3.4.</i> Draw the technical sketch in front and back view for the given sample.</p>	3.*	Design special Purpose Clothing for medical and health care clothing also develop the technical document including includes Flat sketch, Specification table, Drawing of the draft, Lay plan, and Cost sheet.	CO1, CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 3.5.</i> Develop the pattern template in 1:4 scale for the given sample.</p> <p><i>LSO 3.6.</i> Prepare the specification sheet for the given sample.</p> <p><i>LSO 3.7.</i> Estimate the required fabric by marking the lay plan on paper in 1:4 scale for the given sample.</p> <p><i>LSO 3.8.</i> Prepare the cost sheet for the given sample.</p>			
<p><i>LSO 4.1.</i> Apply principles of design, including balance, proportion, and symmetry, to create the given aesthetically pleasing special purpose clothing.</p> <p><i>LSO 4.2.</i> Identify the fabric and trims to make the given garment.</p> <p><i>LSO 4.3.</i> Draw the fashion sketch for the given garment.</p> <p><i>LSO 4.4.</i> Draw the technical sketch in front and back view for the given garment.</p> <p><i>LSO 4.5.</i> Develop the pattern template in 1:4 scale for the given garment.</p> <p><i>LSO 4.6.</i> Prepare the specification sheet for the given garment.</p> <p><i>LSO 4.7.</i> Estimate the required fabric by marking the lay plan on paper in 1:4 scale for the given garment.</p> <p><i>LSO 4.8.</i> Prepare the cost sheet for the given garment.</p>	4.*	Design special Purpose Clothing for subject based Uniform also develop the technical document including Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1, CO2, CO3
<p><i>LSO 5.1.</i> Use the available 3D printing software.</p> <p><i>LSO 5.2.</i> Apply principles of design, including balance, proportion, and symmetry, to create aesthetically pleasing special purpose clothing.</p> <p><i>LSO 5.3.</i> Identify the fabric and trims to make the garment</p> <p><i>LSO 5.4.</i> Draw the fashion sketch.</p> <p><i>LSO 5.5.</i> Draw the technical sketch in front and back view.</p> <p><i>LSO 5.6.</i> Develop the pattern template in 1:4 scale</p> <p><i>LSO 5.7.</i> Prepare the specification sheet</p> <p><i>LSO 5.8.</i> Estimate the required fabric by marking the lay plan on paper in 1:4 scale.</p> <p><i>LSO 5.9.</i> Prepare the cost sheet</p>	5.	Design special Purpose Clothing for subject based Work wear also develop the technical document including Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1, CO2, CO3
<p><i>LSO 6.1.</i> Apply advanced pattern making techniques to create custom-fit design for special purpose clothing.</p> <p><i>LSO 6.2.</i> Demonstrate proficiency in garment construction methods suitable for the</p>	6.	Stitch the special Purpose Clothing for subject based performance wear .	CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p>given type of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 6.3.</i> Develop full size paper pattern for the given sample.</p> <p><i>LSO 6.4.</i> Lay plan the pattern pieces on the fabric for the given sample.</p> <p><i>LSO 6.5.</i> Stitch the garment as per the industry standards for the given sample.</p> <p><i>LSO 6.6.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 6.7.</i> Incorporate principles of fit, function, and durability into the construction of the given special purpose garments.</p>			
<p><i>LSO 7.1.</i> Apply advanced pattern making techniques to create custom-fit design for the given special purpose clothing.</p> <p><i>LSO 7.2.</i> Demonstrate proficiency in garment construction methods suitable for the given types of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 7.3.</i> Develop full size paper pattern for the given sample.</p> <p><i>LSO 7.4.</i> Lay plan the pattern pieces on the fabric for the given sample.</p> <p><i>LSO 7.5.</i> Stitch the given garment as per the industry standards.</p> <p><i>LSO 7.6.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 7.7.</i> Incorporate principles of fit, function, and durability into the construction of the given special purpose garments.</p>	7.	Stitch the special Purpose Clothing for subject based protective wear.	CO4, CO5
<p><i>LSO 8.1.</i> Choose suitable material for printing flexible structure (assembly of same small pieces to give flexible fabric effect).</p> <p><i>LSO 8.2.</i> Apply advanced pattern making techniques to create custom fit designs for the given special purpose clothing.</p> <p><i>LSO 8.3.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping and 3d modeling.</p>	8.	Stitch the special Purpose Clothing for medical or health care sector.	CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 8.4.</i> Develop Full size paper pattern for the given sample.</p> <p><i>LSO 8.5.</i> Lay plan the pattern pieces on the fabric for the given sample.</p> <p><i>LSO 8.6.</i> Stitch the given garment as per the industry standards.</p> <p><i>LSO 8.7.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 8.8.</i> Incorporate principles of fit, function, and durability into the construction of the given special purpose garments.</p>			
<p><i>LSO 9.1.</i> Apply advanced pattern making techniques to create custom fit design for the given for special purpose clothing.</p> <p><i>LSO 9.2.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping and 3d modeling.</p> <p><i>LSO 9.3.</i> Develop Full size paper pattern for the given sample.</p> <p><i>LSO 9.4.</i> Lay plan the pattern pieces on the fabric for the given sample.</p> <p><i>LSO 9.5.</i> Stitch the given garment as per the industry standards.</p> <p><i>LSO 9.6.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 9.7.</i> Incorporate principles of fit, function, and durability into the construction of the given special purpose garments.</p>	9.	Stitch the special Purpose Clothing for subject based Uniform .	CO4, CO5
<p><i>LSO 10.1.</i> Apply advanced pattern making techniques to create custom fit design for the given special purpose clothing.</p> <p><i>LSO 10.2.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping and 3d modeling.</p> <p><i>LSO 10.3.</i> Develop Full size paper pattern for the given sample.</p> <p><i>LSO 10.4.</i> Lay plan the pattern pieces on the fabric for the given sample.</p> <p><i>LSO 10.5.</i> Stitch the given garment as per the industry standards.</p>	10.	Stitch the special Purpose Clothing for subject based Workwear .	CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 10.6.</i> Demonstrate proficiency in garment construction methods suitable for the given type of special purpose clothing, including flat patterning, draping, and 3D modeling.</p> <p><i>LSO 10.7.</i> Incorporate principles of fit, function, and durability into the construction of the given special purpose garments.</p>			
<p>Note: Laboratory experiment from 1 to 5 is compulsory. Stitch any two garments from experiment no 6 to 10.</p>			

L) Suggested Term Work and Self Learning: S2451603E

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. Design and create original prototypes for specific purposes, demonstrating creativity, innovation, and functionality.
 2. Present and defend design concepts and prototypes to peers, instructors, and industry professionals, articulating the rationale behind design decisions and addressing feedback and critiques.
 3. Reflect on the design process and outcomes of practical projects, identifying strengths, weaknesses, and areas for further development.

- c. **Other Activities:**

Participate actively in ongoing assessment activities, including critiques, peer reviews, and self-assessments, to evaluate progress and performance.

Provide constructive feedback to peers on their design work, focusing on areas such as concept development, technical execution, and presentation skills.

Incorporate feedback from instructors, peers, and industry experts into ongoing design projects to continuously improve and refine design outcomes.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	15%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	30%	30%	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 (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction & Understanding Special Purpose Clothing	8	CO1	10	4	6	0
Unit-2.0 Fabric Selection and Technology	12	CO2	14	4	6	4
Unit-3.0 Design Principles for Special Purpose Clothing	8	CO3	16	4	6	6
Unit-4.0 Pattern Making and Garment Construction	12	CO4	20	6	6	8
Unit-5.0 Case Studies and Industry Trends	08	CO5	10	2	4	4
Total	48	-	70	20	28	22

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Design special Purpose Clothing for subject based performance wear and develop the technical document which includes Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1	30	60	10
2.	Design special Purpose Clothing for subject based protective clothing and develop the technical document which includes Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1, CO2, CO3	40	50	10
3.	Design special Purpose Clothing for medical and health care clothing and develop the technical document which includes Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1, CO2, CO3	30	60	10
4.	Design special Purpose Clothing for subject based uniform and develop the technical document which includes Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1, CO2, CO3	30	60	10
5.	Design special Purpose Clothing for subject based Work wear and develop the technical document which includes Flat sketch, Specification table, Drawing of the draft, Lay plan, and cost sheet.	CO1, CO2, CO3	30	60	10
6.	Stitch the special Purpose Clothing for subject based performance wear	CO4, CO5	30	60	10
7.	Stitch the special Purpose Clothing for subject based protective clothing.	CO4, CO5	30	60	10
8.	Stitch the special Purpose Clothing for medical or health care sector.	CO4, CO5	40	50	10
9.	Stitch the special Purpose Clothing for subject based Uniform.	CO4, CO5	40	50	10
10.	Stitch the special Purpose Clothing for subject based workwear.	CO4, CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	Drafting & Designing tools (Stationary equipments)	Rulers: - 12"/24" wooden, metal or plastic rulers. It is used for drawing straight lines per measurement. The marking and divisions on the ruler should be clear and accurate. Tailors square/ 'L' Square: - It is a 24"x 144" metal or plastic ruler with two arms that form a 90-degree angle. It is used to find a 45-degree angle mark outside and inside corners and extend the line through corners.	All
2.	French Curve	French Curve: - It is a curved plastic or metal ruler - It is used to draw curved lines of armholes and necklines.	6 to10
3.	Hip Curve	Hip Curve: - It is a curved plastic or metal ruler available in different sizes. It is used to draw curved lines.	6 to10
4.	Scissors	Scissors: - It is a cutting tool, having a size of 8" to 12", with two sharply pointed straight blades. Used to cut paper patterns and fabric. Paper-cutting scissors and cloth-cutting scissors are different.	6 to10
5.	Notcher	Notcher: - It is a punching tool that makes 'U' shaped notch marks. It is used to make 'U' shaped notch marks, which indicate seam allowance, central lines, etc. It looks like a single-punch machine.	6 to10
6.	Tailor's chalk	Tailors' Chalk: These chalks can be rubbed off easily on the fabric surface. It is available in various colours with fine edges. It is used for marking the lines and design details on fabric.	6 to10
7.	Tracing wheel	Tracing Wheel: - It is a toothed metal wheel with a wooden or plastic handle. It is used to transfer lines from one pattern to another or from the final pattern to the fabric.	6 to10
8.	Pins and its holder	Pins & Pin Holder: - Pins and small stuffed pillows are also required in pattern-making.	6 to10
9.	Paper for the draft	Thick Brown Paper: - These are brown paper rolls or sheets of various sizes and thicknesses. Used for preliminary pattern drafting and the development of the final pattern. - Strong and thick ones are used for making patterns that can be used repeatedly.	6 to10
10.	Brown Paper	All 14 Thick Brown Paper: - These are brown paper rolls or sheets of various sizes and thicknesses. Used for preliminary pattern drafting and the development of the final pattern. - Strong and thick ones are used for making patterns that can be used repeatedly.	6 to10
11.	Sewing thread	Sewing Thread: - A thread is a long strand of material, often composed of several filaments or fibres, used for sewing garments.	6 to10
12.	Hand needle	Hand Needle: - A sewing needle, used for hand-sewing, is a long, slender tool with a pointed tip at one end and a hole (or eye) to hold the sewing thread.	6 to10
13.	Machine Needles	Machine Needle: - A sewing machine needle is a specialized needle used in a sewing machine.	6 to10
14.	Iron	Iron: - A clothes iron is a small appliance that, when heated, is used to press clothes to remove wrinkles and unwanted creases.	6 to10
15.	Iron Board	Iron board: - An ironing board is generally a large, flat piece of board or metal covered with heat-safe padding on which clothing or linens may be ironed safely.	All
16.	Single needle lock stitch machine	Single needle lock stitch machine: - A sewing machine is used to sew fabric and materials together with thread.	All
17.	Overlock Sewing Machine	Overlock sewing machine: - These are specialized sewing machines. Overlocks form interlocking stitches using one or two needles, and one or two loopers help prevent puckering of the fabric pieces.	All
18.	Sewing fabric and Trims	Trims- Any materials or components used in clothing that are not the main fabric are referred to as trims. The trims can be Sewing Thread,	6 to10

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
		decorative machine stitching, Buttons (both functional and decorative element), Rivets, Zipper, Hasps and Slider, Hook and eye closure, all fasteners, Lining, Interlining, Labels, Patches, Motifs, Embroidery, Smocking, Ribbons, Drawstrings, Laces, Tassels, Braid, Rickrack, Appliqués, Ruffles, Fur, Leather, Shoulder pads and Bias binding.	
19.	Dress Form	Dress Form: - Female and male, Female size -40, Male size -42. Dress Forms: It is a standardized duplication of a human form. It is cotton-padded, canvas-covered and set on a movable stand. It is used to take measurements, develop patterns and fit garment samples.	All

R) Suggested Learning Resources:

Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Technical Sourcebook for Designers	Jaeil Lee and Camille Steen	Publication: Fairchild Books; 2nd edition - ISBN-13: 978-1609012250
2.	Performance Apparel: Materials, Design, and Construction	C. A. Lawrence	- Publication: Woodhead Publishing; 1st edition, - ISBN-13: 978-1845696192
3.	Smart Textiles for Protection	Roshan Shishoo	- Publication: Woodhead Publishing; 1st edition, - ISBN-13: 978-0857091122
4.	Designing Apparel for Consumers: The Impact of Body Shape and Size.	Marie-Eve Faust and Hyejeong Kim	- Publication: Woodhead Publishing; 1st edition, - ISBN-13: 978-0857095397
5.	Fashioning Technology: A DIY Intro to Smart Crafting	Syuzi Pakhchyan	Publication: Maker Media, Inc; 1st edition - ISBN-13: 978-0596514372
6.	Advanced Textiles for Health and Wellbeing	Marie O'Mahony	Publication: Woodhead Publishing; 1st edition, - ISBN-13: 978-1845696925
7.	Clothing Biosensory Engineering	Ting Fan and Tingrui Pan	Publication: Springer; 1st edition - ISBN-13: 978-0387345935
8.	Protective Clothing: Managing Thermal Stress	edited by F. Wang and Y. K. Kwok	Publication: CRC Press; 1st edition - ISBN-13: 978-1439845172
9.	Fashion and Sustainability: Design for Change	Kate Fletcher and Lynda Grose	Publication: Laurence King Publishing; 2nd edition, - ISBN-13: 978-1786274976
10.	Metric Pattern Cutting for Children's Wear and Babywear	Winifred Aldrich	Wiley; 4th edition ISBN 978-1405182928
11.	Pattern Making for Kids' Clothes:	Carla Hegeman Crim	B.E.S. Publishing; Illustrated edition ISBN 978-1438003863
12.	Reader's Digest Complete Guide to Sewing: Step by Step	Reader's Association	Reader's Digest ISBN 9780276001826
13.	Metric Pattern Cutting For Women's Wear Edition 5 th	Winifred Aldrich	UK, Blackwell Publishing, 2008; ISBN 13. 978-1405175678
14.	Dress Pattern Designing: The Basic Principles of Cut and Fit	Natalie Bray	UK, Blackwell Publishing, 2008; ISBN-13. 978-1405175678
15.	More Dress Pattern Designing	Natalie Bray	Blackwell Science Ltd., London ISBN: 9780632065028

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
16.	Pattern making for fashion design	Helen J. Armstrong's fashion design.	New Delhi, Pearson India Education Services Pvt. Ltd., 2016. ISBN-13: 978-9332518117
17.	Pattern Cutting Made Easy	Gillian Holman	Blackwell Science Ltd., London ISBN: 9781849940733
18.	Zarapkar System of Cutting	Zarapkar	Sale Publishers, Bombay ISBN: 9788124301999
19.	Fitting and Pattern Alteration: A Multi-Method Approach to the Art of Style Selection, Fitting, and Alteration	Della Pottberg-Steineckert, Elizabeth Liechty, et al.	Paparback publication ISBN-10 1563677830

(b) Online Educational Resources:

1. <https://insdindia.com/fashion-styling>
2. <https://www.fadacademy.com/fashion-courses-pune>
3. <https://www.thedesignersclass.com/>
4. <https://www.academyart.edu/art-degree/fashion/online-degree>
5. <https://www.iiftbangalore.com/courses/online-diploma-fashion-design>

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. <https://aerobasegroup.com/clothing-and-insignias/special+purpose+clothing>
2. <https://www.thesewingdirectory.co.uk/garment-making-techiques3D> Printer Users' Guide
3. <https://www.fulgar.com/en/feature/196/the-different-techniques-for-making-clothing>
4. <https://www.textileschool.com/258/garment-construction-techniques/>

- A) **Course Code** : 2451603F (T2451603F/P2451603F/S2451603F)
 B) **Course Title** : Visual Merchandizing
 C) **Prerequisite Course(s)** :
 D) **Rationale** :

Visual merchandising is the art and science of presenting products in a way that attracts customers and encourages sales. It employs various techniques such as window displays, signage, and product placement to stand out and draw people into the store. Therefore, in the Fashion and apparel retail industry knowledge of visual merchandising is very much essential to enhance the sales of apparel by considering the perceptions of customer mood. The course aims to develop the ability to select and use visual elements such as color schemes, signage, and display fixtures to reinforce the brand image and increase the cohesive shopping experience.

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

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

- CO -1. Categories the retail visuals into the specific visual merchandising technique.
- CO -2. Select the relevant theories of visual merchandising to create a specific mood.
- CO -3. Select the relevant tools for desired visual communication.
- CO -4. Apply the element retails to increase the garment sales.
- CO -5. Apply the concept of branding to increase brand value.

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

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO-1	3	-	1	2	-	1	1		
CO-2	3	-	2	2	-	1	1		
CO-3	3	-	2	2	-	1	1		
CO-4	3	-	2	2	1	1	1		
CO-5	3	-	2	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				
2451603F	Visual Merchandizing	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)	
2451603F	Visual Merchandizing	30	70	20	30	20	30	200

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, other student activities, etc.)

Note:

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

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

J) **Theory Session Outcomes (TSOs) and Units: T2451603F**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Define visual merchandising.</p> <p><i>TSO 1b.</i> Explain the evolution of visual merchandising.</p> <p><i>TSO 1c.</i> Enlist the objectives of visual merchandising.</p> <p><i>TSO 1d.</i> State the importance of visual merchandising.</p>	<p>Unit 1.0 Introduction to Visual Merchandising</p> <p>1.1 Evolution of Visual Merchandising</p> <p>1.2 Importance and Objectives of Visual Merchandising.</p> <p>1.3 Types and Functions of visual merchandising</p> <p>1.4 Basics of Visual Merchandising Technique.</p> <p>1.5 Role of merchandising in garment retailing & E-store management.</p>	CO1
<p><i>TSO 2a.</i> List various types of textures in visual merchandising.</p> <p><i>TSO 2b.</i> Enlist the various types of lights.</p> <p><i>TSO 2c.</i> Explain the basic principle of design.</p> <p><i>TSO 2d.</i> State the psychological effect of color on mood.</p> <p><i>TSO 2e.</i> Explain the elements of visual merchandising with its examples.</p>	<p>Unit-2.0 Theories of Visual Merchandising</p> <p>2.1 Lighting-Light Types, Selection, advantage and disadvantage, impact on merchandising.</p> <p>2.2 Music-Mood setting, color scheme, psychological effects of color, mood.</p> <p>2.3 Principle of design, rhythm, harmony, emphasis.</p> <p>2.4 Textures-types and uses in visual merchandising.</p> <p>2.5 Scent-Importance and Mood Creation.</p> <p>2.6 Consumer psychology, Factors influencing it, the role of perception, motivation, and emotion in purchasing decisions.</p>	CO1, CO2
<p><i>TSO 3a.</i> Explain the effect of exterior design on brand identity.</p> <p><i>TSO 3b.</i> State the concept of store façade in visual communication.</p> <p><i>TSO 3c.</i> Give the importance of window display.</p> <p><i>TSO 3d.</i> Enlist various types of fixtures.</p> <p><i>TSO 3e.</i> State the importance of signage in visual communication.</p> <p><i>TSO 3f.</i> Suggest the window display for the given season.</p> <p><i>TSO 3g.</i> State the importance of props and mannequins.</p> <p><i>TSO 3h.</i> Explain the store exteriors and store interiors.</p>	<p>Unit-3.0 Means of visual communication and its tools</p> <p>3.1 Store exterior marquee, façade, exterior display, surrounding stores, display, and signage</p> <p>3.2 Store interior-Atmosphere, aesthetic, store layouts, utilization of store space.</p> <p>3.3 Window display-types and advantages and disadvantages, Areas and types of display, selection of display location.</p> <p>3.4 Furniture and fixtures types</p> <p>3.5 Graphics and signages- importance, types, advantages, and disadvantages.</p> <p>3.6 Props and Mannequins –types and uses.</p>	CO3, CO4
<p><i>TSO 4a.</i> Explain the importance of retailing in the garment industry.</p> <p><i>TSO 4b.</i> Enlist the various retail formats.</p> <p><i>TSO 4c.</i> State the concept of assortment planning.</p> <p><i>TSO 4d.</i> State the importance of planograms in the garment industry.</p>	<p>Unit-4.0 Introduction to Retail and E-Store</p> <p>4.1 Introduction to the world of retailing</p> <p>4.2 Roles performed by retailer, types of retailer retail formats.</p>	CO3, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 4e.</i> Enlist the factors to be considered for creating the given planogram for a garment retail store.</p> <p><i>TSO 4f.</i> Classify the retail store.</p>	<p>4.3 Customer Buying Behavior and multi-channel retailing.</p> <p>4.4 Assortment planning and inventory management.</p> <p>4.5 planogram and space management, product placement.</p> <p>4.6 Classification of retail based on target market, product range, distribution channel, and Business model.</p> <p>4.7 Role of merchandising in online retail, emerging technologies such as virtual reality and augmented reality in online retail,</p> <p>4.8 Analytics tools to track and analyze e-store performance, current fashion trends, and forecasting trends.</p> <p>4.9 Web analytical tools to track traffic, conversion rates, and customer acquisition costs.</p>	
<p><i>TSO 5a.</i> State the importance of retail branding.</p> <p><i>TSO 5b.</i> Enlist the elements of brand identity.</p> <p><i>TSO 5c.</i> Define the brand identity and brand value.</p> <p><i>TSO 5d.</i> State the concept of the customer locality matrix.</p>	<p>Unit-5.0 Retail Branding and Customer Relationship</p> <p>5.1 Importance of Retail branding.</p> <p>5.2 Definition of brand identity, brand image, and values, Elements of brand identity (logo, typography)</p> <p>5.3 Concept of Customer satisfaction, delight, lifetime values, customer loyalty matrix</p> <p>5.4 Concepts of consumer preferences, customer segmentation, and targeting.</p> <p>5.5 Sales promotion and discounts in garments, brand equity measurement.</p>	CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603F

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Develop planograms for various stores.</p> <p><i>LSO 1.2.</i> Evaluate the planogram design w.r.t effective showcasing the product and inventory management.</p>	1.	*Design a planogram for a small section of a kids/men's store, considering product placement, spacing, and balance.	CO1, CO2
<p><i>LSO 2.1.</i> Select the relevant color scheme for the given display theme.</p> <p><i>LSO 2.2.</i> Record the impact of the color scheme on the purchasing behavior of customers.</p>	2.	* Experiment with different color schemes in a mock-up display to observe how colors influence mood, perception, and purchasing behavior.	CO2
<p><i>LSO 3..1.</i> Identify the relevant lighting scheme for the given display.</p> <p><i>LSO 3..2.</i> Create different moods by changing the lighting scheme.</p>	3.	* Play around with different lighting setups to see how they affect the mood and visibility of merchandise, paying attention to factors like brightness, color temperature, and positioning.	CO2
<p><i>LSO 4.1.</i> Create different arrangements for the product.</p> <p><i>LSO 4.2.</i> Select the relevant order of product sequence w.r.t given scheme.</p>	4.	* Arrange a variety of products into cohesive groups based on themes, colors, or styles to understand how to create visually appealing displays.	CO3
<p><i>LSO 5.1.</i> Identify relevant fixtures for a given theme.</p> <p><i>LSO 5.2.</i> Select the relevant fixtures by considering their advantages for the given display.</p>	5.	* Experiment with different types of store fixtures such as shelves, hooks, and display cases to understand their impact on product visibility and accessibility.	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 5.3. Select the relevant hooks by considering it advantages for the given display.			
LSO 6.1 Design relevant signage for a given theme. LSO 6.2 select the relent signage to convey the information effectively.	6.	*Design and produce signage for different sections of a store, experimenting with typography, color schemes, and messaging to attract attention and convey information effectively	CO3, CO4
LSO 7.1 chooses the relevant dressing style for a given kids' wear product. LSO 7.2 chooses the relevant dressing style for given men's wear.	7.	*Practice dressing and styling mannequins to showcase different outfits of men's wear/kids' ware	CO3, CO4
LSO 8.1 chooses the relevant dressing style for given female wear. LSO 8.2 Develop skills to handle the mannequins properly.	8.	* Practice dressing and styling of female mannequins to showcase different outfits of female ware	CO3, CO4
LSO 9.1 Identify similarities and differences in their approaches to visual merchandising. LSO 9.2 Analyze the impact of layouts on customer experience.	9.	Compare the layouts of competing stores within the same industry. Analyze how these choices impact the customer experience.	CO4
LSO 10.1 Develop the sketch of the window for a given theme.	10.	Sketch out ideas for window displays using simple tools like paper and markers, focusing on composition and theme.	CO4, CO5
LSO 11.1 Identify the relevant home accessories for the given theme. LSO 11.2 Develop the window display for a given theme.	11.	*Create the display of home accessories	CO4, CO5
LSO 12.1 Identify the relevant home accessories for the given theme. LSO 12.2 Develop the window display for a given theme	12.	Create the display for kids/fashion accessories.	CO4
LSO 13.1 Evaluate the given visual merchandising display. LSO 13.2 Develop the relevant checklist for evaluating the given window display.	13.	*Maintain and evaluate the visual merchandising display.	CO4
LSO14.1 Identify the various interactive displays for showcasing the product. LSO14.2 Prepare the cost sheet for the given display.	14.	Develop concepts for interactive displays that engage customers through elements like touchscreens, motion sensors, or QR codes, considering both practicality and creativity.	CO4
LSO15.1 Categories the different visual merchandising techniques based on the product.	15.	* Visit different stores and analyze their visual merchandising techniques.	CO5

L) Suggested Term Work and Self-Learning: S2451603F

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.
- i. Prepare a PowerPoint presentation of different photography of visual merchandising in FCT.
 - ii. Design simple signage or price tags for products. Experiment with fonts, colors, and layouts to create visually appealing and informative signage.
 - iii. Analyze window displays of various stores and identify the factors that make them attractive and attention-grabbing. Take note of the use of lighting, props, and themes.

b. Micro Projects:

- i. Set up a small area at home with items you have (such as clothing, accessories, or household items) and practice arranging them in visually appealing displays. Experiment with different layouts and focal points.
- ii. Create a Mood Board: -Compile images, colors, textures, and themes that represent a specific target audience or brand identity.
- iii. Choose a retail store and conduct a thorough analysis of its visual merchandising techniques. Identify how products are displayed, signage, lighting, and overall store layout Research searching history of fashion accessories such as handbags, hats, and jewellery.
- iv. Choose a product and create a story of it. Develop a display that communicates this story effectively through visuals and props

c. Other Activities:

1. Seminar Topics:

2. Visits:

- Visit different stores and observe their visual merchandising techniques. Take notes on how products are displayed, the use of signage, and the overall store layout.
- Share your visual merchandising ideas or setups with friends, family, or online communities and gather constructive feedback to improve your skills.

3. Self-Learning Topics:

- E store Management in FCT.
- Latest trends in window display in FCT.

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	20%	20%	15%	-	-	20%	20%
CO-2	20%	20%	10%	25%	-	10%	20%
CO-3	30%	30%	15%	25%	33%	15%	20%
CO-4	15%	20%	30%	25%	33%	15%	20%
CO-5	15%	10%	30%	25%	34%	40%	20%
Total Marks	30	70	20	20	10	20	30
			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 CO.

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

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to Visual Merchandising	8	CO1	10	4	2	4
Unit-2.0 Theories of Visual Merchandising	12	CO1, CO2	18	4	6	8
Unit-3.0 Means of visual communication and its tools	10	CO3	18	4	6	8
Unit-4.0 Introduction to Retail and E-Store	10	CO4	16	4	4	8
Unit-5.0 Retail Branding and Customer Relationship	8	CO5	08	4	2	2
Total	48	-	70	20	20	30

Note: A similar table can also be used to design class/mid-term/ internal question papers 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.	* Design a planogram for a small section of a kids/men's store, considering product placement, spacing, and balance.	CO1, CO2	30	60	10
2.	* Experiment with different color schemes in a mock-up display to observe how colors influence mood, perception, and purchasing behavior.	CO2	40	50	10
3.	* Play around with different lighting setups to see how they affect the mood and visibility of merchandise, paying attention to factors like brightness, color temperature, and positioning.	CO2	30	60	10
4.	* Arrange a variety of products into cohesive groups based on themes, colors, or styles to understand how to create visually appealing displays.	CO3	30	60	10
5.	* Experiment with different types of store fixtures such as shelves, hooks, and display cases to understand their impact on product visibility and accessibility.	CO3	30	60	10
6.	Design and produce signage for different sections of a store, experimenting with typography, color schemes, and messaging to attract attention and convey information effectively.	CO3, CO4	30	60	10
7.	Practice dressing and styling mannequins to showcase different outfits of men's wear/kid's wear.	CO3, CO4	30	60	10
8.	* Practice dressing and styling of female mannequins to showcase different outfits of female wear.	CO3, CO4	40	50	10
9.	Compare the layouts of competing stores within the same industry. Analyze how these choices impact the customer experience.	CO4	40	50	10
10.	Sketch out ideas for window displays using simple tools like paper and markers, focusing on composition and theme.	CO4, CO5	40	50	10
11.	*Create the display of home accessories.	CO4, CO5	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
12.	Create the display for kids/fashion accessories.	CO4	30	60	10
13.	*Maintain and evaluate the visual merchandising display.	CO4	30	60	10
14.	Develop concepts for interactive displays that engage customers through elements like touchscreens, motion sensors, or QR codes, considering both practicality and creativity.	CO4	30	60	10
15.	*Visit different stores and analyze their visual merchandising techniques.	CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

Note: This table can be used for both end semester as well as progressive assessment of practicals. Rubrics need to be prepared by the course teacher for each experiment/practical to assess the student's 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 Lectures, Tutorial, Case Methods, Group Discussions, Industrial visits, Industrial Training, Field Trips, Portfolio, 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.	Pencils (HB), colors (poster colors/fabric colors pencil color), mannequins, display stands, hooks, and hangers, screwdrivers, drills, and wrenches, Adobe Photoshop or GIMP, Spaceman, JDA Space Planning, or EZ Retail, AutoCAD or SketchUp, Adobe Dimension or Mockup hone	Used for developing the planogram and visual display	All

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	"Visual Merchandising: Window and In-Store Displays for Retail"	Tony Morgan	Laurence King Publishing Ltd 361–373 City Road London, ISBN 978 178067 687 6.
2.	Retail Management	Gibson G. Vedamani	Pearson Education; 5th edition , SBN-10 : 9789386873279
3.	Visual Merchandising and Display	Pegler Martin M.	Bloomsbury Publishing PLC, ISBN: 9781609010843.
4.	E-Retailing Principles and Practice	D. P. Sharma	Himalaya Publishing House; First Edition, ISBN-10 : 9352024478

(b) Online Educational Resources:

1. <https://www.udemy.com/course/visual-merchandising-course-for-retailers-and-students/?couponCode=NVDPRODIN35>
2. <https://mvix.com/blog/6-elements-of-visual-merchandising/>
3. <https://www.shiksha.com/online-courses/articles/visual-merchandising-meaning-elements-and-advantages/>
4. <https://www.creativedisplaysnow.com/guides/design-elements-to-consider-for-beverage-displays/design-elements-in-visual-merchandising/>

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

(c) Others: -

- A) **Course Code** : 2451603G (T2451603G/P2451603G/S2451603G)
 B) **Course Title** : Apparel Merchandising
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

The Apparel Industry is growing at a fast pace & specialization is required in each job. Buyers expect professionalism & a merchandiser can understand their needs & fulfil them. One needs skills for handling customers & their problems & merchandisers are trained in acquiring those skills. From design to sourcing to costing to manufacturing, finishing, packing & dispatch, a merchandiser is required to complete orders with high efficiency. Production, planning & control is essential in Apparel business. Skills in Apparel merchandising can fetch jobs & place students as merchandisers in Factories or retail outlets or at e-commerce sites.

- 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.** Adopt the concepts of fashion & merchandising.
CO -2. Adopt new marketing strategies required for fashion merchandiser.
CO -3. Apply merchandising skills for effective production.
CO -4. Practice retail sale strategies to increase sales, achieve targets of profitability.
CO -5. Prepare documents as required for apparel Merchandising.

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 Lifelong Learning	PSO-1	PSO-2
CO-1	3	1		3	-	-	2		
CO-2	3	-	-	3	1	-	3		
CO-3	3	3	3	3	3	2	2		
CO-4	3	2	1	3	2	-	2		
CO-5	3	2	-	3	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				
2451603G	Apparel Merchandising	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)	
2451603G	Apparel Merchandising	30	70	20	30	20	30	200

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: T2451603G**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Differentiate between fashion & merchandising. TSO 1b. Analyze their dependency on fashion & merchandising. TSO 1c. Distinguish Retail Merchandising from factory Merchandising & from other forms of Merchandising. TSO 1d. Exhibit the products as a Visual merchandiser to attract customers. TSO 1e. Plan on a micro & macro level merchandising. TSO 1f. Recognize the prevailing fashion trends. TSO 1g. Plan production as per the fashion trends. TSO 1h. Interpret short-term & long-term fashion cycles. TSO 1i. Enquire with the consumers to find out their requirements. TSO 1j. Arrange supply as per demand. TSO 1k. Measure the effectiveness of various distribution channels. TSO 1l. Adopt suitable distribution channels. TSO 1m. Choose from the channels of Sales promotion for effective marketing. TSO 1n. Select suitable media of advertising. TSO 1o. Arrange events for publicity & marketing. TSO 1p. Adopt new marketing strategies to attract customers	Unit 1.0 Introduction 1.1 Introduction to Fashion and Merchandising, their definitions & their inter-relation. 1.2 Difference between Retail Merchandising, Factory Merchandising, Visual Merchandising & Merchandising for E Commerce/ magazines/ Mail orders. 1.3 Use of a merchandiser for Garment Industry 1.4 Micro Vs Macro Merchandising 1.5 Fashion terms like Classic, Fad, Style, Vogue, Trend, Contemporary, Pret, Haute Couture, Status symbols, etc. 1.6 Fashion cycle. Trickle up & trickle down fashion & trickle across fashion. 1.7 Influences on Fashion Merchandising like Trends, Economic influence, Global influence, technological influence & Consumer Demand 1.8 Marketing Chain/ Distribution channel from Manufacturer to consumer. Includes Wholesaler, retailer, agent, etc 1.9 Sales promotion – channels of sales promotion like Advertising, personal selling, direct marketing & publicity 1.10 New marketing strategies	CO1, CO2, CO3
TSO 2a. Plan production with the help of Charts TSO 2b. Foresee bottlenecks. TSO 2c. Adopt preventive measures. TSO 2d. Plan on a Micro & Macro Level TSO 2e. Develop a Tech pack. TSO 2f. Follow given Tech packs. TSO 2g. Source the required raw materials. TSO 2h. Survey the market for raw materials. TSO 2i. Conduct market surveys for suitability of product	Unit 2.0 Fashion Merchandiser 2.1 Follow up from design to dispatch with the help of Production planning chart & Block planning charts. 2.2 Control in Production. Foreseeing and avoiding bottlenecks 2.3 Spec sheet/ Tech pack. How to follow specifications 2.4 Sourcing -Importance of Sourcing 2.4.1 Sources of sourcing like books, magazines, travel, fairs, Internet, existing suppliers, Stock lot dealers, etc. 2.4.2 Factors to consider while sourcing like price, demand & supply, distance, time requirement, transportation charges	CO2, CO3, CO5

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	2.4.3 Types of sourcing- outsourcing, In-sourcing, global, national & zonal sourcing, single, multi & open sourcing, Qualitative, Quantitative & strategic sourcing. 2.5 Survey.	
TSO 3a. Employ effective communication skills in talking to buyers/ Consumers TSO 3b. Write official letters. TSO 3c. Develop Contacts. TSO 3d. Identify Customer Needs. TSO 3e. Solve production problems TSO 3f. Plan production as well as display TSO 3g. Organize product displays TSO 3h. Incorporate Quality consciousness in employees TSO 3i. Predict the fashion trends TSO 3j. Evaluate Collection. TSO 3k. Develop vision & Mission statements	Unit– 3.0 Merchandising Skills 3.1 Communication including Business Correspondence, Confidence, Persuasion, Business connections/contacts, Co-ordination, Team spirit, Identifying customer needs using SPIN technique, After sales service, Sincerity & Commitment, Positive attitude, Problem solving using techniques such as Seam technique & Role play, Creativity using some techniques, Learning, Planning & Organizing, Quality consciousness, Fashion Forecasting based on market research, trends & evaluation of collections, making Mission & Vision statements, planning Horizons, etc.. 3.2 Understanding & developing these skills.	CO3, CO5
TSO 4a. Compare the past & present requirements in Retailing TSO 4b. Predict future trends in Retailing TSO 4c. Discover new markets TSO 4d. Classify different Clothing segments in Retail TSO 4e. Impact of Demand & Supply on pricing as well as sales TSO 4f. Propose ideas to run an outlet profitably TSO 4g. Recommend purchase based on speculation & market changes TSO 4h. Evaluate the various strategies for selling TSO 4i. Adopt the most effective strategies. TSO 4j. Formulate new strategies for sales TSO 4k. Change customer perceptions in Branding. TSO 4l. Examine the role of wholesalers in retail. TSO 4m. Set up a store or rearrange an existing space utilization. TSO 4n. Design a window display	Unit 4.0 Retail Outlets 4.1 Introduction to fashion retailing. Changing dimensions- past, present & future trends. Retailing in the past. First few important retail stops. Growth of retail & causes & conditions for expansion & growth. 4.2 Retail Market. Definition of market. Market based on area like local, Regional, National & international/Global market, age like Child, teenager, adult & senior citizen as consumer, income like low income, lower middle class, higher middle class, Rich, etc. 4.3 Clothes for retail. 4.4. Demand & Supply. Their effect on the business 4.5 Starting & running a retail outlet profitably. 4.6 Retail buying & selling. Specification buying. 4.7 Strategies of selling like discount sales, edited retailing, Tele marketing, mail order, Internet, concessionaires/ shops within shops, franchising, MLM & network marketing. 4.8 Retail branding. Building a brand 4.9 Types of retail stores- Departmental stores, Shopping Centers, specialty stores, boutiques, Discount clothing stores, franchise outlets. Multiple chain stores & variety chain stores, supermarkets, malls, hyper malls etc. 4.10 Role of Wholesalers in Retail 4.11 Value edited retailing& service-oriented retailing 4.12 Visual Merchandising- Elements of visual merchandising. Planning of retail stores- space planning, Display area planning. Designing- windows & interiors. Seasonal planning.	CO2, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 5a. Create a Company profile TSO 5b. Rewrite an existing profile as per changes in demand. TSO 5c. Detect critical clauses in a tender. TSO 5d. Differentiate between Tender & Quotation. TSO 5e. Scrutinize an order form. TSO 5f. Prepare Invoices TSO 5g. Prepare Challans TSO 5h. Investigate the success of a firm with a merchandising audit. TSO 5i. Infer the strength & weaknesses of the company with a SWOT analysis TSO 5j. Prepare a Marketing calendar based on events TSO 5k. Describe the schedules & routing of consignments with the freight agents TSO 5l. Use Documentation agents for preparation of Documents as required	Unit 5.0 Documentation 5.1 Making a company profile. Important points 5.2 Quotations & Tenders. 5.3 Order form 5.4 Invoices- Proforma, final & Consular. 5.5. Delivery Challans. 5.6 Merchandising Audit 5.7 SWOT analysis 5.8 Design development-elements, principles, line selection, merchandising plan for the design 5.9 Product development- appeal to consumers, target market product development plan 5.10 Marketing calendar 5.11 Working with document agents and freight forwarders.	CO3, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603G

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Analyze the different channels of distribution LSO 1.2 Estimate the cost factor in adopting each LSO 1.3 Hypothesize the time requirement LSO 1.4 Develop your own plan.	1	Develop a Marketing Chain/ Distribution channel to suit different fashion products	CO3, CO4, CO5
LSO 2.1 Prepare an advertisement for a newspaper keeping in mind the column size & cost. LSO 2.2 illustrate an advertisement for magazine. LSO 2.3 Simulate a Radio / TV/ movie advertisement. LSO 2.4 Prepare an advertisement for Internet LSO 2.5 Prepare an advertisement for a hoarding LSO 2.6 Compare the effectiveness of each media with respect to cost, efforts, consumer response & effective sales.	2	Illustrate/ dramatize/ Simulate an Advertisement for different media like newspaper, magazine, radio, mobile app, T.V, movie, internet, hoarding, etc. (Different students given different topic & then asked to present).	CO3, CO5
LSO 3.1 Brainstorm to find new strategies. LSO 3.2 Plan strategies for personal selling/ direct marketing & publicity LSO 3.3 Make Groups & work in teams LSO 3.4 Organize strategies in order of effectiveness LSO 3.5 Examine each strategy for effectiveness LSO 3.6 Contrive a strategy that will work	3	Brainstorm to find new Planning strategies for personal selling, direct marketing & publicity (Students will work in groups for each & then make presentation).	CO3, CO5
LSO 4.1 Hypothesize the problems that can occur LSO 4.2 Find solutions to probable problems. LSO 4.3 Calculate the number of days required for Cutting, stitching, finishing & packing LSO 4.4 Plan Production LSO 4.5 Schedule the entire production	4.	Prepare a Production Planning Chart (for 3 to 5 orders simultaneously working)	CO2, CO3, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 4.6 Conclude the date of delivery after deliberating on the schedule for production. LSO 4.7 Arrange the orders in the way they can be taken up depending on which raw materials will reach first.			
LSO 5.1 Scrutinize the orders in hand LSO 5.2 Compare it to the production capacity LSO 5.3 Plan orders on a macro level. LSO 5.4 Calculate the delivery date as per capacity & schedule LSO 5.5 Decide on dates that can be committed based on this chart LSO 5.6 Determine the time required for each order	5.	Make a Block Planning Chart (with 3 orders & 2 batches)	CO2, CO3, CO5
LSO 6.1 Draw a clear diagram of the product that can show the number of buttons or other fastenings, the kind of stitches required. LSO 6.2 Determine the required specifications. LSO 6.3 Calculate the ratios as required. LSO 6.4 Instruct the manufacturer on the types of stitches required. LSO 6.5 Grade sizes as required LSO 6.6 Recommend the packing methods to be followed LSO 6.7 Scrutinize each specification given to see if possible in production. LSO 6.8 Procure raw materials as specified LSO 6.9 Plan production methods suitable to specification. LSO 6.10 Check if inventory needed is available or needs to be procured. LSO 6.11 Inquire about the machinery & equipment required. LSO 6.12 Decide whether to rent or purchase	6.	Prepare a spec sheet/ Tech pack & demonstrate on how to follow specs	CO2, CO3, CO5
LSO 7.1 Develop a profile with requirements like history of the company, strengths, location, etc. LSO 7.2 List the machines in house LSO 7.3 Assess the strengths. LSO 7.4 List Inventory. LSO 7.5 list out Buyers LSO 7.6 Rate company standards with existing competitors.	7.	Develop a company profile including list of machinery & List of buyers	CO2, CO3, CO 5
LSO 8.1 Correspond using right & impressive words LSO 8.2 Compose a letter using proper punctuations LSO 8.3 Develop acceptable official formats for Letter writing	8.	Write a letter to a Buyer	CO2, CO3, CO 5
LSO 9.1 Question customers to assess their needs LSO 9.2 Dissect the answers to check problems LSO 9.3 Propose possible solutions LSO 9.4 Analyze each solution without criticism LSO 9.5 Conclude with most acceptable solution	9.	Identify customer needs using SPIN technique,	CO2, CO3, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 10.1 State a problem LSO 10.2 Recognize the problem LSO 10.3 Expand the problem LSO 10.4 Scrutinize the origin of the problem LSO 10.5 Alter the statement to see if problem exists somewhere else LSO 10.6 Maximize the problem LSO 10.7 Check repercussions. LSO 10.8 Infer a solution after collecting different aspects of the problem	10.	Solve Problems using Seam technique	CO2, CO3, CO5
LSO 11.1 Examine a problem with the other persons point of view LSO 11.2 Contrast views taken from both sides LSO 11.3 Compare the situation from both angles LSO 11.4 interpret each persons behavior LSO 11.5. Explain possible solutions to problems LSO 11.6 Conclude with most acceptable solution	11.	Dramatize a situation using Role play to solve a problem, (A group of students will be given a situation (but individually told about it) that they will enact & the rest of the class observes & judges the actors. At the end each actor would explain how they felt in that role & audience would critically observe the behaviour of the person in that role)	CO3, CO5
LSO 12.1 Think Creatively LSO 12.2 Alternate solutions to problems LSO 12.3 Alternate methods of construction LSO 12.4 imagine better	12.	Develop Creativity using different techniques,	CO3, CO5
LSO 13.1 Differentiate between studying & learning LSO 13.2 Practice different methods of learning LSO 13.3 Invent new techniques of learning	13.	Contrive learning skill by adopting different methods,	CO3, CO5
LSO 14.1 Predict future colour in fashion LSO 14.2 Relate fashion in colour to new architectural developments, technology & current affairs LSO 14.3 Interpret the effects of these factors in deciding the final colour LSO 14.4 Predict future fashion silhouettes LSO 14.5 Relate fashion silhouettes to health obsessions, new requirements by designers & Industry, technology. LSO 14.6 infer on the new requirements LSO 14.7 Develop designs as per forecast. LSO 14.8 Predict future fashion texture LSO 14.9 Relate fashion textures to the current affairs, new inventions LSO 14.10 Employ these textures in fashion design LSO 14.11 Develop textures as per forecast. LSO 14.12 Predict future fashion designs LSO 14.13 Design a new collection by taking taking inspirations from latest trends, fashion changes, consumer preferences, etc LSO 14.14 Organize a design collection by combining all the above forecasts.	14.	Forecast Fashion based on analysis of last 4 years (Forecast of colour, Forecast of Silhouette, Forecast of texture, Forecast of Design) (Students will work in different groups to forecast each of the above)	CO3
LSO 15.1 Summarize the aims & values of the organization. LSO 15.2 Organize these aims in order of importance	15.	Prepare a Mission statement	CO3, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 15.3 Formulate the mission statement taking into consideration these factors			
LSO 16.1 Summarize the short term & long-term goals of the organization. LSO 16.2 Organize these goals in order of achievement target dates LSO 16.3 Formulate the Vision statement	16.	Prepare a Vision statement	CO3, CO5
LSO 17.1 Design the store within a given space LSO 17.2 Choose the interiors LSO 17.3 Inventory assessment. LSO 17.4 Select the important items to be displayed LSO 17.5 Arrange the display within a given space. LSO 17.6 Inspect the windows & interiors as they exist in terms of attraction, space utilization, etc LSO 17.7 Re-do the windows where required LSO 17.8 Re-Arrange the interiors LSO 17.9 Create new designs in Window Interiors	17,	Plan a retail stores- Plan space & Display area planning. Design- windows & interiors.	CO 3, CO 4
LSO 18.1 Examine the clothing needs of consumers as per season LSO 18.2 list out the requirements LSO 18.3 Group them into categories	18.	Categorize clothing requirements based on Seasons.	CO3, CO 4
LSO 19.1 Discover all the items that can be incorporated in a theme LSO 19.2 Prepare a chart of all these items LSO 19.3 Consider the suitability to the garment or article being made. LSO 19.1 Prepare a theme board incorporating these.	19.	Prepare a theme board (Students are grouped & given different themes to work on like Jungle, Cartoon, Bohemian, Arty, Peppy, Retro, Vintage, Gothic, etc)	CO3, CO 4
LSO 20.1 Prepare a theme board for the given theme LSO 20.2 Design the window display based on the available space in which you can arrange the articles suitable LSO 20.3 Arrange the articles accordingly	20.	Illustrate a Window display for a theme or a Season	CO 3, CO 4
LSO 21.1 Prepare a mood board LSO 21.2 Search online for mood boards for different seasons LSO 21.3 Prepare a mood board for a specific season	21.	Prepare a mood board (Students are grouped & given different seasons to work on like Spring, Summer, Autumn, Winter, Rain & occasional seasons like Christmas, Diwali, Eid, etc)	CO 3, CO 4
LSO 22.1 list the requirements for a Quotation LSO 23.2 Analyze the necessary terms & conditions LSO 23.3 Decide the payment terms LSO 23.4 Prepare of the Quotation based on the above.	22.	Prepare a Quotation	CO3, CO5
LSO 23.1 Generalize the terms & conditions required in a tender form LSO 23.2 Finalize specific terms required by the company for the particular article LSO 23.3 Prepare the Tender form by incorporating the above. LSO 23.4 Probe into the requirements in the given form	23.	Prepare & Fill a Tender form	CO3, CO 5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 23.5 Scrutinize the form to check for any terms & conditions that can be problematic LSO 23.6 Fill the form			
LSO 24.1 List the requirements for a proforma invoice LSO 24.2 Decide the terms & Conditions LSO 24.3 Decide the payment terms LSO 24.4 Prepare the Proforma incorporating all the important terms & conditions.	24.	Prepare a Proforma Invoice	CO3, CO5
LSO 25.1 Check the Challans for number of pieces delivered LSO 25.2 Prepare a final Invoice based on the Challans & proforma given earlier.	25.	Prepare a final Invoice	CO3, CO 5
LSO 26.1 identify the important things in an order form LSO 26.2 Decide the terms & conditions required. LSO 26.3 Calculate the required values based on size ratios.	26.	Prepare an Order form alongwith the required terms & conditions	CO 3, CO 5
LSO 27.1 Categorize the items delivered LSO 27.2 Prepare a challan based on chronological order of delivery	27.	Prepare a Delivery Challan	CO 5
LSO 28.1 Compare space utilization Vs sale LSO 28.2 Compare staff employed & their salaries Vs sale LSO 28.3 Compare rent paid Vs sale LSO 28.4 Prepare an audit based on all the above factors	28.	Calculate the success rate by a Merchandising Audit	CO3, CO 5
LSO 29.1 List out the strengths of the company that should be retained. LSO 29.2 List out the Weaknesses of the company that we need to be worked upon. LSO 29.3 List out the opportunities that seem possible in the near future. LSO 29.4 List out the threats of the company that should be tackled.	29.	Analyze a company position with SWOT	CO3, CO 5
LSO 30.1 Plan the dates of the season LSO 30.2 Plan the activities LSO 30.3 Plan the events that we would participate in or organize. LSO 30.4 Plan the dates of the events in chronological order LSO 30.5 Plan the activities before each event like Market survey, Designing, Sourcing, Cutting, Stitching, embellishing, accessorizing, Finishing & Packing LSO 30.6 Organize these activities in order of completion for each event	30.	Prepare a Marketing calendar for a season for 2 events	CO3
LSO 31.1 Plan the target market LSO 31.2 Study the types of consumers LSO 31.3 list what appeals to such consumers LSO 31.4 check what is already available LSO 31.5 check requirements of what is in demand but not in supply LSO 31.6 Prepare a product development plan	31.	Prepare a product development plan-	CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 32.1 Recognize the need of packaging LSO 32.2 Eliminate chances of pilferage LSO 32.3 Design for attraction LSO 32.4 Make it functional.	32.	Plan Packaging for a ready article along with a price tag	CO3

L) Suggested Term Work and Self Learning: S2451603G

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: A suggestive list of micro-projects is given here. Similar micro-projects that match the COs could be added by the concerned course teacher.

- i. Design development-elements, principles, line selection, merchandising plan for a design. The USP of the design & strategies for selling
- ii. Product development- appeal to consumers, target market product development plan
- iii. New marketing strategies. Students should be given a product to sell & should see which strategies worked

c. Other Activities:

1. Seminar Topics:

- Online Survey as well as a Physical survey. Survey of one raw material, different raw materials given to different students. They will do a presentation of the same.
- Survey of one market for feasibility of a product. Students could be grouped & can study a market in groups & present the same.
- Working with document agents and freight forwarders. Finding out different documentation agents freight agents in your city & nearby areas. Visiting their offices or meeting them online to check the jobs they can handle, the terms & conditions & the advantages & disadvantages of working with them

2. Visits:

- Visit to a mall to study different retail outlets.
- Case Study: any one case study of a retail outlet that started small & grew big with the right marketing strategies (each student will study one case & present).
- Case Study: any one case study of a retail outlet that started big but collapsed with the wrong marketing strategies (each student will study one case & present).

3. Self-Learning Topics:

- Retailing in the past. First few important retail stops. Growth of retail & causes & conditions for expansion & growth.

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%	10%	-	-	10%	10%
CO-2	15%	15%	10%	25%	10%	10%	10%
CO-3	25%	25%	15%	25%	20%	25%	25%
CO-4	20%	20%	30%	25%	40%	15%	25%
CO-5	30%	30%	35%	25%	30%	40%	30%
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 Introduction	06	CO1	07	2	2	3
Unit-2.0 Importance & Role of a Fashion Merchandiser	08	CO1, CO2	10	3	3	4
Unit-3.0 Merchandising skills	12	CO3, CO4	18	5	5	8
Unit-4.0 Retail Outlets	10	CO3, CO4	14	4	4	6
Unit-5.0 Documentation	12	CO4, CO5	21	6	6	9
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.	Develop a Marketing Chain/ Distribution channel to suit different fashion products	CO 3, CO 4, CO 5	60	30	10
2.	Illustrate/ dramatize/ Simulate an Advertisement for different media like newspaper, magazine, radio, mobile app, T.V, movie, internet, hoarding, etc. (Different students given different topic & then asked to present).	CO 3, CO 5	60	30	10
3.	Brainstorm to find new Planning strategies for personal selling, direct marketing & publicity (Students will work in groups for each & then make presentation).	CO 3, CO 5	50	40	10
4.	Prepare a Production Planning Chart (for 3 to 5 orders simultaneously working)	CO2, CO3, CO 5	50	40	10
5.	Make a Block Planning Chart (with 3 orders & 2 batches)	CO2, CO 3, CO 5	60	30	10
6.	Prepare a spec sheet/ Tech pack & demonstrate on how to follow specs	CO 2, CO 3, CO 5	60	30	10
7.	Develop a company profile including list of machinery & List of buyers	Co 2, CO 3, CO 5	50	40	10
8.	Write a letter to a Buyer	CO 2, CO 3, CO 5	20	70	10
9.	Identify customer needs using SPIN technique,	CO2, CO3, CO 5	40	50	10
10.	Solve Problems using Seam technique	CO2, CO3, CO 5	60	30	10
11.	Dramatize a situation using Role play to solve a problem, (A group of students will be given a situation (but individually told about it) that they will enact & the rest of the class observes & judges the actors. At the end each actor would explain how they felt in that role & audience would critically observe the behaviour of the person in that role)	CO 3, CO 5	60	30	10
12.	Develop Creativity using different techniques,	CO3, CO5	60	30	10
13.	Contrive learning skill by adopting different methods,	CO3, CO5	40	50	10
14.	Forecast Fashion based on analysis of last 4 years (Forecast of colour, Forecast of Silhouette, Forecast of texture, Forecast of Design) (Students will work in different groups to forecast each of the above)	CO3	60	30	10
15.	Prepare a Mission statement	CO3, CO5	60	30	10
16.	Prepare a Vision statement	CO3, CO5	60	30	10
17.	Plan a retail stores- Plan space & Display area planning. Design- windows & interiors.	CO 3, CO 4	60	30	10
18.	Categorize clothing requirements based on Seasons.	CO3, CO 4	60	30	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva- Voce (%)
			PRA* (%)	PDA** (%)	
19.	Prepare a theme board (Students are grouped & given different themes to work on like Jungle, Cartoon, Bohemian, Arty, Peppy, Retro, Vintage, Gothic, etc)	CO3, CO 4	60	30	10
20.	Illustrate a Window display for a theme or a Season	CO 3, CO 4	60	30	10
21.	Prepare a mood board (Students are grouped & given different seasons to work on like Spring, Summer, Autumn, Winter, Rain & occasional seasons like Christmas, Diwali, Eid, etc)	CO 3, CO 4	60	30	10
22.	Prepare a Quotation	CO3, CO5	60	30	10
23.	Prepare & Fill a Tender form	CO3, CO 5	60	30	10
24.	Prepare a Proforma Invoice	CO3, CO5	60	30	10
25.	Prepare a final Invoice	CO3, CO 5	60	30	10
26.	Prepare an Order form alongwith the required terms & conditions	CO 3, CO 5	60	30	10
27.	Prepare a Delivery Challan	CO 5	60	30	10
28.	Calculate the success rate by a Merchandising Audit	CO3, CO 5	60	30	10
29.	Analyze a company position with SWOT	CO3, CO 5	60	30	10
30.	Prepare a Marketing calendar for a season for 2 events	CO3	60	30	10
31.	Prepare a product development plan-	CO3	60	30	10
32.	Plan Packaging for a ready article along with a price tag	CO3	60	30	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.	High end computers	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Drawing tables/ Cutting long tables	Wood	All
3.	Stools	Wood	All
4.	Window for display	Glass front & wood behind in which mannequins can be kept	20
5.	Mannequinn	Adjustable for male	20
6.	Mannequinn	Adjustable for female	20
7.	Mannequinn	Adjustable for child	20

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Fashion- From Concept to Consumer	Frings Gini Stephens	Pearson Publications, 2001 ISBN-13: 978- 8131701744 ISBN-10: 8131701743
2.	Strategic Marketing	Dr. Ben Kajwang, Dr. Dymphna Bakker- Edoh, Kipro Eric Kibos	IPRJB Publishers ISBN: 978-9914-728-19-4
3.	Fashion Marketing	Mike Easey	Blackwell Science ASIN: 1405139536
4.	Fashion Retailing	Dimitri Koumbis	Bloomsbury Publishing, 2019 ISBN: 9789388002370

(b) Online Educational Resources:

- <https://researchguides.austincc.edu/fashionmarketing/oer>
- <https://libraryguides.mdc.edu/c.php?g=522259&p=7323444>
- <https://www.iastatedigitalpress.com/itaa/article/id/15901/>
- <https://fitnyc.libguides.com/AltOER/Subject>
- <https://www.ohio.edu/education/recreation-sport-pedagogy-consumer-sciences/retail-merchandising>

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:

- New Marketing Strategies, Brent Hale & Natallie Menno, Audi book, narrated by Marcus Mulenga
- <https://www.ohio.edu/education/recreation-sport-pedagogy-consumer-sciences/retail-merchandising>
- <https://libguides.sdstate.edu/c.php?g=443826&p=3026838>
- <https://www.youtube.com/watch?v=1tJHFaujzpA>
- <https://design.umn.edu/academics/programs/about-retail-merchandising>

- A) **Course Code** : 2451603H (T2451603H/P2451603H/S2451603H)
 B) **Course Title** : Smart Textiles
 C) **Pre- requisite Course(s)** :
 D) **Rationale** :

Textiles have been used in our daily life since antiquity in both economies and social relationships. Nowadays, Smart textiles can be described as textiles that are able to sense stimuli from the environment, to react to them and adapt to them by integration of functionalities in the textile structure. The stimulus as well as the response can have an electrical, thermal, chemical, magnetic or other origin. This course on Smart Textiles tries to develop understanding of the process of making smart textiles in the students. It also covers fabrication methods, various materials used, product applications. The knowledge gained through this course will help the students to take up advanced courses in future.

- 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. Characterize materials used in smart fabrics and clothing.
 CO -2. Select appropriate manufacturing method for different smart textiles.
 CO -3. Identify smart and intelligent textiles for high protection and comfort properties in various fields.
 CO -4. Analyze requirements of smart clothing in day today activities.
 CO -5. Explore new materials and attempt to design garments using smart textiles based on the requirements.

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	-	3	3	-	-	3		
CO-2	3	2	-	3	-	-	-		
CO-3	3	3	-	3	3	-	-		
CO-4	3	3	-	3	3	3	3		
CO-5	3	-	3	3	-	3	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)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2451603H	Smart Textiles	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)	
2451603H	Smart Textiles	30	70	20	30	20	30	200

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: T2451603H**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain Smart Textiles and related terminologies.</p> <p><i>TSO 1b.</i> Outline the history and need of smart textiles</p> <p><i>TSO 1c.</i> Outline need of smart fabrics in present era.</p> <p><i>TSO 1d.</i> Classify Smart Textiles used in general and specific to fashion industry.</p> <p><i>TSO 1e.</i> List typical components of the given smart textile systems.</p> <p><i>TSO 1f.</i> Explain difference between Smart and Intelligent textiles</p>	<p>Unit-1.0 Introduction to Smart Textiles</p> <p>1.1 History of Smart Textiles.</p> <p>1.2 Basic Definition of smart fabric textiles</p> <p>1.2.1 Smart Materials</p> <p>1.2.2 Smart textile materials.</p> <p>1.2.3. Smart Textiles</p> <p>1.3 Classification of Smart Fabric Textiles in general and fashion industry</p> <p>1.3.1. Passive smart fabric Textiles</p> <p>1.3.2. Active smart fabric textiles.</p> <p>1.3.3. Advanced smart fabric textiles</p> <p>1.3.4, Aesthetic Smart Textiles</p> <p>1.3.5 Performance Smart Textiles</p> <p>1.4 Components of Smart textile System Fibers, Yarns, fabrics, Chemicals.</p> <p>1.5 Intelligent textiles. Definition, Comparison between Intelligent and Smart Textiles.</p>	CO1
<p><i>TSO 2a.</i> List the basic functions of Smart textiles.</p> <p><i>TSO 2b.</i> Explain the basic function(s) of the given smart textile(s).</p> <p><i>TSO 2c.</i> Write the step by step procedure for working of the given sensor(s) / Actuator(s)</p> <p><i>TSO 2d.</i> Explain data processing, storage and communicators in detail.</p> <p><i>TSO 2e.</i> Explain functions of Conductive and Shape memory polymer and their application in manufacturing of intelligent fabrics.</p> <p><i>TSO 2f.</i> List functions of photosensitive materials and application methods in smart textiles</p> <p><i>TSO 2g.</i> Explain the method of inserting Phase changing materials.</p> <p><i>TSO 2h.</i> Explain the induction of Electronic sensors in to the textiles.</p> <p><i>TSO 2i.</i> Review recent developments in fabrication materials used in manufacturing of smart textiles.</p>	<p>Unit-2.0 Basic Functions, Fabrication Materials used in Manufacturing of Smart Textiles</p> <p>2.1 Basic Functions</p> <p>2.1.1. Sensors</p> <p>2.1.2 Data Processing</p> <p>2.1.3. Actuators</p> <p>2.1.4. Storage</p> <p>2.1.5. communicators</p> <p>2.2 Fabrication Materials used in manufacturing of smart textiles.</p> <p>2.2.1. Conductive Polymers</p> <p>2.2.2. Shape memory Polymers</p> <p>2.2.3 Chemical Responsive Polymers</p> <p>2.2.4. Photosensitive Materials</p> <p>2.2.5. encapsulated phase changing materials</p> <p>2.2.6. Electronic sensors.</p> <p>2.2.7. Micro Nano materials.</p> <p>2.3 Recent developments in fabrication materials used for manufacture of smart textiles</p>	CO1, CO2
<p><i>TSO 3a.</i> List the fabrication Method(s) of the given Smart and Intelligent textiles</p> <p><i>TSO 3b.</i> Explain the fabrication weaving and Knitting Technology of the given textile</p>	<p>Unit-3.0 Fabrication Methods and Types of Smart Textiles</p> <p>3.1 Fabrication methods of Yarns, and Fibers</p>	CO3, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 3c.</i> Explain the method of Embroidery and Lamination and stitching techniques in smart textiles.</p> <p><i>TSO 3d.</i> Outline the process of making the given smart color changing textiles, and temperature controlling fabric Textile(s).</p> <p><i>TSO 3e.</i> Write the fabrication method for the given shape memory fabric.</p> <p><i>TSO 3f.</i> Explain the usage of the given waterproof and Breathable textiles along with the construction.</p> <p><i>TSO 3g.</i> Explain the concept of wearable electronic smart textiles and phase changing textiles highlighting the performance of the given textile(s).</p>	<p>3.1.1 Weaving Technology</p> <p>3.1.2 Knitting technology.</p> <p>3.1.3 Embroidery.</p> <p>3.1.4 Lamination</p> <p>3.1.5 Stitching</p> <p>3.2 Types of Smart Textiles and methods of making them.</p> <p>3.2.1 Smart Colour-Changing Fabric Textile</p> <p>3.2.2 Temperature-Controlling Fabric Textiles</p> <p>3.2.3 Shape Memory Fabric Textiles</p> <p>3.2.4 Waterproof and Breathable Fabric Textiles</p> <p>3.2.5 Wearable Electronics Smart Textile</p> <p>3.2.6 Phase-Changing Textiles.</p>	
<p><i>TSO 4a.</i> Outline the applications of the given smart textiles in Medical and Health care segment/Sports/ Transportation/ Road/ Building Construction/ Defense/ Home Automation/ Space/ Agricultural / Entertainment Field/ Geological activities.</p>	<p>Unit-4.0 Application Smart and Intelligent Textiles</p> <p>Applications of Smart Textiles in,</p> <p>4.1 Medical and Health care field</p> <p>4.2 Sports</p> <p>4.3 Transportation and road</p> <p>4.4 Defense</p> <p>4.5 Home Automation</p> <p>4.6 Space</p> <p>4.7 Building Construction</p> <p>4.8 Agriculture</p> <p>4.9 Entertainment field.</p> <p>4.10 Geological Field</p>	<p>CO3, CO4</p>
<p><i>TSO 5a.</i> Describe the use of smart textiles in Different areas of fashion.</p> <p><i>TSO 5b.</i> List the companies producing smart clothing.</p> <p><i>TSO 5c.</i> List out Clothing manufactured by different companies.</p> <p><i>TSO 5d.</i> Analyze the difference between each garments and techniques used in manufacturing of smart clothing.</p> <p><i>TSO 5e.</i> Compare the properties of smart garments produced by different companies.</p> <p><i>TSO 5f.</i> Examine the new components used in manufacturing of smart clothing and textiles.</p>	<p>Unit-5.0 3D Smart and Intelligent Textiles in Fashion Industry. Companies producing smart clothing</p> <p>5.1 Use of Smart textiles in Fashion</p> <p>5.1.1 Aesthetic use</p> <p>5.1.2 Performance enhancement</p> <p>5.1.3 Interaction</p> <p>5.1.4. Chameleonic textiles</p> <p>5.2 Companies Producing Smart Clothing</p> <p>5.2.1 Cute Circuit</p> <p>5.2.2 AiQ Smart Clothing (Taiwan)</p> <p>5.2.3 Athos (U.S.)</p> <p>5.2.4 Carre Technologies (Canada)</p> <p>5.2.5 Sensoria (U.S.)</p> <p>5.2.6 Clothing Plus (Finland)</p> <p>5.2.7 Cityzen Sciences (France)</p> <p>5.2.8 Vulpes Electronics (Japan)</p> <p>5.2.9 DuPont (U.S.)</p> <p>5.2.10 Wearable X (U.S.)</p> <p>5.2.11 Applycon (Czechia)</p> <p>5.2.12 Toray Industries (Japan)</p> <p>5.2.13 Myontec (Finland)</p> <p>5.2.14 Myzone (U.S.)</p> <p>5.2.15 Siren (U.S.)</p>	<p>CO4, CO5</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	5.2.16 Owlet (U.S.)	

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451603H

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1. Identify the components required for manufacturing of smart Textiles. LSO 1.2. Use the sensors and components as per its functionality.	1.	Create collage sheets on components of smart Textiles.	CO1
LSO 2.1. Surf web and downloading research article LSO 2.2. Review the article by group discussion and write summary of the same	2.	Research article review on History of Smart Textiles.	CO1, CO2
LSO 3.1. Identify field of interest. LSO 3.2. Design garments with full descriptions. LSO 3.3. Specify construction method and functionality of the Garments.	3.	Design 2 Garments using conductive polymer finished smart fabric for field of your choice.	CO1, CO2, CO3
LSO 4.1. Identify the components required for the experiment. LSO 4.2. Identify Method of testing for the given sample. LSO 4.3. Analyze the results and distinguish the differences.	4.	Test durability of different samples of shape Memory fabrics.	CO2, CO3
LSO 5.1 Identify the theme LSO 5.2 Design garment based on selected theme LSO5.3 Identify the components required for developing e garment. LSO 5.3 Integrate the components in to the Garment for the required application.	5.	Develop a e garment based on theme.	CO1, CO2, CO5
LSO 6.1 Predict the area to work on. LSO 6.2 Identify the components required for the given experiment. LSO 6.3 Design the products based on end use. LSO 6.4 Construct the design created.	6.	Design household products using smart fabric	CO1, CO2, CO3, CO4, CO5
LSO 7.1. Develop a tool for survey. LSO 7.2. Identify the target group. LSO 7.3. Use survey tool for gathering information. LSO 7.4. Interpret the results.	7.	Survey on use of Smart fabrics in Medical field/Sports/Defence	CO1, CO3, CO4
LSO 8.1 List out the garments manufactured by different companies. LSO 8.2 Identify the type of smart fabric used in the garments	8.	Compare characteristics of smart garments manufactured by different companies	CO3, CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 8.3 Classify garments according to type. LSO 8.4 Compare the characteristics and record.			
LSO 9.1 Identify the Components required for incorporating in the design LSO 9.2 Integrate the components for the required application.	9.	Design 4 garments based on theme using smart fabrics.	CO5, CO3, CO4,
LSO 10.1 Develop a tool for survey LSO 10.2 Identify the target group LSO 10.3 Use survey tool for gathering information. LSO 10.4 Interpret the results	10	Survey on use of Smart fabrics in Construction (Road, Building, etc.)/Agriculture and Geological field.	CO5, CO3, CO4
LSO 11.1 Identify the accessories to be created. LSO 11.2 Identify the methods of making color changing Textiles. LSO 11.3 Design the range of products. LSO 11.4 Prepare one of the Accessory from the range created.	11	Create a range of Fashion Accessories using Color Changing Textiles.	CO5, CO3, CO4

L) Suggested Term Work and Self Learning: S2451603H

Some sample suggested assignments, micro project and other activities are mentioned here for reference.

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

b. Micro Projects:

- i. Write a review on the current trends and future applications of Nanotechnology in sportswear Fashion industry.
- ii. Download 5 videos on functioning of smart textiles in FCT, watch them and write a report to detail the steps involved, method of manufacturing, used, materials used, complexity involved, their performance and durability of the fabric etc.,
- iii. Write an article on The Next Generation electronic textiles in FCT.

c. Other Activities:

1. Seminar Topics:

- Commercially available Machineries used in Manufacture of Smart textiles/Garments.
- Developing Stimuli Sensitive Polymers for breathability applications in FCT industry.
- Future of Smart Textiles
- Smart Textiles- Exploring New possibilities in FCT.

2. Visits: Visit nearby /textile industry with smart fabric/ garment manufacturing facilities. Prepare report of visit with special comments of smart clothing technique used, materials used, single component/batch production/mass production and cost of smart textile/ Garments.

Self-Learning Topics:

- Computing textiles
- Machinery involved in Manufacturing of smart 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%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	15%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	30%	30%	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 (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Introduction to Smart Textiles	8	CO1	10	3	3	4
Unit-2.0 Basic Functions, fabrication Materials used in Manufacturing of Smart Textiles	12	CO1, CO2	8	3	2	3
Unit-3.0 Fabrication Methods and Types of Smart Textiles	8	CO3, CO4	10	5	2	3
Unit-4.0 Application of smart and Intelligent textiles.	8	CO3, CO4	21	5	7	9
Unit-5.0 Smart and Intelligent Textiles in Fashion Industry. Companies Producing Smart Clothing	12	CO4, CO5	21	4	6	11
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.	Design collage sheets on components of smart Textiles	CO1	30	60	10
2.	Research article review on History of Smart Textiles.	CO1, CO2	40	50	10
3.	Design 2 Garments using conductive polymer finished smart fabric for field of your choice.	CO1, CO2, CO3	30	60	10
4.	Test durability of different samples of shape Memory fabrics.	CO2, CO3	40	50	10
5.	Develop a " e garment" based on theme.	CO1, CO2, CO5	30	60	10
6.	Design household products using smart fabric	CO1, CO2, CO3, CO4, CO5	30	60	10
7.	Survey on use of Smart fabrics in Medical field/Sports/Defence	CO1, CO3, CO4	60	30	10
8.	Compare characteristics of smart garments manufactured by different companies.	CO3, CO4, CO5	45	45	10
9.	Design 4 garments based on theme using smart fabrics.	CO5 CO3, CO4,	30	60	10
10.	Survey on use of Smart fabrics in Construction (Road, Building, etc.)/Agriculture and Geological field.	CO1, CO3, CO4	40	50	10
11.	Create a range of Fashion Accessories using Color Changing Textiles	CO2, CO3, CO5	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	High end computers	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Bursting strength tester	As per requirement of textile testing laboratory	04

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Wearable, Smart Textiles and Smart Apparel	Paret Dominique and Pierre Crego,	ISTEb Press- Elsevier November 27,2018 Hardback ISBN: 9781785482939 ebook ISBN9780081027646
2.	Smart Textiles for protection	R. Chapman	Woodhead Publishing First edition, 2012 Hard book ISBN:9780857090560 eBook ISBN:9780857097620
3.	Smart textile production. Over view of materials, sensors and Production Technologies for Industrial smart Textiles	Inga Gehrke, Vadim Tenner, Volker Lutz, David Schmelzeisen, Thomas Gries	Published April2019, ISBN: 9783038970 (Hard Back) ISBN 9783038974987(PDF)
4.	Smart textiles and their applications	Valdan Koncar	Woodhead publishing Published April 2016, ISBN: 9780081005743 ISBN:9780081005835
5	Advances in Smart Medical Textiles	Lieva van Langenhove	Woodhead publishing December 2015 Hardback ISBN:9781782423799 eBook ISBN: 9781782424000
6	Electronic Textiles Smart Fabrics and Wearable Technology	Tilak Dias	Woodhead Publishing April 2015 Hard back ISBN:9780081002018 eBook ISBN:9780081002230
7	Functional and Technical Textiles	Shubhankar Maity, Kunal Singh, Pintu Pandit	Woodhead Publishing, January2023 Paperback ISBN:9780323915939 eBook ISBN:9780323915946
8	Smart Fibers, Fabrics and Clothing	Xiaoming Tao	October2001 Hardback ISBN:9781855735460 eBook ISBN:9781855737600
9	Nano Sensors and Nano devices for Smart Multifunctional Textiles	Andrea Ehrmann, Tuan Anh Nguyen, Phuong Nguyen Tri	Elsevier, September 2020 Paperback ISBN: 9780128207772 eBook ISBN: 9780128209417
10	Textiles for Sports Wear	Roshan Shishoo	Woodhead Publishing May 2015 Hardcover: 978-1-78242-229-7 eBook : 978-1-78242-236-5
12	Advances in the Dyeing and Finishing of Technical Textiles	M. L. Gulrajani	Woodhead Publishing Published: February 8, 2013 Hardback ISBN: 9780857094339 eBook ISBN: 9780857097613

(b) Online Educational Resources:

1. <https://youtu.be/jDqi5cAiuVI>
2. <https://youtube.com/shorts/qjOMeEvGZDo?feature=share>
3. <https://youtu.be/PdN6ZA7X8Oc>
4. https://youtu.be/b_AjmLX3t3A
5. <https://youtu.be/BEB8iR3SOEU>
6. <https://youtu.be/uFB9cBgcomc>
7. <https://youtu.be/4dEhjfSGxjc>
8. <https://youtu.be/NvPI8ytEe3Q>
9. <https://youtu.be/TNcDXKQNOoM>
10. <https://youtu.be/LKHt2hRmVZY>

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. Lab Manuals
2. Technical textile Journals
3. Fashion and clothing Journals

- A) **Course Code** : 2400604B (T2400604B/P2400604B/S2400604B)
 B) **Course Title** : Artificial Intelligence (Advance)
 C) **Pre-requisite Course(s)** : Artificial Intelligence (Basic)
 D) **Rationale** :

In Artificial Intelligence (Basic) course, students have learned the basics for Artificial Intelligence problem solving techniques, data analytics and articulates the different dimensions of these areas. This Artificial Intelligence (Advance) course offers the students the comprehension of Machine learning which is a subset of artificial intelligence in the field of computer. The course also exposes students to Tens or flow a Python-based open-source library for numerical computation used in machine learning and developing neural networks. After completing the course students will be able to implement various techniques used in machine learning and neural networks using open-source tools.

- 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** Elaborate the use of Machine learning in Artificial Intelligence.
CO-2 Implement various supervised and unsupervised learning models and methods.
CO-3 Illustrate Artificial neural networks and its applications.
CO-4 Implement various Neural network models and Learning Methods.
CO-5 Solve machine learning and artificial neural network problems using Tens or flow.

- 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	2	-	-	-	1		
CO-2	3	3	3	3	-	-	2		
CO-3	-	3	3	3	-	-	2		
CO-4	3	1	3	3	-	-	2		
CO-5	3	3	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)					Total Credit (C)
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	
		L	T				
2400604B	Artificial intelligence (Advance)	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)	
2400604B	Artificial Intelligence (Advance)	30	70	20	30	20	30	200

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: T2400604B**

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number (s)
TSO 1a. Describe the basic terminology of Machine learning TSO 1b. Explain the concept of dataset and ways to handle them TSO 1c. illustrate the process of dataset division TSO 1d. Explain process involved in machine learning	Unit – 1.0: Introduction to machine learning Concept of Machine Learning, Define Learning, Learn the Network, Evaluate the Network, datasets and ways to handle them, Feature sets, Dataset division: test, train and validation sets, cross validation. Applications of Machine Learning, processes involved in Machine Learning	CO-1
TSO 2a. Identify the category or class of a particular dataset using KNN algorithm TSO 2b. Use Linear regression for predictive analysis TSO 2c. Predict the categorical dependent variable using Logistic Regression TSO 2d. Use SVM for classification problems in Machine Learning TSO 2e. determine the performance of the classification models TSO 2f. evaluate the performance of the classification model using ROC-curve TSO 2g Explain characteristics of Unsupervised learning. TSO 2h. Explain different clustering methods TSO 2i. Implement K-means clustering algorithm to group the unlabeled dataset	Unit 2.0: Supervised and unsupervised learning Supervised learning: Introduction to Supervised Learning, K-Nearest Neighbor, Linear Regression, Logistic Regression, Support Vector Machine (SVM), Evaluation Measures: confusion matrix, precision, precision and recall, ROC-Curve (Receiver Operating Characteristic curve) Unsupervised learning: Introduction to Unsupervised Learning, Introduction to clustering, Types of Clustering: Hierarchical, Agglomerative Clustering and Divisive clustering; Partitional Clustering - K-means clustering. Expectation-Maximization (EM) Algorithm	CO-2
TSO 3a. Explain Structure and working of Biological Neural Network. TSO 3b. differentiate between Artificial Neural Network and Biological Neural Network TSO 3c. State key historical points in development of ANN TSO 3d. Explain the architecture of an artificial neural network	Unit 3.0: Introduction to neural networks Structure and working of Biological Neural Network, Fundamentals of Artificial Neural Networks & Applications, Characteristics of Artificial Neural Networks, History of neural network research, characteristics of neural networks terminology.	CO-3
TSO 4a. Use neuron McCulloch – Pitts model in designing logical operations TSO 4b. Apply Rosenblatt's Perceptron to solve linear classification problems TSO 4c. Implement Adaptive Linear Neuron (Adaline)	Unit 4.0: Neural networks models and Learning Methods Models of neuron McCulloch – Pitts model, Rosenblatt's Perceptron, Adaline model, Basic	CO-4

Major Theory Session Outcomes (TSOs)	Units	Relevant Cos Number (s)
<p>training algorithm in neural network</p> <p>TSO 4d. Use Backpropagation neural training algorithm</p> <p>TSO 4e. Use ART (Adaptive Resonance Theory) learning model</p> <p>TSO 4f: Implement Bidirectional Associative Memory (BAM) model in Artificial Neural Network</p>	<p>learning laws, Topology of neural network architecture, Multilayer Neural Networks, Learning Methods, Backpropagation, Counter propagation, Adaptive Resonance Theory (ART), Associative memories, BAM.</p>	
<p>TSO 5a. Illustrate the features of Tens or flow</p> <p>TSO 5b. Manipulate tensors</p> <p>TSO 5c. Explain features of Tens or Board visualization</p> <p>TSO 5d Explain the concept and features of Tens or flow playground</p>	<p>Unit-5.0 Tensor flow</p> <p>features of TensorFlow, Tensor Data structure- Rank, shape, type, one dimension and two-dimension tensor, Tensor handling and manipulations, Tensor board visualization- symbols</p> <p>Tensors, Variables, Automatic differentiation, Graphs and tf.function, modules layers and models, training loops, features of Tens or flow playground- data ,the ration of train and test data, features, hidden layers, Epoch, learning rate, activation function, regularization, problem type</p>	CO-5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604B

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Implement data classification algorithms	1	Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.	CO-2
<p>LSO 2.1 Implement Machine learning algorithms</p> <p>LSO 2.2 Evaluate the performance of classification model</p>	2	<p>(a) Implement SVM for Iris Dataset- download the dataset from (https://gist.github.com/netj/8836201)</p> <p>(b) Find confusion matrix and evaluation matrix for SVM</p> <p>Hint: SVM model can be constructed using sklearn command,</p> <pre>import pandas as pd from sklearn.svm import SVC from sklearn.model_selection import train_test_split from sklearn.metrics import confusion_matrix from sklearn.metrics import classification_report from sklearn.metrics import accuracy_score</pre> <ol style="list-style-type: none"> 1. Read the csv Iris dataset file 2. Condition the data 3. Condition the training and Testing data 4. Construct the Linear model 5. Test the model with Linear kernel 6. Prepare confusion matrix 7. prepare Classification Report 	CO-2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 3.1 Perform clustering operations using k-means algorithm	3	a) Explore k-means algorithm for the small sample dataset. b) Explore k-means algorithm for Iris Dataset	CO-2
LSO 4.1 Perform clustering operations using EM algorithm	4	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.	CO-2
LSO 5.1 Build artificial neural network LSO 5.2 Test artificial neural network	5	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	CO-4
LSO 6.1 Detect features or business intelligence in the input data using perceptron	6	Implement the perceptron algorithm from scratch in python.	CO-4
LSO 7.1 Use Tensors for given problems	7	Write a programme to implement two dimension and three-dimension Tensor.	CO5
LSO 8.1 Use basic features for tensor handling and manipulations	8	Write a programme to add and multiply two 4x4 matrix, you can Import "tens or flow" and "numpy".	CO5
LSO 9.1 Test artificial intelligence (AI) algorithms through the use of Google's TensorFlow machine learning libraries.	9	Solve a classification problem on the Tens or flow playground. Hint: refer https://www.educba.com/tensorflow-playground/	CO5
LSO 10.1 Implement artificial intelligence (AI) algorithms through the use of Google's TensorFlow machine learning libraries LSO 10.2 perform predictive analysis using linear regression	10	Implement algorithm for linear regression in tens or flow	CO5, CO2

L) Suggested Term Work and Self Learning: S2400604B

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:

Use python programming for the solutions of Microproject problems

- Create a Bar plot to get the frequency of the three species of the Iris data.
 - Create a Pie plot to get the frequency of the three species of the Iris data.
 - Write a Python program to create a graph to find relationship between the sepal length and width.
- Write a Python program to split the iris dataset into its attributes (X) and labels (y). The X variable contains the first four columns (i.e. attributes) and y contains the labels of the dataset.
 - Write a Python program using Scikit-learn to split the iris dataset into 70% train data and 30% test data. Out of total 150 records, the training set will contain 120 records and the test set contains 30 of those records. Print both datasets.
- Conduct performance analysis of Classification Algorithms (any 2) on a specific dataset.

- 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 the student in each of these designed activities is to be assessed 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%	30%	20%	30%	--	--
CO-2	10%	25%	20%	20%	20%	30%	33%
CO-3	30%	25%	30%	20%	20%	--	--
CO-4	20%	20%	20%	20%	30%	30%	33%
CO-5	20%	15%	10%	20%	--	40%	34%
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. Introduction to machine learning	08	CO1	11	5	4	2
Unit-2.0. Supervised and unsupervised learning	10	CO2	18	5	6	7
Unit-3.0. Introduction to neural networks	10	CO3	17	5	7	5
Unit-4.0. Neural networks models and Learning Methods	10	CO4	14	3	3	8
Unit-5.0. Tensor flow	10	CO5	10	2	6	2
Total Marks	48		70	20	26	24

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva- Voce (%)
			PRA* (%)	PDA** (%)	
1.	Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.	CO-2	-	90	10
2.	(a) Implement SVM for Iris Dataset- download the dataset from (https://gist.github.com/netj/8836201) (b) Find confusion matrix and evaluation matrix for SVM	CO-2	-	90	10
3.	a) Explore k-means algorithm for the small sample dataset. b) Explore k-means algorithm for Iris Dataset	CO-2	20	70	10
4.	Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Python ML library classes/API in the program.	CO-2	-	90	10
5.	Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.	CO-4	10	80	10
6.	Implement the perceptron algorithm from scratch in python.	CO-4	10	80	10
7.	Write a programme to implement two dimension and three-dimension Tensor.	CO-5	-	90	10
8.	Write a programme to add and multiply two 4x4 matrix, you can Import "tens or flow" and "numpy".	CO-5	-	90	10
9.	Solve a classification problem on the Tens or flow playground.	CO-5	20	70	10
10.	Implement algorithm for linear regression in tens or flow	CO-2, CO-5	10	80	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, Group Discussion, Portfolio Based Learning, Live Demonstrations in Classrooms, Lab, 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.	Computer Systems	Desktop Computers with i3 processor, 16 GB RAM, 512 GBHDD	S. No. 1 to 10
2.	Online Python IDE	https://www.online-python.com/	S. No. 1 to 10
3.	Jupyter Notebook	Download from https://jupyter.org/	S. No. 1 to 10
4.	Pip Python package manager	Download Pip 22.3 From https://pypi.org/project/pip/	S. No. 1 to 10
5.	Google colab	https://colab.research.google.com/github/tensorflow/docs/blob/master/site/en/tutorials/quickstart/beginner.ipynb#scrollTo=DUNzJc4JTj6G	S. No. 1 to 10
6.	Various modules, Libraries and Packages	Tens or flow, NumPy, Pandas, package	S. No. 1 to 10

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Machine Learning using Python	Manaranjan Pradhan, U Dinesh Kumar	Wiley, ISBN-10: 8126579900 ISBN-13: 978-8126579907
2.	Introduction to Machine Learning	Jeeva Jose	Khanna Book Publishing Co. (P) ltd, 2020. ISBN-10: 9389139066 ISBN-13: 978-9389139068
3.	Machine Learning for Dummies	John Paul Mueller and Luca Massaron, For Dummies,	For Dummies; 2nd edition, ISBN-10: 1119724015 ISBN-13: 978-1119724018
4.	Machine Learning	Rajeev Chopra	Khanna Book Publishing Co., 2021 ISBN-10: 9789386173423 ISBN-13: 978-9386173423
6.	Learn TensorFlow 2.0: Implement Machine Learning and Deep Learning Models with Python	Pramod Singh, Avinash manure	Apress, 978-1484255605 ISBN-10: 1484255607 ISBN-13: 978-1484255605

(b) Online Educational Resources:

1. NPTEL Course: Introduction to Machine Learning, Prof. Balaraman Ravindran, IIT Madras
2. <https://www.tensorflow.org/resources/learn-ml>
3. <https://www.tutorialspoint.com/tensorflow/index.htm>
4. <https://www.javatpoint.com/tensorflow>
5. <https://developers.google.com/machine-learning/crash-course/exercises>

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

(c) Others:

- **Data Source:**
 - <https://archive.ics.uci.edu/ml/machine-learning-databases/auto-mpg/>
 - <https://archive.ics.uci.edu/ml/machine-learning-databases/iris/iris.data>
 - <https://www.kaggle.com/arshid/iris-flower-dataset>
 - <https://www.kaggle.com/rohankayan/years-of-experience-and-salary-dataset>

- A) **Course Code** : 2400604C (T2400604C/P2400604C/S2400604C)
 B) **Course Title** : Internet of Things (Advance)
 C) **Pre- requisite Course(s)** : IoT (Basics), Computer Networks
 D) **Rationale** :

The rise and rise of IoT technologies are redefining business opportunities and process. This has led to a growing need to learn advance skills to remain competitive in the market. Put together, these are a potent combination of technologies that will dictate how our future is written, which is a strong indicator of rewarding job opportunities in those domains. Introduction of the Advanced IoT follows a rigorous curriculum which blends the academic excellence and industry-relevant applications. This course will be exposed to a breadth of skills which will help students to become multi-faceted software engineers with a deeper understanding of these modern technologies, their applications, and interdependence.

- 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 basic Python features in Programming.
CO-2 Use advance Python features in Programming.
CO-3 Explain features of Cloud and IoT data storage on it.
CO-4 Explain IoT Networking and its application.
CO-5 Develop IoT App for the given problem

- 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	3	2	2	-	2	-		
CO-2	3	3	2	2	-	2	-		
CO-3	1	-	3	2	2	2	2		
CO-4	1	-	2	3	-	2	2		
CO-5	3	3	3	2	2	3	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)		Lab Instruction (LI)	Notional Hours (TW+SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400604C	IoT (Advance)	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)	
2400604C	IoT (Advance)	30	70	20	30	20	30	200

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: T2400604C

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO.1. a. Write the steps to install Python.</p> <p>TSO.1. b. Explain given types of variables in python.</p> <p>TSO.1. c Explain use and importance of Tuple, Dictionary, operators in python</p> <p>TSO.1. d. Explain use of array in python.</p> <p>TSO.1. e. Explain use of 2-Dimensional Array in python</p> <p>TSO.1. f Explain uses of given type of Conditional statement in python.</p>	<p>Unit-1.0 Python Basics: -</p> <p>1.1 Installation of Python</p> <p>1.2 Variables, Print () function, Escape character sequence and run python Program</p> <p>1.3 Python Tuple, Dictionary, operators</p> <p>1.4 Python arrays, create, reverse and append data into it.</p> <p>1.5 Python 2 Dimensional arrays.</p> <p>1.6 Python Conditional statement.</p>	CO-1 and CO-5
<p>TSO.2. a. Explain uses of given type of do & while loops in python</p> <p>TSO.2. b. Explain working of break, continue and pass statement in python</p> <p>TSO.2. c. Write the benefits of using OOP methodology in python.</p> <p>TSO.2. d. Explain given type of string operation related to python.</p> <p>TSO.2. e. Explain given function in python</p> <p>TSO.2. f Explain use of Lambda function in python.</p>	<p>Unit 2. Python Advance: -</p> <p>2.1 Python Do & while loops</p> <p>2.2 Python break, continue, pass statements</p> <p>2.2 Python OOPs Class, Object, Inheritance and Constructor</p> <p>2.4 Python Strings Replace, Join, Split, Reverse, Uppercase, Lowercase, count, find, split and length</p> <p>2.5 Python Functions, Built-in functions and user defined functions</p> <p>2.6 Lambda function and uses</p>	CO-1 and CO5
<p>TSO.3. a. Differentiate between Cloud and IoT cloud.</p> <p>TSO.3. b. Explain features of Cloud in IoT environment</p> <p>TSO.3. c. List features of various types of Cloud</p> <p>TSO.3. d. List features of cloud services like SaaS, PaaS and IaaS</p> <p>TSO.3. f List advantages of cloud data storage.</p> <p>TSO.3. g Explain Arduino architecture and its applications.</p> <p>TSO.3.h Explain Raspberry pi architecture and its applications.</p>	<p>Unit-3.0 Cloud Features: -</p> <p>3.1 Cloud computing and IoT cloud</p> <p>3.2 Benefits of cloud in IoT</p> <p>3.3 Types of Cloud public, private and hybrid</p> <p>3.4 Cloud services like SaaS, PaaS and IaaS</p> <p>3.5 Cloud connectivity and Data storage on Cloud.</p> <p>3.6 Arduino: Architecture, Programming, and Applications</p> <p>3.7 Raspberry Pi Architecture, Programming, and Application basic level for IoT applications</p>	CO-1, CO-2 and CO-5
<p>TSO.4. a. Explain wired network</p> <p>TSO.4. b. Explain short range wireless network</p> <p>TSO.4. c. Explain M2M communication</p> <p>TSO.4. d. Explain various generation of wireless network</p> <p>TSO.4. e. Explain the importance of LWPAN in IoT</p> <p>TSO.4. f Differentiate between SigFox & LoRaWAN</p> <p>TSO.4. g Explain use of NB-IOT (Narrow Band IOT)</p> <p>TSO.4.h Create heterogenous network using RFID.</p>	<p>Unit.4 IoT Networking and Application: -</p> <p>4.1 Wired and short-range wireless network</p> <p>4.2 M2M – 2G, 3G, 4G & 5G networks</p> <p>4.3 LPWAN – Low Power Wide Area Networks</p> <p>4.4 SigFox & LoRaWAN.</p> <p>4.5 NB-IOT (Narrow Band IOT)</p> <p>4.6 RFID and Bar code basics- Components of an RFID system-Data -Tags-Antennas- Connectors-Cables- Readers- encoder/ printers for smart labels- Controllers software</p> <p>4.7 RFID advantages over Bar codes.</p>	CO-1 and CO-4
<p>TSO.5. a. Identify suitable framework for IoT app development</p> <p>TSO.5. b. Identify various stages of selected app</p> <p>TSO.5. c. Develop the app.</p> <p>TSO.5. d. Implement and deploy the app</p>	<p>Unit. 5 IoT App Development: -</p> <p>5.1 Framework selection for IoT app development</p> <p>5.2 Identify stages of app to be developed.</p> <p>5.3 Develop, Implement, and Deploy the App</p> <p>5.4 Testing and Integration</p> <p>5.5 Maintain and improve</p>	CO-4 and CO-5

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.5. e Maintain and improve the app based on the feedback		

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604C

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Python installation LSO 1.2 Prepare and run python program on given problem LSO 1.3 Prepare python program on Dictionary, Tuple and operators. LSO 1.4 Prepare program on arrays LSO 1.5 Prepare a program on 2-dimensional array LSO 1.6 Create program on conditional statement	1.	1.1 Install given version of Python on the computer system. 1.2 Prepare a python program using print() function and run it. 1.3 Access given value from the tuple 1.4 Print the given value of key from the dict. 1.5 Write a Python program to create an array of 5 integers and display the array items. Access individual element through indexes 1.6 Write a Python program which takes two digits m (row) and n (column) as input and generates a two-dimensional array. 1.7 Write a python program to check whether person is eligible for voting or not. (accept age from the user) 1.8 Write a python program to check whether the entered number is even or odd. 1.9 Write a python program to check whether entered number is divisible by another entered number. 1.10 Write a python program to display "Yes" is entered number is divisible by 5 otherwise display "No"	CO-1
LSO 2.1 Prepare python program on Do & while loops LSO 2.2 Prepare python program on break and continue statement. LSO 2.3 Prepare Python program using break and continue statements LSO 2.4 prepare python program using OOP LSO 2.5 Prepare Python program using functions	2.	2.1 Prepare a python program which can print first 10 even and odd numbers using while statement 2.2 Write a python program which can print first 10 integers and its square using while/for loop. 2.3 Write a python program which can print sum of first 10 natural numbers using while/for loop. 2.4 Write a python program which can identify the prime number between the range given using while/for loop. 2.5 Consider a situation where you want to iterate over a string and want to print all the characters until a letter 'e' or 's' is encountered. It is specified that you have to do this using loop and only one loop is allowed to use. 2.6 Consider the situation when you need to write a program which prints the number from 1 to 10 and but not 6. It	CO-2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
		<p>is specified that you have to do this using loop and only one loop is allowed to use.</p> <p>2.7 Create a Class with instance attributes</p> <p>2.8 Create a Vehicle class without any variables and methods</p> <p>2.9 Write a Python function to find the Max of three numbers.</p> <p>2.10 Write a Python program to reverse a string.</p>	
<p>LSO 3.1 Signup for free cloud storage</p> <p>LSO 3.2 Store data into cloud and retrieve it.</p>	3.	<p>3.1 Create a free cloud account</p> <p>3.2 Store data on cloud and retrieve it</p>	CO-3
<p>LSO 4.1 Design various types of network cables</p> <p>LSO 4.2 Connect computer in LAN.</p> <p>LSO 4.3 Connect devices using wireless network</p> <p>LSO 4.4 Connect machine with machine</p> <p>LSO 4.5 Connect devices using IEEE 802</p> <p>LSO 4.6 Connect devices using LPWAN</p> <p>LSO 4.7 Connect devices using RFID</p>	4	<p>4.1 Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.</p> <p>4.2 Connect the computers in Local Area Network</p> <p>4.3 Connect 2 or more devices using Bluetooth</p> <p>4.4 Connect 2 or more devices using infrared</p> <p>4.5 Connect 2 more machine using m2m</p> <p>4.6 Connect 2 or more different devices using access point</p> <p>4.7 Connect 2 devices using LPWAN (Smart Meter)</p> <p>4.8 Connect 2 or more devices using RFID</p>	CO-4
<p>LSO 5.1 Develop a IoT app</p> <p>LSO 5.2 Develop IoT applications using smartphones.</p>	5.	<p>5.1 Identify a problem and develop an app</p> <p>5.2 Building a temperature monitoring system using sensors and Smartphone</p>	CO-5

L) Suggested Term Work and Self Learning: S2400604C

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. Prepare a report on Python programming language.
2. Develop a small software in python to solve a IoT data analysis.
3. Create an id on free cloud storage and share data on it for others.
4. Create a heterogenous network and connect different dives.
5. Create a an IoT app for the identified problem

c. Other Activities:

1. Seminar Topics: - "Future of wireless network."
2. "Smart electricity billing ", "Cloud computing and IoT"
3. Visit to industry for IoT implementation in industrial process.
4. Reading RFID cards using 8051- RFID in the supply chain- Vehicles parking using RFID- library management system- electronic toll payment- smart shipping containers fleet monitoring and management.

5. Building IoT Applications like pressure, air quality, temperature and motion detector using Arduino and raspberry-pi Universal boards.
6. Surveys of market for availability of various types of network devices and its pricing.
7. Product Development: Development of projects for real life problem solution app.
8. Software Development: Using Python

d. Self-Learning Topics:

1. Deeper knowledge in Python features
2. Network devices and its capabilities
3. Advantages of IoT implementations

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%	20%	--	33%	10%	20%
CO-2	15%	10%	20%	--	33%	15%	20%
CO-3	30%	30%	20%	--	34%	15%	20%
CO-4	20%	30%	20%	50%	--	30%	20%
CO-5	25%	20%	20%	50%	--	30%	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 Python basics	5	CO1	7	2	2	3
Unit-2.0 Python Advance	5	Co1, CO2	7	2	2	3
Unit-3.0 Cloud features	14	CO3	21	8	8	5
Unit-4.0 Networking and Application	14	CO4, CO3	21	5	7	9
Unit-5.0 IoT Applications	10	CO5, CO3 and CO4	14	3	6	5
Total Marks	48		70	20	25	25

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.	Install given version of Python the computer system.	CO-1	70	20	10
2.	Prepare a python program using print() function and run it.	CO-1	60	30	10
3.	Access given value from the tuple	CO-1	60	30	10
4.	Print the given value of key from the dict.	CO-1	60	30	10
5.	Write a Python program to create an array of 5 integers and display the array items. Access individual element through indexes	CO-1	60	30	10
6.	Write a Python program which takes two digits m (row) and n (column) as input and generates a two-dimensional array.	CO-1	60	30	10
7.	Write a python program to check whether person is eligible for voting or not. (accept age from the user)	CO-1	60	30	10
8.	Write a python program to check whether the entered number is even or odd.	CO-1	60	30	10
9.	Write a python program to check whether entered number is divisible by another entered number.	CO-1	60	30	10
10.	Write a python program to display "Yes" is entered number is divisible by 5 otherwise display "No"	CO-1	60	30	10
11.	Prepare a python program which can print first 10 even and odd numbers using while statement	CO-2	60	30	10
12.	Write a python program which can print first 10 integers and its square using while/for loop.	CO-2	60	30	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
13.	Write a python program which can print sum of first 10 natural numbers using while/for loop.	CO-2	60	30	10
14.	Write a python program which can identify the prime number between the range given using while/for loop.	CO-2	60	30	10
15.	Consider a situation where you want to iterate over a string and want to print all the characters until a letter 'e' or 's' is encountered. It is specified that you have to do this using loop and only one loop is allowed to use.	CO-2	60	30	10
16.	Consider the situation when you need to write a program which prints the number from 1 to 10 and but not 6. It is specified that you have to do this using loop and only one loop is allowed to use.	CO-2	60	30	10
17.	Create a Class with instance attributes	CO-2	60	30	10
18.	Create a Vehicle class without any variables and methods	CO-2	60	30	10
19.	Write a Python function to find the Max of three numbers.	CO-2	60	30	10
20.	Write a Python program to reverse a string.	CO-2	60	30	10
21.	Create a free cloud account	CO-3	70	20	10
22.	Store data on cloud and retrieve it.	CO-3	60	30	10
23.	Study of different types of Network cables and Practically implement the cross-wired cable and straight through cable using clamping tool.	CO-4	70	20	10
24.	Connect the computers in Local Area Network	CO-4	70	20	10
25.	Connect 2 or more devices using Bluetooth	CO-4	70	20	10
26.	Connect 2 or more devices using infrared	CO-4	70	20	10
27.	Connect 2 more machine using m2m	CO-4	70	20	10
28.	Connect 2 or more different devices using access point	CO-4	70	20	10
29.	Connect 2 devices suing LPWAN (Smart Meter)	CO-4	70	20	10
30.	Connect 2 or more devices using RFID	CO-4	70	20	10
31.	Identify a problem and develop an app	CO-5	70	20	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1	Python software	Openly available as per instruction	As mentioned above list
2	Cables connectors and crimping tools	Cat 6e cable, RJ-45 connectors and Crimping Tool	
3	Bluetooth and infrared devices	Any mobile and wireless keyboard and mouse	
4	IoT free cloud	Free available	
5	Smart devices	Like meters, bulbs etc.	
6	Wireless access point	Wireless router or access point	-
8	Arduino development board	Arduino Uno and Arduino Nano.	-
6	Raspberry Pi	Raspberry Pi 4/ Raspberry Pi 3/ Raspberry Pi 2	-

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1	Let Us Python	Kanetkar Yashavant	BPB Publications ISBN: 9789388511568, 9789388511568
2	IOT (Internet of things) and Its Application	P K Pandey	T Balaji Publication (1 January 2020) ISBN-10: 8194136385 ISBN-13: 978-8194136385
3	Raspberry Pi Cookbook: Software and Hardware Problems and Solutions	Simon Monk	Shroff/O'Reilly; Third edition (4 October 2019), ISBN-10: 9352139267 ISBN-13: 978-9352139262
4	Raspberry Pi Cookbook: Software and Hardware Problems and Solutions,	Simon Monk	Shroff/O'Reilly; Third edition (4 October 2019), ISBN-10: 9352139267 ISBN-13: 978-9352139262
5	Cloud Computing: Concepts, Technology & Architecture	Erl	Pearson Education India; 1st edition (1 January 2014) ISBN-10: 9332535922 ISBN-13: 978-9332535923

(b) Online Educational Resources:

1. nptel.iitm.ac.in/courses/.../IIT.../lecture%2023%20and%2024.htm
2. en.wikipedia.org/wiki/Shear_and_moment_diagram
3. www.freestudy.co.uk/mech%20prin%20h2/stress.pdf
4. www.engineerstudent.co.uk/stress_and_strain.html
5. https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf
6. https://www.veritis.com/blog/aws-vs-azure-vs-gcp-the-cloud-platform-of-your-choice/
7. https://wiki.python.org/moin/TimeComplexity
8. www.engineerstudent.co.uk/stress_and_strain.html
9. https://www.iit.edu/arc/workshops/pdfs/Moment_Inertia.pdf
Amini, P. (2014). Sulley: Pure Python fully automated and unattended fuzzing frame- work.
<https://github.com/OpenRCE/sulley>

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

(c) Others:

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

- A) **Course Code** : 2400604D (T2400604D/P2400604D/S2400604D)
 B) **Course Title** : Drone Technology (Advance)
 C) **Pre- requisite Course(s)** : Drone Technology (Basics)
 D) **Rationale** :

In previous semester, a course in drone technology broadly discussed about basic principles, functions and interface of different components and design simple drone structure. In order to understand the successive development of drones / UAVs in terms of their geometric structure, working methodology and navigation control etc., so it is important to study the advanced course on Drone Technology. This course includes the study of Static and dynamic force analysis on drone, advance flying features, navigation control, maintenance and advance applications of different types of drone.

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

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

- CO-1** Apply the concept of engineering mechanics for stability of drone.
CO-2 Design the structure of drone using GPS module and thermal Image camera.
CO-3 Operate drone using advance flight controller board.
CO-4 Perform drone maintenance and assembly.
CO-5 Use drone in advance applications like precision agriculture, security, IoT, etc.

- 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	2	2	-	3	3	-	-		
CO-3	2	2	3	3	-	-	-		
CO-4	3	-	-	3	-	-	-		
CO-5	-	2	2	-	-	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				
2400604D	Drone Technology (Advance)	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.

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

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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)	
2400604D	Drone Technology (Advance)	30	70	20	30	20	30	200

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 (SW) 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: T2400604D**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
TSO 1a. Draw free body diagram of quadcopter drone. TSO 1b. Determine centroid of given drone structure. TSO 1c. Determine center of gravity of different drone structure. TSO 1d. Analyze different types of force acting drone system. TSO 1e. Differentiate between static and dynamic force analysis. TSO 1f. Explain how gyroscopic motion keeps drone balanced and hovering.	Unit-1.0 Engineering mechanics for Drone Technology 1.1 Drone Mechanics <ul style="list-style-type: none"> Free body diagram of drone Method of finding resultant of force system Equilibrium of coplanar force system 1.2 Center of Gravity <ul style="list-style-type: none"> Centroid of plane figure Center of gravity of solid bodies 1.3 Force analysis in drone <ul style="list-style-type: none"> Force analysis in drone Forces of flight Principle axes and rotation of aerial systems 1.4 Dynamics of machine <ul style="list-style-type: none"> Static and dynamic force analysis Gyroscopic motions 	CO-1
TSO 2a. Describe properties and application of smart materials use in UAV frame. TSO 2b. Calculate the diameter of the propeller for given drone frame size. TSO 2c. Determine size of quadcopter frame and diameter of propeller of drone TSO 2d. Describe working of GPS and its hardware interfacing. TSO 2e. Write steps to interface GPS module for drone navigation. TSO 2f. Describe different RF blocks and antennas used in RF transmitter and receiver.	Unit-2.0 Drone Frame and Components 2.1 Drone frame design <ul style="list-style-type: none"> Calculation principle for drone frame sizes Quadcopter frame design Smart materials for UAV frame Green material uses in drone 2.2 Advance Drones component <ul style="list-style-type: none"> GPS, Interfacing of GPS hardware Thermal and chemical sensor Tilt and LiDAR sensor 2.3 RF transmitter and receiver <ul style="list-style-type: none"> RF blocks RF antennas 2.4 Micro-electromechanical systems (MEMS) based sensor 2.5 HD and thermal Image camera	CO-2
TSO 3a. Identify features and specifications of FCB use in different application TSO 3b. Explain ports of any given advance flight controller board.	Unit-3.0 Advance flight controller Board (FCB) 3.1 Specification and ports of FCB 3.2 Software for FCB <ul style="list-style-type: none"> Software installation 	CO-3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number (s)
TSO 3c. Write steps of software installation of flight controller board. TSO 3d. Describe installation and calibration steps of radio telemetry with FCB. TSO 3e. Write steps of calibration of accelerometer and ESC with FCB. TSO 3f. Describe interfacing of GPS with FCB.	3.3 Radio Communication with FCB <ul style="list-style-type: none"> • Installation of Radio Telemetry • Radio Calibration with FCB 3.4 Calibration of accelerometer 3.5 Calibration of ESC 3.6 Interface of motor with FCB using ESC 3.7 GPS interface with FCB 3.8 Safety features of advance FCB	
TSO 4a. Describe challenges comes in drone maintenance. TSO 4b. Describe measuring devices and instrument use in drone maintenance. TSO 4c. Describe measuring instrument used to measure electrical parameters in drone. TSO 4d. Write sequence of steps use in assembling of drone.	Unit-4.0 Maintenance and assembling of Drone 4.1 Need and scope of drone maintenance 4.2 Types of maintenance 4.3 Routine drone maintenance and its checklist <ul style="list-style-type: none"> • Recording basic details • Structural inspection • Battery check • Software/firmware 4.4 Types of measuring instrument use in drone maintenance 4.5 Measurement of different electrical parameters related with drone hardware 4.6 Assembly of drones <ul style="list-style-type: none"> • Concept of interchangeability • Principle of gauging and their applicability in drone assembly • Parameters and profile measurements of standard propellers • Concepts of drone assembly using 3D modeling 	CO-4
TSO 5a. Describe function of autonomous drone using AI. TSO 5b. Describe IoT enable UAV for surveillance and data gathering. TSO 5c. Explain drone applications based on cost saving, enhanced efficiency and profitability aspects.	Unit-5.0 Advance Drone Application 5.1 Application of AI in Drone Technology 5.2 IoT and Computer vision integrated Drone 5.3 Drone interface with smart-phone 5.4 Drone Applications in <ul style="list-style-type: none"> • Military • Precision Agriculture 	CO-5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604D

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Use the force of gravity to compute the centre of gravity for a given drone structure.	1.	Determine Centre of gravity of different drone structure.	CO-1
LSO 2.1 Develop skills of observation and interpreting phenomenal changes on Drone model for stability and hovering.	2.	Demonstrate gyroscopic effect on a drone model	CO-1
LSO 3.1 Draw various frame to be required in designing drone structure. LSO 3.2 Use Measuring instrument in designing drone frame. LSO 3.3 Choose suitable materials for making drone frame	3.	Compare different types of airframe structure like quadcopter frame (plus shape, cross shape and H-shape), hexacopter frame (hexa + and hexa S).	CO-2, CO-4
LSO 4.1 Identify and measure the condition of sensors. LSO 4.2 Interface Tilt and LiDAR sensors in drone.	4.	Test Tilt and LiDAR sensors and their characteristics with Microcontroller based Flight controller board.	CO-2
LSO 5.1 Identify different component of GPS module LSO 5.2 Measure and use signals from GPS module to determine latitude & longitude. LSO 5.3 Diagnose problems using appropriate instruments/tools related to GPS navigation.	5.	Demonstrate the interfacing of GPS module to drone navigation.	CO-2, CO-3
LSO 6.1 Measure characteristics of HD and thermal Image camera. LSO 6.2 Diagnose common problems related to HD and thermal Image camera.	6.	Test HD and thermal Image camera and their characteristics.	CO-2
LSO 7.1 Identify the characteristics of RF circuit blocks like amplifier, and filters. LSO 7.2 Identify different antennas used. LSO 7.3 Operate drone using RC transmitter and receiver.	7.	Identify, configure and operate 433MHz and 2.4 GHz RC transmitter and receiver.	CO-2
LSO 8.1 Test the different peripheral interconnections with FCB LSO 8.2 Troubleshoot advance Flight control board (FCB)	8.	Programming and configure of parameters in flight control board (FCB).	CO-3
LSO 9.1 Configure radio communication device to control drones. LSO 9.2 Operate drone using RC transmitter and receiver.	9.	Test and perform communication of advance Flight control board with RF transceiver.	CO-3, CO-2
LSO 10.1 Measure various parameters of GPS system LSO 10.2 Interface GPS system with flight controller board.	10.	Test and perform communication of Flight control board (FCB) with GPS	CO-3, CO-2
LSO 11.1 Configure HD and thermal image camera with drone. LSO 11.2 Demonstrate use of HD and thermal image camera with FCB	11.	Test and troubleshoot HD and thermal image camera with advance FCB in drone.	CO-3, CO-2
LSO 12.1 Measure voltage, current frequency using Digital Multimeter LSO 12.2 Measure peak to peak voltage, time period, and duty cycle using DSO and waveform generator. LSO 12.3 Measure unknown frequency and its level using spectrum analyzer.	12.	Measure various electric parameters in drone hardware	CO-4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 13.1 Inspect drone as per the given checklist LSO 13.2 Diagnose drone problems after flying of 50 and 100hrs	13.	Perform preventive maintenance of drone components	CO-4
LSO 14.1 Perform dismantle process of drone. LSO 14.2 perform services need for operation LSO 14.3 Check and Install different parts of the drone system. LSO 14.4 Assemble drone component.	14.	Dismantle and service of different parts of drone system	CO-4

L) Suggested Term Work and Self Learning: S2400604D

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. Prepare maintenance report for small UAV.
2. Survey nearby electronics shop and Prepare report on types of drone frames and drone sensors available and its specification.
3. Prepare report of surveying & mapping of our institute using drone with HD and thermal image camera.
4. Prepare report on land and crops quality of nearby agriculture field using drone.
5. Prepare report on Identify and select different application drones like agriculture, Surveillance, Inspections and gathering Information for disaster management.
6. Download 5 videos on advance FCB of drone design. Watch them and write report on it.
7. Market survey on different types of FCB, its specification and specific application and prepare report.
8. Develop mission completion drone with the help of GPS based Advance FCB.

c. Other Activities:

1. Seminar Topics-Drone stability using gyroscopic motion, Quadcopter frame, Green material use in drone design, GPS based drones, types of HD and thermal Image camera, Safety features in advance drone, Drone Assembling, Military drone.
2. Visits: Visit nearby small industry, Drone institute facilities. Prepare report of visit with special comments of advance drone technology used, material used, cost of printed component.
3. Surveys: Survey nearby electronics shop and Prepare report of list of advance drone components and its specification.
4. Product Development
5. Software Development

d. Self-Learning Topics:

1. Different types Drones frame
2. Overview of GPS technology
3. Different types of HD and thermal Image camera
4. Safety features in Drone
5. Advance drone application

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self-Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	20%	20%	20%	25%	25%
CO-2	20%	20%	20%	20%	20%	25%	25%
CO-3	25%	25%	20%	20%	20%	25%	25%
CO-4	25%	25%	20%	20%	20%	25%	25%
CO-5	15%	15%	20%	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 Engineering mechanics for Drone Technology	8	CO-1	12	04	04	04
Unit 2.0 Drone frame and components	10	CO-2	14	04	04	06
Unit 3.0 Advance Flight Controller Board	12	CO-3	16	04	06	06
Unit 4.0 Maintenance and assembling of drone	10	CO-4	16	04	06	06
Unit 5.0 Advance Drone Application	8	CO-5	12	04	04	04
Total Marks	48		70	20	24	26

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA /ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Determine Centre of gravity of different drone structure.	CO-1	50	40	10
2.	Demonstrate gyroscopic effect on a drone model	CO-1	40	50	10
3.	Compare different types of airframe structure like quadcopter frame (plus shape, cross shape and H-shape), hexacopter frame (hexa + and hexa S).	CO-2	50	40	10
4.	Test Tilt and LiDAR sensors and their characteristics with Microcontroller based Flight controller board.	CO-2	50	40	10
5.	Demonstrate the interfacing of GPS module to drone navigation.	CO-2, CO-3	50	40	10
6.	Test HD and thermal Image camera and their characteristics.	CO-2	50	40	10
7.	Identify, configure and operate 433MHz and 2.4 GHz RC transmitter and receiver.	CO-2	60	30	10
8.	Programming and configuration of parameters in flight control board (FCB).	CO-3	60	30	10
9.	Test and perform communication of advance Flight control board with RF transceiver.	CO-3, CO-2	60	30	10
10.	Test and perform communication of Flight control board (FCB) with GPS	CO-3, CO-2	60	30	10
11.	Test and troubleshoot HD and thermal image camera with advance FCB in drone.	CO-3, CO-2	60	30	10
12.	Measure various electric parameters in drone hardware	CO-4	40	50	10
13.	Perform preventive maintenance of drone components	CO-4	60	30	10
14.	Dismantle and service of different parts of drone system	CO-4	60	30	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Drone Frame	Tricopter/Quadcopter/Hexacopter	1-15
2.	Propellers	15 X 5.5 CW/Others	1-15
3.	GPS module	M8N Series	1-15
4.	Drone Camera	15-20 Megapixel	1-15
5.	Camera Gimble	3 Axis feature, 360 Degree movement	1-15
6.	Tilt Sensor	8-30 volt	1-15
7.	LiDER sensor	Range 75m to 200m	1-15
8.	Battery	Lithium Polymer Battery,8000 to 10000 mAh	1-15
9.	Motor	BLDC, 370kv	1-15
10.	Electronic speed Controller (ESC)	40 Amp	1-15
11.	Flight Controller Board	CC3D/Pixhawk/Others	1-15
12.	Transmitter and Receiver for radio signal	10 Channels and more, 2.4 GHz & 5.8 GHz	1-15
13.	Embedded system for AI application on UAV	Open Source Jetson Baseboard /Others	1-15

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

S. No.	Titles	Author (s)	Publisher and Edition with ISBN
1.	Make: DIY Drone and Quadcopter Projects: A Collection of Drone-Based Essays, Tutorials, and Projects	Editors of Make	Shroff/Maker Media, First edition 2016, ISBN-978-9352133994
2.	Make: Getting Started with Drones: Build and Customize Your Own Quadcopter	Terry Kilby & Belinda Kilby	Shroff/Maker Media, First edition 2016, ISBN-978-9352133147
3.	Agricultural Drones: A Peaceful Pursuit	K R Krishna	Apple Academic Press,1st edition 2018, ISBN-978-1771885959
4.	Building Multicopter Video Drones: Build and fly multicopter drones to gather breathtaking video footage	Ty Audronis	Packt Publishing Limited; Illustrated edition,2014, ISBN-978-1782175438
5.	The Complete Guide to Drones	Adam Juniper	Ilex Press, Extended 2nd Edition,2018 ISBN-9781781575383
6.	Unmanned Aircraft Systems - UAVS Design, Development and Deployment (Aerospace Series)	R Austin	John Wiley & Sons Inc, 1st edition, 2010, ISBN-978-0470058190

(b) Online Educational Resources:

1. <https://archive.nptel.ac.in/courses/101/104/101104083/>
2. https://onlinecourses.nptel.ac.in/noc21_ae14/preview
3. https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle
4. <https://fusion.engineering/>
5. <https://robocraze.com/blogs/post/best-flight-controller-for-drone>
6. <https://www.youtube.com/watch?v=lrkFG7GilPQ>
7. <https://www.youtube.com/watch?v=KjG6FKCNCbM>
8. <https://ardupilot.org/>
9. <https://px4.io/>

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

(c) Others:

1. Development of an Autonomous IoT-Based Drone for Campus Security, Abdelrahman Mahmoud Gaber, Rozeha A. Rashid, Nazri Nasir, Ruzairi Abdul Rahim, M. Adib Sarijari, A. Shahidan Abdullah, Omar A. Aziz, Siti Zaleha A. Hamid, Samura Ali, 2021
2. IoT based UAV platform for emergency services; S. K. Datta, J. L. Dugelay, & C. Bonnet, 2018
3. Development of an Autonomous Drone for Surveillance Application; M. A. Dinesh, S. Santhosh Kumar, J. Sanath, K. N. Akarsh & K. M. Manoj Gowda, 2018
4. Autonomous cloud-based drone system for disaster response and mitigation; C. Alex & A. Vijaychandra, 2016
5. <https://www.geeetech.com/Documents/CC3D%20flight%20control%20board.pdf>
6. https://www.bhphotovideo.com/lit_files/201146.pdf
7. http://tricopter.hu/docs/cc3d_manual.pdf

- A) **Course Code** : 2400604E (T2400604E/P2400604E/S2400604E)
 B) **Course Title** : 3D Printing and Design (Advance)
 C) **Pre- requisite Course(s)** : 3D Printing and Design (Basic)
 D) **Rationale** :

This advanced course on 3D Printing tries to develop understanding of the process of making real complex objects from digital models in the students using various 3D printing processes and materials (Plastics, Ceramics and Metals). It also covers the post processing required and details about various printing process and parameters to make a quality 3D printed component. This course can only be taken up after completing 3D Printing and Design (Basic) course offered in previous semester.

- 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** Select newer 3D Printing material for various applications.
CO-2 Use solid based 3D Printing processes to develop products.
CO-3 Use liquid-based 3D Printing processes to develop products.
CO-4 Use powder-based 3D Printing processes to develop products.
CO-5 Apply post processing techniques and quality checks on 3D printed components.

- 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	-	2	2	-	-	2		
CO-4	3	-	2	2	-	-	2		
CO-5	3	2	-	3	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)					Total Credits (C)
		Classroom Instruction (CI)		Lab Instruction (LI)	Notional Hours (TW+ SL)	Total Hours (CI+LI+TW+SL)	
		L	T				
2400604E	3D Printing and Design (Advance)	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)	
2400604E	3D Printing and Design(Advance)	30	70	20	30	20	30	200

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: T2400604E

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain various forms of 3D printing raw material.</p> <p><i>TSO 1b.</i> Select material for the given popular 3D printing processes with justification.</p> <p><i>TSO 1c.</i> Select various Polymer based 3D printing raw materials with justification.</p> <p><i>TSO 1d.</i> Explain procedure of Powder preparation for the given 3D printing material.</p> <p><i>TSO 1e.</i> Explain properties of the given Metal/Ceramics 3D printing material.</p> <p><i>TSO 1f.</i> Choose suitable 3D printing material on the basis of Performance Requirements and Material Properties.</p>	<p>Unit-1.0 3D Printing Materials</p> <p>1.1 Various forms of 3D printing raw material- Liquid, Solid, Wire, Powder.</p> <p>1.2 Popular FDM, SLA, SLS, Binder Jetting, Material Jetting and Direct Energy deposition 3D printing materials.</p> <p>1.3 Polymers, Metals, Non-Metals, Ceramics.</p> <p>1.4 Polymers and their properties.</p> <p>1.5 Powder Preparation and their desired properties.</p> <p>1.6 Choosing the Right 3D Printing Material on the basis of Performance Requirements and Material Properties.</p>	CO1
<p><i>TSO 2a.</i> Explain working of a typical FDM based 3D Printer.</p> <p><i>TSO 2b.</i> Justify use of FDM based 3D printing process and material for the given component.</p> <p><i>TSO 2c.</i> Explain the Laminated Object Manufacturing process.</p> <p><i>TSO 2d.</i> Estimate the cost and time of the given FDM based 3D printed component.</p>	<p>Unit-2.0 Solid based 3D Printing Processes</p> <p>2.1 Basic principle and working of fused deposition modeling (FDM) process.</p> <p>2.2 Liquefaction, solidification and bonding.</p> <p>2.3 Laminated Object Manufacturing process.</p> <p>2.4 Cost estimation of FDM 3D printed component.</p>	CO1, CO2
<p><i>TSO 3a.</i> Explain the phenomenon of Photo Polymerization.</p> <p><i>TSO 3b.</i> Explain the working of a typical Stereo Lithography based 3D Printer.</p> <p><i>TSO 3c.</i> Explain procedure of 3D Scanning of the given component.</p> <p><i>TSO 3d.</i> Justify use of SLA based 3D printing process and material for the given component.</p> <p><i>TSO 3e.</i> Estimate the cost and time of the given SLA based 3D printed component.</p> <p><i>TSO 3f.</i> Apply Curing process to SLA based 3D printed component.</p>	<p>Unit-3.0 Liquid based 3D Printing Processes</p> <p>3.1 Photo polymerization.</p> <p>3.2 Principle and working of stereo lithography apparatus.</p> <p>3.3 SLA based 3D printing processes.</p> <p>3.4 SLA based 3D printing process materials.</p> <p>3.5 Scanning techniques.</p> <p>3.6 Curing processes.</p> <p>3.7 Cost estimation of SLA 3D printed component.</p>	CO1, CO3
<p><i>TSO 4a.</i> Explain powder fusion mechanism.</p> <p><i>TSO 4b.</i> Explain working of a typical SLA based 3D Printer.</p> <p><i>TSO 4c.</i> Justify use of SLA based 3D printing process and material for the given component.</p> <p><i>TSO 4d.</i> Explain Net shape process.</p> <p><i>TSO 4e.</i> Explain Binder Jet 3D printing process.</p> <p><i>TSO 4f.</i> Justify use of Binder Jet 3D printing process and material for the given component.</p> <p><i>TSO 4g.</i> Estimate the cost and time of the given SLS based 3D printed component.</p>	<p>Unit-4.0 Powder based 3D Printing Processes</p> <p>4.1 Powder fusion mechanism.</p> <p>4.2 Principle and working of Selective Laser Sintering (SLS) process.</p> <p>4.3 SLS based 3D printers.</p> <p>4.4 Laser Engineering Net Shaping process.</p> <p>4.5 Electron Beam Melting.</p> <p>4.6 Binder Jet 3D Printing.</p> <p>4.7 Materials and Process parameters for SLS based 3D printing processes.</p>	CO1, CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	4.8 Cost estimation of SLS based 3D printed component.	
<p><i>TSO 5a.</i> Justify the need of post processing in the given 3D printed component.</p> <p><i>TSO 5b.</i> List the various post processing techniques.</p> <p><i>TSO 5c.</i> List the steps to perform post processing.</p> <p><i>TSO 5d.</i> Explain the given Cleaning related post processing approach for 3D printed component.</p> <p><i>TSO 5e.</i> Explain the given Surface finishing related post processing approach for 3D printed component.</p> <p><i>TSO 5f.</i> Apply simple inspection and testing techniques on the given 3D printed component.</p> <p><i>TSO 5g.</i> Identify the type of defect(s) in the given 3D printed component.</p>	<p>Unit-5.0 Post Processing and Quality</p> <p>5.1 Need of post processing: Functional and Aesthetic reasons.</p> <p>5.2 Steps of Post Processing: Cleaning/Support removal, Fixing, Curing or hardening, Surface finishing, Colouring.</p> <p>5.3 Cleaning: Support Removal (FDM and Material Jetting); Powder Removal (SLS and Powder Bed Fusion); Washing (SLA and Photo polymerisation).</p> <p>5.4 Fixing: Filling, Gluing, Welding.</p> <p>5.5 Surface finishing: Sanding, Polishing, Tumbling, Hydro dipping, Epoxy coating, Electro Plating, Vapour smoothing-Acetone treatment.</p> <p>5.6 Colouring, Coating, Priming and Painting.</p> <p>5.7 Inspection and testing: Digital, Visual, Physical.</p> <p>5.8 Defects and their causes.</p>	CO1, CO2, CO3, CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604E

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 1.1.</i> Use the available 3D printing software.</p> <p><i>LSO 1.2.</i> Select printing process parameters based on the type/make of Printer and raw material</p> <p><i>LSO 1.3.</i> Set printing process parameters.</p> <p><i>LSO 1.4.</i> Produce a complex component using available FDM Printer.</p>	1.	Develop the assigned digital single complex component using FDM based 3D Printer and available material.	CO1, CO2
<p><i>LSO 2.1.</i> Use the available 3D printing software.</p> <p><i>LSO 2.2.</i> Select printing process parameters based on the type/make of Printer and raw material</p> <p><i>LSO 2.3.</i> Set printing process parameters.</p> <p><i>LSO 2.4.</i> Produce a complex component using available SLA Printer.</p> <p><i>LSO 2.5.</i> Perform curing of the SLA based 3D printed component.</p>	2.	Develop the assigned digital single complex component using SLA based 3D Printer and available material.	CO1, CO3
<p><i>LSO 3.1.</i> Use the available 3D printing software.</p> <p><i>LSO 3.2.</i> Select printing process parameters based on the type/make of Printer and raw material</p> <p><i>LSO 3.3.</i> Set printing process parameters.</p> <p><i>LSO 3.4.</i> Produce a complex component using available SLS Printer.</p>	3.	Develop the assigned digital single complex component using SLS based 3D Printer and available material.	CO1, CO4

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 4.1.</i> Use the available 3D printing software.</p> <p><i>LSO 4.2.</i> Select printing process parameters based on the type/make of Printer and raw material</p> <p><i>LSO 4.3.</i> Set printing process parameters.</p> <p><i>LSO 4.4.</i> Produce a complex component using available FDM, SLA and SLS Printer.</p> <p><i>LSO 4.5.</i> Perform Cost, Time, Surface finish and Strength estimations related to 3D printed components.</p>	4.	Develop same digital single complex component using FDM, SLA and SLS based 3D Printers and compare the printed components on the basis of Cost, Time, Surface finish, Strength.	CO1, CO2, CO3, CO4
<p><i>LSO 5.1.</i> Use the available 3D printing software.</p> <p><i>LSO 5.2.</i> Select printing process parameters based on the type/make of Printer and raw material</p> <p><i>LSO 5.3.</i> Select appropriate tolerance, fit and printing process parameters.</p> <p><i>LSO 5.4.</i> Produce an assembly using available SLA/SLS Printer.</p>	5.	Print one digital assembly on SLA/SLS based 3D Printer.	CO2/CO3/CO4
<p><i>LSO 6.1.</i> Use of available 3D scanner.</p> <p><i>LSO 6.2.</i> Develop 3D digital model using scanning approach.</p> <p><i>LSO 6.3.</i> Use the available 3D printing software.</p> <p><i>LSO 6.4.</i> Produce a complex component using available SLA Printer.</p>	6.	Scan the given real complex component and print it using FDM/SLA/SLS based 3D Printer.	CO2, CO3, CO4
<p><i>LSO 7.1.</i> Identify tools/devices/chemicals for post processing</p> <p><i>LSO 7.2.</i> Perform post processing operations on printed component.</p>	7.	Apply post processing techniques on the 3D printed component of experiment number 1 and/or 2 and/or 3.	CO5
<p><i>LSO 8.1.</i> Identify tools/devices/techniques for inspection and testing.</p> <p><i>LSO 8.2.</i> Identify the defects in 3D printed components</p> <p><i>LSO 8.3.</i> Apply remedial measures to bring soundness in the defective 3D printed component.</p>	8.	Check the soundness of the 3D printed component of experiment number 1 and/or 2 and/or 3 using available devices/techniques.	CO5

L) Suggested Term Work and Self Learning: S2400604E

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. Prepare a list of solid, liquid and powder form 3D printing raw materials stating their cost, colour opacity, flexibility and weight per unit volume.
 2. Download 5 videos of 3D printing of different components using FDM, SLA and SLS each. 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. Prepare a report on post processing steps and techniques used for 3D printed components using FDM, SLA, SLS.
4. Prepare a report to compare FDM, SLA, SLS based 3D printing process on the basis of cost, surface finish, printer setting time, printing time and post processing time and cost involved.
5. Download 5 videos of 3D printing processes **other than** FDM, SLA and SLS. 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.
6. Download 1 video related to inspection and testing of 3D printed components using different techniques like Visual inspection, Scanning Electron Microscopy (SEM), CT system, X-ray, Penetration testing, Infrared thermography, Leak or pressure testing for complex structures, Eddy current, Mechanical property inspection to measure tensile, yield, shear, fatigue, hardness, density, impact strength, Metallography (Microstructure testing). Watch them and write a report to detail out the steps involved and equipment used.

c. Other Activities:

1. Seminar Topics:

- Newer 3D printing raw materials
- Direct energy 3D printing process
- Material jetting 3D printing process
- Micro 3D printing process
- Metal and Ceramic 3D printing
- 3D printing of Jewelry
- 3D printing of Bio implants
- Printing of flexible plastic components

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 transparent, soft and flexible plastic components
- 3D printing of metal components
- 3D printing of ceramic components
- 3D scanning process.
- Chemical post processing techniques

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

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

Legend:

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

**: Mentioned under point- (N)

#: Mentioned under point-(O)

Note:

- The 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 3D Printing Materials	6	CO1	10	3	2	5
Unit-2.0 Solid based 3D Printing Processes	10	CO1, CO2	14	4	5	5
Unit-3.0 Liquid based 3D Printing Processes	10	CO1, CO3	14	4	5	5
Unit-4.0 Powder based 3D Printing Processes	10	CO1, CO4	14	4	5	5
Unit-5.0 Post Processing and Quality	12	CO1, CO2, CO3, CO4, CO5	18	5	5	8
Total	48	-	70	20	22	28

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Develop the assigned digital single complex component using FDM based 3D Printer and available material.	CO1, CO2	30	60	10
2.	Develop the assigned digital single complex component using SLA based 3D Printer and available material.	CO1, CO3	30	60	10
3.	Develop the assigned digital single complex component using SLS based 3D Printer and available material.	CO1, CO4	30	60	10
4.	Develop same digital single complex component using FDM, SLA and SLS based 3D Printers and compare the printed components on the basis of Cost, Time, Surface finish, Strength.	CO1, CO2, CO3, CO4	30	60	10
5.	Print one assembly on SLA/SLS based 3D Printer.	CO2/CO3/CO4	30	60	10
6.	Scan the given real complex component and print it using FDM/SLA/SLS based 3D Printer.	CO2, CO3, CO4	40	50	10
7.	Apply post processing techniques on the 3D printed component of experiment number 1 and/or 2 and/or 3.	CO5	40	50	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
8.	Check the soundness of the 3D printed component of experiment number 1 and/or 2 and/or 3 using available devices/techniques.	CO5	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	High end computers	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Parametric Computer Aided Design software	CATIA/Solid works/NX/Creo OR Available with CoE	1 to 5
3.	FDM based 3D printer	Fused Deposition Modelling system with complete accessories; Build Volume-300 x 300 x 300mm or Higher; Layer Thickness-0.1 – 0.4 OR Available with CoE	1,4,5,6
4.	SLA based 3D printer	Printing Technology: SLA, 145 x 145 x 175mm build volume, Common layer thickness 25–100 µm, Dimensional Accuracy ± 0.5% (lower limit: ±0.10 mm), cure time of only 1-3s per layer, Material type: UV-sensitive liquid resin, Curing unit.	2,4,5,6
5.	SLS based 3D printer	Printing Technology: SLS., Build Volume: 130 x 130 x 180 mm, Recommended min. wall thickness: 0.8 mm, Powder Diameter: 60 Microns, Material Type: Nylon, TPU, Light Source: Laser Diode	3,4,5,6
6.	3D Printing Material	ABS/PLA, Resin based Photosensitive material, Polymer/metal/ceramic powder OR Available with CoE	1,2,3,4,5,6
7.	3D Printing software	Latest version of software like: Cura/PrusaSlicer/ideaMaker/Meshmixer/MeshLab OR Available with CoE	1 to 6
8.	3D Scanner and Processing software	Handheld 3D scanner, Accuracy up to 0.1 mm, Resolution up to 0.2 mm, Real time onscreen 3D model projection and processing, Wireless technology with an inbuilt touch screen and battery, Extended field of view for capturing both large and small objects, Processing Software OR Available with CoE	6
9.	Post processing equipments and tools	Deburring tools (tool handle & deburring blades), Electronic Digital Caliper, Cleaning Needles, Art knife set, Long nose pliers, Flush cutters, Wire brush, Nozzle cleaning kit, Tube cutter, Print removal spatula, Needle file, Cutting mat, Glue stick, Wire stripper, Chemicals, Etching agents etc.	7

10.	Inspection and Testing devices	<ul style="list-style-type: none"> • Visual inspection, Devices related to: • Scanning electron microscopy (SEM), CT system, X-ray, • Penetration testing, • Infrared thermography, • Leak or pressure testing for complex structures, • Eddy current, • Mechanical property inspection to measure tensile, yield, shear, fatigue, hardness, density, impact strength • Metallography (Microstructure testing) 	8
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R) Suggested Learning Resources:**(a) Books:**

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing	Lan Gibson, David W. Rosen, Brent Stucker	Springer, 2010 ISBN: 9781493921133
2.	Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing	Andreas Gebhardt,	Hanser Publisher, 2011 ISBN: 156990507X, 9781569905074
3.	3D Printing and Design	Sabrie Soloman	Khanna Publishing House, Delhi ISBN: 9789386173768
4.	3D Printing and Rapid Prototyping- Principles and Applications	C.K. Chua, Kah Fai Leong	World Scientific, 2017 ISBN: 9789813146754
5.	Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution	Liza Wallach Kloski, Nick Kloski	Make Community, LLC; 2nd edition, 2021 ISBN: 9781680450200
6.	Laser-Induced Materials and Processes for Rapid Prototyping	L. Lu, J. Fuh, Y.S. Wong	Kulwer Academic Press, 2001 ISBN: 9781461514695

(b) Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. <https://archive.nptel.ac.in/courses/112/104/112104265/>
3. <https://bigrep.com/post-processing/>
4. <https://www.mdpi.com/2227-7080/9/3/61>
5. <https://all3dp.com/2/best-3d-printing-books/>
6. <https://www.youtube.com/watch?v=TQY2IF-sFal>
7. <https://www.youtube.com/watch?v=Oz0PoS5LPxg>
8. <https://www.youtube.com/watch?v=6ejjh0GdyDc>

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

(c) Others:

1. 3D Printing Projects DK Children; Illustrated edition, 2017
2. The 3D Printing Handbook: Technologies, design and applications Ben Redwood, Filemon Schöffner, Brian Garret, 3D Hubs; 1st edition, 2017
3. <https://www.improrecision.com/inspection-method-for-3d-printed-parts/>
4. 3D Printer Users' Guide
5. 3D Printer Material Handbook
6. Lab Manuals

- A) **Course Code** : 2400604F (T2400604F/P2400604F/S2400604F)
 B) **Course Title** : Industrial Automation (Advance)
 C) **Pre- requisite Course(s)** : Industrial automation (Basic), Digital Electronics and Basic programming skills

D) **Rationale** :
 This course on Advanced industrial automation offers students a hands-on approach to implement industrial control using modern controllers like Programmable Logic Controller (PLC), Distributed Control System (DCS) Supervisory Control and Data Acquisition (SCADA). Students will learn to identify and connect field inputs and outputs; communicate with, and program microprocessor-based controllers. Students will also connect, communicate with, and develop displays for computer-based operator interfaces. Process manufacturers typically employ Distributed Control System (DCS) Supervisory Control and Data Acquisition (SCADA) technologies to monitor and control the operations in their facilities. DCS and SCADA systems are now doing much more than simply monitoring and controlling. The course will enable the students to use of basic instructions and addressing, advanced PLC instructions in Ladder Logic and to identify and troubleshoot the faults in PLC system and do PLC maintenance. This course also introduces the students to industrial automation communications, PLC maintenance and troubleshooting also to become a successful automation engineer.

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

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

- CO-1. Apply the principles of communication for industrial automation.
- CO-2. Test the output of the PLC ladder logic programs for the given application
- CO-3. Maintain PLC systems
- CO-4. Use SCADA for supervisory control and for acquiring data from the field.
- CO-5. Develop simple automation systems

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 Engineer- ingTools	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	2	-	2		
CO-2	3	3	3	3	-	-	2		
CO-3	3	3	3	3	2	2	2		
CO-4	3	2	2	2	2	2	2		
CO-5	3	2	2	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				
2400604F	Industrial Automation (Advance)	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)	
2400604F	Industrial Automation (Advance)	30	70	20	30	20	30	200

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: T2400604F**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO.1a Describe how does a PLC communicate? TSO.1b Differentiate between parallel and series communication TSO.1c Describe the data transfer mechanism for the given communication protocols. TSO.1d Describe the given communication protocol used in PLC communication. TSO.1e Summarize PLC to PLC communication procedure TSO.1f Describe the common procedure to interface the PLC with other given hardware.	Unit-1.0 Industrial automation communication and Interfacing 1.1 Analog and Digital Communications on Plant Floors 1.2 Introduction to Industrial Networking 1.3 RS232-422-485 standards for data communication 1.4 Industrial Ethernet 1.5 Concept of Fieldbus 1.6 MODBUS protocol 1.7 Highway Addressable Remote Transducer (HART) Protocol 1.8 Interfacing of Programmable Logic Controller with other hardware	CO-1
TSO.2a Specify the proper I/O addressing format of the given PLC. TSO.2b Explain the use of different relay type instructions for the given operation. TSO.2c Describe how a program is executed with the help of Program Scan cycle TSO.2d Develop ladder logic program using arithmetic functions to perform the given operation. TSO.2e Develop ladder logic programs using logical and comparison instructions to perform the given operation TSO.2f Develop ladder logic programs using on delay, off delay and reset/retentive timer in a given PLC to create a delay in operation. TSO.2g Develop ladder logic programs using Up, Down and UP-down counter in a given PLC to count the number of products	Unit-2.0 PLC Programming 2.1 PLC I/O addressing in ladder logic 2.2 PLC programming instructions using ladder logic and relay type instructions 2.3 Program Scan cycle 2.4 PLC arithmetic functions - Addition, subtraction, multiplication, division instructions, increment decrement, trigonometric 2.5 PLC logical functions - AND, OR, XOR, NOT functions, PLC compare and convert functions. 2.6 Programming Timer –Addressing a timer block, status bits, On delay, Off Delay and reset/retentive timer 2.7 Programming Counter- Addressing a counter block, status bits, Up and Down counter, up-down counter, counter examples, register basics 2.8 Develop ladder logic for various simple applications	CO-2
TSO.3a Describe Requirements for PLC enclosure. TSO.3b Describe Proper grounding techniques. TSO.3c Describe noise reduction Techniques. TSO.3d Explain preventive maintenance procedure associated with PLC	Unit-3.0 Installation and maintenance of PLC systems 3.1 PLC enclosure, grounding requirements, noise generating inductive devices, leaky inputs and outputs, techniques to reduce electrical noise and leakage. 3.2 Introduction to PLC Trouble shooting and maintenance, trouble shooting of hardware and software. 3.3 Diagnostic LED Indicators in PLCs	CO-3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>system to reduce environmental impact</p> <p>TSO.3e Identify faults in the given PLC system</p> <p>TSO.3f Explain the procedure for Troubleshooting PLC system</p> <p>TSO.3g Prepare preventive maintenance plan for the PLC system</p> <p>TSO.3h Use safety equipment's.</p> <p>TSO.3i Follow safe practices</p>	<p>3.4 Common problems</p> <ul style="list-style-type: none"> • Internal problems – Check for PLC Power Supply, Emergency Push Button, Power Supply Failure, Battery Failure, Electrical Noise Interference, Verify the PLC Program with the Master Program, Corrupted PLC Memory • External problems - Power failure, faulty grounding and electrical noise interference (RFI or EMI), Status of the Output Modules and their associated Circuitry, Status of the Input Modules and their associated Circuitry, Field Input and Output Devices, Communication Issues. • Environmental Conditions. Check for humidity, temperature, vibration, and noise-level limits specified by its manufacturer <p>3.5 Troubleshooting of Specific Components of the PLC System</p> <ul style="list-style-type: none"> • Power Supply Troubleshooting • I/O Modules Troubleshooting • Troubleshooting PLC Program Errors • Troubleshooting the Working Environment of a PLC • Replacement of CPU <p>3.6 PLC trouble shooting flowchart</p> <p>3.7 PLC maintenance – PLC maintenance checklist, preventive maintenance procedure, maintenance plan for the PLC system.</p> <p>3.8 Safety procedure and safety equipment's.</p>	
<p>TSO.4.a Describe the function of given element of a SCADA system.</p> <p>TSO.4.b Interface the given PLC with SCADA system using the given Open Platform Communications (OPC).</p> <p>TSO.4.c Describe the steps to develop a simple SCADA screen for the given industrial application.</p> <p>TSO.4.d Describe the procedure to maintain the SCADA based PLC system for the given application.</p>	<p>Unit-4.0 SCADA and DCS</p> <p>4.1 Introduction, need, benefits and typical applications of SCADA and DCS</p> <p>4.2 SCADA Architecture - Remote Terminal Units (RTUs), Master Terminal Units, Various SCADA editors, Communication protocols for SCADA</p> <p>4.3 Comparison of SCADA with DCS</p> <p>4.4 Interfacing SCADA system with PLC- Typical connection diagram, Object Linking and Embedding for Process Control (OPC) architecture</p> <p>4.5 Creating SCADA Screen HMI for simple object, Steps for linking SCADA object (defining Tags and items, creating trends etc.,) with PLC ladder program using OPC, configuring simple applications using SCADA: Traffic light control, water distribution, pipeline control, Power generation, transmission and distribution etc.</p> <p>4.6 Procedure to maintain the SCADA based PLC system.</p>	<p>CO-3</p>
<p>TSO.5a Identify different components used for automation in the given system</p> <p>TSO.5b Select automation components for a given situation</p> <p>TSO.5c In the given manufacturing or service industry Identify the areas where automation is possible.</p> <p>TSO.5d Prepare plan for sustainable automation as per the requirement.</p>	<p>Unit-5.0 Applications of Industrial Automation</p> <p>5.1 Manufacturing- Industrial Robots- welding robots, pick and place robots, Cabot's, Machine monitoring system, supply chain, Automated assembly system, Flexible Automation and programmable Automation.</p> <p>5.2 Health Care- microscopic robots for medical diagnosis, automated medication dispensing devices, AESOP, ZEUS, RP_7(remote presence 7th generation), DaVinci</p>	<p>CO-5</p>

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	<p>5.3 Defense- guided rockets and missiles, counter measures, UAV drones, launcher, radar antenna, engagement control system</p> <p>5.4 Automobile –Break monitoring system, Vehicle tracking system, Rear-view alarm to detect obstacles behind, Four-wheel drive, Traction control system, Dynamic steering response, Anti-lock braking system (ABS) Adaptive cruise control, Adaptive headlamps, Intelligent Parking Assist System, Driverless/Autonomous Cars</p> <p>5.5 Agriculture- harvesters, irrigation systems, plowing machines, self-driving tractors, grain yield sensor</p> <p>5.6 Mining- Mine planning system, mine picture compilation, mine control system, seismic imagining, laser imaging, Rig control system, automated drilling, automated exploration, automated truck</p>	

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604F

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1</i> Data communication from PLC to PC and vice versa	1.	Transfer the control data from PLC to PC and vice versa	CO1
<i>LSO 1.2</i> Establish Communication channels between PLC s.	2.	Transfer the control data from PLC to PLC	CO1
<i>LSO 1.3</i> Transfer data from sensors to PLC and from PLC to PC.	3.	Transfer the sensor data from sensor to PLC to PLC and PC	CO1
<i>LSO 1.4</i> Interface the given PLC with a PC or a Laptop	4.	Interface the given PLC with a PC or a Laptop	CO1
<i>LSO 2.1</i> Identify Different parts and front panel indicators of a PLC	5.	Identify the various parts and front panel status indicators of the given PLC.	CO2
<i>LSO 2.2</i> Develop Ladder logic program for different arithmetic operations	6.	Develop/Execute ladder logic program for different arithmetic operations such as Addition, subtraction, multiplication, division increment, decrement, trigonometric in a given PLC	CO2
<i>LSO 2.3</i> Develop Ladder logic program for different logical operations	7.	Develop/Execute ladder logic program for logical operations such as AND, OR, NOT, NAND, NOR, X-OR, X-NOR gate along with truth table	CO2
<i>LSO 2.4</i> Program Latch and Unlatch circuit in a PLC for motor operation	8.	Program the given PLC to start run and stop the given motor using latch circuit	CO2
<i>LSO 2.5</i> Create delay in operation using on delay, off delay and retentive timer function in a given PLC.	9.	Test the functionality of on delay, off delay and retentive timer for its correct operation in a given PLC.	CO2
<i>LSO 2.6</i> Count the number of objects/events using Up counter, Down counter and UP/Down counter in a PLC	10.	Test the functionality of Up, Down and Up-down counter for its correct operation in a given PLC.	CO2
<i>LSO 2.7</i> Program PLC using ladder logic to control a LED/Lamp	11.	Develop/Execute a ladder logic program to put LED/lamp in the blinking mode	CO2
<i>LSO 2.8</i> Program PLC using ladder logic to control a simple traffic light system	12.	Develop/Execute a ladder logic program to control a simple traffic light control system using PLC	CO2

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO 3.1</i> Use hygrometer to measure the humidity inside the panel</p> <p><i>LSO 3.2</i> Use thermometer to measure ambient temperature inside the panel</p> <p><i>LSO 3.3</i> Use tester to determine the voltage fluctuation at the power supply terminals is within specifications</p> <p><i>LSO 3.4</i> Test the ground connections of the given PLC.</p> <p><i>LSO 3.5</i> A given PLC is not working as per the logic instructions investigate the PLC to identify the cause of failure to show the desired output</p> <p><i>LSO 3.6</i> Investigate the cause of Noise in the given PLC</p> <p><i>LSO 3.7</i> PLC goes on blackout out by losing its operating power. Troubleshoot the cause of failure.</p> <p><i>LSO 3.8</i> Troubleshoot the corrupted PLC memory.</p> <p><i>LSO 3.9</i> Replace CPU and power supply fuses in a given PLC system.</p>	13.	Troubleshooting of PLC system	CO3
<p><i>LSO 4.1</i> Download any open source SCADA software and install the same.</p> <p><i>LSO 4.2</i> Interpret the available components in symbol factory of SCADA software</p> <p><i>LSO 4.3</i> Create simple SCADA HMI applications and apply dynamic properties. (Select any Three from the given list)</p> <ol style="list-style-type: none"> i. Turn on and off a tube light using a Switch ii. Apply filling and object size properties to a rectangle, square and round object iii. Move the object, fill the object using slider and meter reading. iv. Apply orientation property to a fan and control its direction using a slider. v. Move a square object horizontally first, then vertically and again horizontally by applying visibility property. <p><i>LSO 4.4</i> Create historical and real time trends for the given automation</p>	14.	Develop simple SCADA HMI applications using any one open source SCADA software and apply dynamic properties	CO4
<p><i>LSO 5.1</i> Develop a smart irrigation device to detect the change in moisture level in the soil and controls the flow of water accordingly with a DC pump.</p> <p><i>LSO 5.2</i> Build an electronic device that can remotely control home appliances with your Bluetooth-enabled smartphone and a special Android application</p> <p><i>LSO 5.3</i> Develop a PLC program to control the robot in such a way that the robot can automatically pick and</p>	15.	Develop simple automation systems for the given requirement (Select any Three from the given list)	CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p>place components and works in sync with the conveyor belt system.</p> <p><i>LSO 5.4</i> Develop a Automation system to Open and close the door in the shop</p> <p><i>LSO 5.5</i> Develop a line following robot with RFID sensor for supplying materials and automating workflow.</p> <p><i>LSO 5.6</i> Develop smart street light controlling mechanism which will Switch on/off the lights automatically depending on the intensity of the sunlight at that particular time of the day.</p> <p><i>LSO 5.7</i> Develop smart automated railway crossing system to detect train arrival and departure and send appropriate signals to the microcontroller.</p>			

L) Suggested Term Work and Self Learning: S2400604F

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. State three advantages of using programmed PLC timer over mechanical timing relay.
- ii. It is required to have a pilot light glow, meeting all of the circuit requirements given below:
 - All four circuit pressure Switches must be closed.
 - At least two out of three circuit limit Switches must be closed.
 - The reset Switch must not be closed.
- iii. Using AND, OR, and NOT gates, design a logic circuit that will solve this hypothetical problem
- iv. Prepare a comparison chart of different types of PLC
- v. Prepare a maintenance plan for a given PLC system.

b. Micro Projects:

1. Troubleshoot the faulty equipment/kit available in automation laboratory
2. Select one industry and analyze the process and propose the automation strategies' that can be used for automation.
3. Develop a working model of a given application using given actuators and valves.
4. Develop a smart irrigation device to detect the change in moisture level in the soil and controls the flow of water accordingly with a DC pump.
5. Build an electronic device that can remotely control home appliances with your Bluetooth-enabled smartphone and a special Android application
6. Develop a PLC program to control the robot in such a way that the robot can automatically pick and place components and works in sync with the conveyor belt system.

c. Other Activities:

1. Seminar Topics- PLC instructions, Timers and Counters used in a given PLC
2. Seminar Topics- Industrial Applications of PLC and SCADA, AGV, Application of automation in different area, trouble shooting of different types of PLC
3. Visits – Visit any industry with full or semi automation and prepare a report on industrial automation used by the industry in the given section, components used, power requirement, output achieved and maintenance activities required.
4. Surveys- Carry out a market/internet survey of PLC and prepare the comparative technical specifications of any one type of PLC (Micro or Mini) of different manufacturer.
5. Product Development- Develop a prototype automatic railway crossing system
- a. Software Development- Download any open source software for PLC and install on your laptop/PC and carry out basic PLC programming
6. Also download any open source software for SCADA and install on your laptop/PC and carry out basic SCADA HMI programming
7. Surveys – Carry out a internet based survey to compare SCADA and DCS

d. Self-Learning Topics:

- Basic concepts of working of robot
- Automated material handling.
- Instrumentation systems for inspection and testing for quality of the product
- Use of robots in different applications
- Intelligent Transportation Systems
- Communication standards and protocols used in PLC
- Use of PLC for different industrial applications
- Use of SCADA for different industrial applications
- Interfacing of PLC

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%	20%	20%	--	33%	10%	20%
CO-2	15%	25%	20%	--	33%	15%	20%
CO-3	15%	20%	20%	--	34%	15%	20%
CO-4	30%	20%	20%	50%	--	30%	20%
CO-5	30%	15%	20%	50%	--	30%	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 Industrial automation Communication and Interfacing	9	CO1	14	5	4	5
Unit-.2.0 PLC Programming	12	CO2	17	5	6	6
Unit-.3.0 Installation and maintenance of PLC systems	10	CO3	14	4	5	5
Unit-.4.0 SCADA and DCS	9	CO4	14	4	5	5
Unit-.5.0 Applications of Industrial Automation	8	CO5	11	2	4	5
Total Marks	48		70	20	24	26

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva - Voce (%)
			PRA* (%)	PDA** (%)	
1.	Transfer the control data from PLC to PC and vice versa	CO1	50	40	10
2.	Transfer the control data from PLC to PLC	CO1	50	40	10
3.	Transfer the sensor data from sensor to PLC to PLC and PC	CO1	50	40	10
4.	Interface the given PLC with a PC or a Laptop	CO1	50	40	10
5.	Identify Different parts and front panel indicators of a PLC	CO2	50	40	10
6.	Develop Ladder logic program for different arithmetic operations	CO2	50	40	10
7.	Develop Ladder logic program for different logical operations	CO2	50	40	10
8.	Program Latch and Unlatch circuit in a PLC for motor operation	CO2	50	40	10
9.	Create delay in operation using on delay, off delay and retentive timer function in a given PLC	CO2	50	40	10
10.	Count the number of objects/events using Up counter, Down counter and UP/Down counter in a PLC	CO2	50	40	10
11.	Program PLC using ladder logic to control a LED/Lamp	CO2	50	40	10
12.	Program PLC using ladder logic to control a simple traffic light system	CO2	50	40	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva - Voce (%)
			PRA* (%)	PDA** (%)	
13.	Use hygrometer to measure the humidity inside the panel	CO3	50	40	10
14.	Use thermometer to measure ambient temperature inside the panel	CO3	50	40	10
15.	Use tester to determine the voltage fluctuation at the power supply terminals is within specifications	CO3	50	40	10
16.	A given PLC is not working as per the logic instructions investigate the PLC to identify the cause of failure to show the desired output	CO3	50	40	10
17.	Investigate the cause of Noise in the given PLC	CO3	50	40	10
18.	PLC goes on blackout out by losing its operating power. Troubleshoot the cause of failure.	CO3	50	40	10
19.	Troubleshoot the corrupted PLC memory.	CO3	50	40	10
20.	Replace CPU and power supply fuses in a given PLC system	CO3	50	40	10
21.	Download any open source SCADA software and install the same.	CO4	50	40	10
22.	Interpret the available components in symbol factory in SCADA software	CO4	50	40	10
23.	Create simple SCADA HMI applications and apply dynamic properties (Any Three) . i. Turn on and off a tube light using a Switch ii. Apply filling and object size properties to a rectangle, square and round object iii. Move the object, fill the object using slider and meter reading. iv. Apply orientation property to a fan and control its direction using a slider. v. Move a square object horizontally first, then vertically and again horizontally by applying visibility property.	CO4	50	40	10
24.	Create historical and real time trends for the given automation	CO4	50	40	10
24	Select any three of the following: - i. Develop a smart irrigation device to detect the change in moisture level in the soil and controls the flow of water accordingly with a DC pump. ii. Build an electronic device that can remotely control home appliances with your Bluetooth-enabled smartphone and a special Android application iii. Develop a PLC program to control the robot in such a way that the robot can automatically pick and place components and works in sync with the conveyor belt system. iv. Develop a Automation system to Open and close the door in the shop v. Develop a line following robot with RFID sensor for supplying materials and automating workflow. vi. Develop smart street light controlling mechanism which will Switch on/off the lights automatically depending on	CO5	60	30	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva - Voce (%)
			PRA* (%)	PDA** (%)	
	the intensity of the sunlight at that particular time of the day. vii. Develop smart automated railway crossing system to detect train arrival and departure and send appropriate signals to the microcontroller.				

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	SCADA software (reputed make like Allen Bradley, Siemens etc.,)	Ready-to-use symbol library, React and respond in real-time, Real-time monitoring, Friendly, manageable, secure, extensible, Easy-to-use, easy to implement, Easy configuration, simplified maintenance, Communication with PLC, easy and flexible alarm definition, data collection and analysis for new and existing systems, easy-to-use for report generation, open access to historical data, different packages available with input/output structure. Open-source software SCADA software: like Ellipse/FTVSE/Wonderware/ open SCADA can also be used	14
2.	Universal PLC Training System with HMI (Of reputed make such as Allen bradely, Siemens, etc.,) Compatible with SCADA software	Human Machine Interface (HMI) display, PLC with 16 digital inputs, 16 digital outputs with RS232 communication facility. Open platform to explore wide PLC and HMI applications. Industrial look & feel. Toggle Switches, push to ON Switch, proximity sensor, visual indicator, audio indicator, and DC motor. Experiments configurable through patch board. Powerful instruction sets. Several sample ladder and HMI programs. PC based ladder and HMI programming. Extremely easy and student friendly software to develop different programs. Easy downloading of programs. Practice troubleshooting skills. Compact tabletop ergonomic design. Robust construction. PLC gateway for cloud connectivity. Open source software like Ladder logic simulator, Pico soft Simulator, Logixpro simulator, Simple EDA tools can also be used	1 to 12
3.	Safety gears	Gloves, Safety goggles, Ear protection, Dust masks and respirators.	13
4.	Power tools	Power drills, Orbital sanders, Circular saws, Impact wrenches.	13
5.	Hand tools	Screwdrivers, Hammers, Hand saws, Hex Key Allen Wrench Set Inch and Metric, relay puller, Multi-Tool Wire Stripper/Crimper/Cutter	13

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
6.	Electrical tools	Wire and cable strippers, Multimeters- Volts, Ohms, and Amps, Crimpers- Side Cutter Crimping, Wire Crimp Connector Kit, Digital Multimeter Clamp Meter with Amp, Volt, and Ohm, Non-Contact Voltage Tester	13
7.	Spare parts	PLC Programming Cables, SD Card Reader Compact flash, Wire Nut Set, Fuses- Class J 30, 35, 60, and 100-amp fuses, Class CC 2, 3, 5, 10, 15, 20, and 30-amp fuses, 5mm x 20mm 0.032 (for 4-20mA circuits), 0.5, 1, 2, 5, 10, and 15 amps, Cube Relays, Resistor Kit, batteries, LED Indicators PLC Processor (CPU), Input/ output module	13
8.	Thermo-hygrometer	Measuring range Temp.: -30 ... 60°C / -22 ... 140°F Measuring range rel. Humidity: 0 ... 100% rh, Measurement protocol as PDF, Data export possible as CSV, Readable without software, data sets of measured values can be stored.	13
9.	Digital Hygrometer	maximum humidity measurement- 100%RH, temperature measurement resolution -0.1degree centigrade, humidity measurement resolution -0.1%RH, minimum operating temperature - -10 to -20-degree centigrade, Maximum operating temperature +45 to +50 degree centigrade	13

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Programmable Logic Controllers	Dunning, G.	Thomson /Delmar learning, New Delhi, 2005, ISBN 13: 9781401884260
2.	Programmable Logic Controllers	Petruzella, F.D.	McGraw Hill India, New Delhi, 2010, ISBN: 9780071067386
3.	Programmable Logic Controllers	Hackworth, John; Hackworth, Federic	PHI Learning, New Delhi, 2003, ISBN: 9780130607188
4.	Industrial automation and Process control	Stenerson Jon	PHI Learning, New Delhi, 2003, ISBN: 9780130618900
5.	Programmable Logic Controller	Jadhav, V. R.	Khanna publishers, New Delhi, 2017, ISBN: 9788174092281
6.	Programmable Logic Controllers and Industrial Automation - An introduction,	Mitra, Madhuchandra; Sengupta, Samarjit,	Penram International Publication, 2015, ISBN: 9788187972174
7.	Control System	Nagrath & Gopal	New Age International Pvt Ltd, ISBN: 9789386070111, 9789386070111
8.	Linear Control Systems with MATLAB Applications, Publisher:	Manke, B. S.	Khanna Publishers, ISBN: 9788174093103, 9788174093103
9.	Supervisory Control and Data Acquisition	Boyar, S. A.	ISA Publication, USA, ISBN: 978-1936007097
10.	Practical SCADA for industry,	Bailey David; Wright Edwin	Newnes (an imprint of Elsevier), UK 2003, ISBN:0750658053

(b) Online Educational Resources:

1. Software: - www.fossee.com
2. Software: - www.logixpro.com
3. Software: - www.plctutor.com
4. Software; - www.ellipse.com
5. PLC lecture: - <https://www.youtube.com/watch?v=pPiXefBO2qo>

6. PLC tutorial: http://users.isr.ist.utl.pt/~jag/aulas/apil3/docs/API_I_C3_3_ST.pdf
7. <https://www.youtube.com/watch?v=277wwYWolpw>-PLC system troubleshooting and repair. Industrial control panel. PLC system repair.
8. <https://www.youtube.com/watch?v=5Jmtvrch5Jg>
9. <https://www.youtube.com/watch?v=peyV9bwEaLY>
10. <https://www.youtube.com/watch?v=QdJhRmtKpxk&list=RDCMUCke36Liq-w5fboMHkq1APZw&index=3>
11. <https://www.youtube.com/watch?v=ygrrRwajz3M>

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

(c) Others:

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

- A) **Course Code** : 2400604G (T2400604G/P2400604G/S2400604G)
 B) **Course Title** : Electric Vehicle (Advance)
 C) **Prerequisite Course(s)** : Electric Vehicle (Basic)
 D) **Rationale** :

The automobile manufacturing sector in India is rapidly switching over to electric vehicles used for the public as well as private transport. The Govt. of India has launched the FAME-II Scheme (Faster Adoption and Manufacturing of Hybrid & Plug-in Electric Vehicles) to encourage the progressive induction of reliable, affordable and efficient electric and hybrid vehicles and to create demand for Electric Vehicles in the country. The technology is being evolved to enhance the vehicle's efficiency and running mileage by controlling the manufacturing, maintenance and recurring costs of such vehicles. Due to the rapid increase in EV demand, industries will also require skilled manpower in this area. This advanced course on electric vehicles is included as an open elective for all the diploma programmes to provide a sound knowledge of EVs to engineering diploma students and develop skills related to testing and maintenance of various electrical, electronic and mechanical systems in EVs.

- E) **Course Outcomes (COs):** After the completion of the course, teachers are expected to ensure the learners' accomplishment of the following course outcomes. 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 student will be able to-

- CO-1** Compute various parameters affecting Vehicle movement.
CO-2 Test the operation of the different elements of the Automobile System.
CO-3 Test the battery and motor used for Power Transmission in EVs.
CO-4 Test electronic control unit system of EVs.
CO-5 Interpret the impact of Grid to Vehicle (G2V) and Vehicle to Grid (V2G) during the charging cycle.

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

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

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

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

G) Teaching & Learning Scheme:

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				
2400604G	Electric Vehicle (Advance)	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)	
2400604G	Electric Vehicle (Advance)	30	70	20	30	20	30	200

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 the course level and session level and their attainment by the students through Classroom Instruction (CI), Laboratory Instruction (LI), Term Work (SW) 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: T2400604G

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p>TSO 1a. Explain the vehicle movement process</p> <p>TSO 1b. Derive various equations for the movement of Vehicles</p> <p>TSO 1c. Compute different resistances affecting Vehicle movement.</p> <p>TSO 1d. Explain the dynamics of the given type of EV system.</p>	<p>Unit-1.0 Vehicle Dynamics</p> <p>1.1 Vehicle Movement</p> <p>1.2 Rolling Resistance: Equation, Coefficient, factor affecting rolling resistance, typical values of rolling resistance</p> <p>1.3 Grading resistance</p> <p>1.4 Road resistance</p> <p>1.5 Acceleration resistance</p> <p>1.6 Total driving resistance</p> <p>1.7 Aerodynamic drag: Equation, typical values of the drag coefficient.</p> <p>1.8 Vehicle dynamics</p> <ul style="list-style-type: none"> • Hybrid and Electric Vehicles • DC Motor Dynamics and Control • AC Motor Dynamics and Control 	CO1
<p>TSO 2 a. Identify the given elements of Automobile Systems.</p> <p>TSO 2 b. Describe the functions of the given elements of Automobile Systems.</p> <p>TSO 2 c. Explain the dynamic characteristics of the Disc Braking System for the given braking steps.</p> <p>TSO 2 d. Describe the Procedure for testing the given AC/DC motors.</p> <p>TSO 2 e. Describe the Procedure of Installation and Testing of the given EV Charging Stations.</p> <p>TSO 2 f. Describe the Procedure for Commissioning EV Charging Stations.</p> <p>TSO 2 g. Explain the functions of the EV Control Unit.</p>	<p>Unit-2.0 Elements of Automobile</p> <p>2.1 Suspension and Damping systems</p> <p>2.2 Brake system: Half-step braking, Full step Braking</p> <p>2.3 Transaxle</p> <p>2.4 Elements of Noise Vibration and Harshness Control</p> <p>2.5 Body balancing</p> <p>2.6 Tyre Technology</p> <p>2.7 AC/DC motor</p> <p>2.8 Air-conditioning and Heating System</p> <p>2.9 Lighting System</p> <p>2.10 Automotive wiring system</p> <p>2.11 Earthing and Insulation</p> <p>2.12 Charging stations – Installation and Commissioning</p> <p>2.13 Vehicle control unit</p>	CO2
<p>TSO 3a. Compare different power transmission systems in EVs.</p> <p>TSO 3b. List the main Components of the EV Power Train.</p> <p>TSO 3c. Explain the functions of the given EV Power Train component.</p> <p>TSO 3d. Describe the testing procedure of the given EV Power Train component.</p> <p>TSO 3e. Explain the regenerative braking operation in the given EV motor.</p> <p>TSO 3f. Describe the speed control mechanism of the given motor.</p> <p>TSO 3g. Explain various parameters of the given battery.</p> <p>TSO 3h. Select the suitable battery for the given EV application.</p> <p>TSO 3i. Describe the assembling and dismantling procedure of the given battery.</p> <p>TSO 3j. Describe the Mechanism of Gear and Differential Assembly.</p>	<p>Unit-3.0 EV Power Transmission System</p> <p>3.1 Transmission System: Single and Multi-transmission system</p> <p>3.2 EV Power Train</p> <p>3.3 EV Power Train Components: Battery Pack, DC-AC Converter, Electric Motor, On-Board Charger.</p> <p>3.4 Battery Parameters: Voltage, Current, Charging rate, efficiency, energy density, power density, State of Charge (SoC), Depth of Discharge (DoD), State of Health (SoH), Operating Temperature, specific energy, specific power, life cycle and cost.</p> <p>3.5 Battery Assembly and Dismantling.</p> <p>3.6 Gear and Differential Assembly</p> <p>3.7 Safe disposal of used battery</p>	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4a. Describe the Vehicle Control Unit (VCU). TSO 4b. Describe the functions of the given component of the Electronic Control Unit. TSO 4c. Describe the connections of the given control unit with the EV sub-system. TSO 4d. Explain the Interaction of Controller Area Network Communication with VCU. TSO 4e. Describe the Troubleshooting and Assessment procedure of VCU.	Unit- 4.0 Vehicle Control Unit (VCU) 4.1 Electronic Control Unit: Battery Management System, DC-DC Converter, Thermal Management System and Body Control Module. 4.2 Predefined functions 4.3 Connections with EV subsystem 4.4 Controller Area Network (CAN) communication 4.5 Interaction of CAN Communication with VCU. 4.6 Troubleshooting and Assessment 4.7 Dynamometers: Introduction 4.8 Environmental Chambers	CO4
TSO 5a. Explain the Classification of Charging Technologies. TSO 5b. Explain the impact of the Grid on Vehicle Charging and Vehicle Charging on the Grid. TSO 5c. Describe the testing procedure of the given Bi-directional charging systems. TSO 5d. Explain the Energy Management Strategies in the EV. TSO 5e. Explain the Wireless Power Transfer (WPT) technique for EV Charging.	Unit- 5.0 EV Charging Technologies 5.1 Charging Technology: Classification 5.2 Grid-to-Vehicle (G2V) 5.3 Vehicle to Grid (V2G) or Vehicle to Buildings (V2B) or Vehicle to Home(V2H). 5.4 Bi-directional EV Charging Systems. 5.5 Energy Management Strategies. 5.6 Wireless Power Transfer (WPT) technique for EV Charging.	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604G

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 2.1 Test the operation of the Control Disc Braking system and control the regenerative braking system using a test rig. LSO 2.2 Test the performance (Speed v/s Braking Torque) of the Disc Braking System in Half step and Full step braking modes.	1.	<ul style="list-style-type: none"> Testing of Control Disc Braking system and Control Regenerative Braking system. 	CO2
LSO 2.3 Test the performance of different types of propulsion motors.	2.	<ul style="list-style-type: none"> Testing of Motors 	
LSO 2.4 Test the continuity of the automotive wiring system in the EV	3.	<ul style="list-style-type: none"> Testing of the automotive wiring system. 	
LSO 3.1 Test the performance of a new set of batteries and aged batteries. LSO 3.2 Compare the performance of the battery and find the Fuel Gauge after discharging the battery. a. 0% - 100% b. 30% - 100% c. 50% - 100% LSO 3.3 Evaluate the following parameters of the given EV battery. a. Specific power b. Specific energy c. Life span and	4.	<ul style="list-style-type: none"> Testing of Batteries used in EVs 	CO2, CO3

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 3.4 d. Cost parameters Evaluate the State of Health (SoH) of the given EV Battery after several charge/discharge cycles.			
LSO 3.5 Test the dynamic performance of the given motor; a) Speed and torque spectrum. b) Speed and torque oscillation c) Friction torque friction spectrum. LSO 3.6 Test the following speed-controlled performance characteristics of the given motor; a. Motor voltage over time b. Motor current over time. c. Speed and torque over time. d. Torque over speed. e. Current over speed. f. Electrical input power and the mechanical input power over speed	5.	<ul style="list-style-type: none"> Speed control of Electrical Motors 	
LSO 4.1 Connect the components of the EC Units with EV subsystems. LSO 4.2 Troubleshoot basic faults in the electronic control unit of EV.	6.	<ul style="list-style-type: none"> Connection of Electronic Control Unit components Troubleshooting of electronic control unit 	CO4
LSO 5.1 Evaluate the impact of the Grid on Vehicle Charging and Vehicle Charging on the Grid.	7.	<ul style="list-style-type: none"> Impacts of G2V and V2G 	CO5
LSO 5.2 Prepare a layout of a charging station	8.	<ul style="list-style-type: none"> Demonstration of Charging stations 	

L) Suggested Term Work and Self-Learning: S2400604G

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.
- b. Micro Projects:**
- Design and build a physical model of an EV motor and powertrain components from scratch.
 - Build and simulate communication systems of EVs using some software tools.
 - Prepare a report on “the way carbon credit works and companies utilize it to reduce their emission values”.
 - Develop an EV prototype power train using locally procured hardware components.
- c. Other Activities:**
- Seminar Topics:**
 - Safe disposal process of Used Batteries.
 - Charging Technologies used for charging the EV.
 - EV power transmission systems.
 - Surveys** – Visit an electric vehicle manufacturing plant and prepare report on HVAC system used in EV.

3. Self-Learning Topics:

- Impact of fleet charging of EVs on Power Systems.
- Energy Management in EV.
- Fuel Cell powered bus.
- EV Battery disposal and recycling.
- Mobility and connectors.

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 the 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%	--	--	--	--
CO-2	20%	20%	20%	--	--	35%	25%
CO-3	20%	30%	20%	70%	40%	40%	25%
CO-4	20%	25%	20%	30%	20%	10%	25%
CO-5	20%	10%	20%	--	40%	15%	25%
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 the cognitive domain of the full course.

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Vehicle Dynamics	8	CO1	12	4	5	3
Unit-2.0 Elements of Automobile.	10	CO2	15	5	6	4
Unit-3.0 EV Power Transmission System.	14	CO3	20	4	10	6
Unit-4.0 Vehicle Control Unit (VCU)	10	CO4	15	4	6	5
Unit-5.0 Charging Technologies	6	CO5	8	3	3	2
Total Marks	48		70	20	30	20

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

O) Suggested Assessment Table for Laboratory (Practical):

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1	Testing of Control Disc Braking system and Control Regenerative Braking system.	CO2	60	30	10
2	Testing of Motors.				
3.	Testing of automotive wiring system.				
4.	Testing of Batteries used in EVs	CO2, CO3	60	30	10
5.	Speed control of Electrical Motors				
6.	Connection of Electronic Control Unit components	CO4	60	30	10
7.	Troubleshooting of electronic control unit				
8.	Impacts of G2V and V2G	CO 5	30	60	10
9.	Demonstration of Charging stations				
			70	20	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
1.	Disc Braking and Regenerative braking system test rig	Test rig equipment for Demonstration of Disc Braking and Regenerative Braking system operation.	1
2.	Disc Braking System	Test rig / Software for testing the performance of the disc braking system in Half step and Full step braking mode.	1
3.	Induction motor	Induction motor For EV applications with testing kit	2,5
4.	Switched reluctance motor	Switched reluctance motor for EV applications with testing kit	2,5
5.	Permanent magnet (PM) DC motors	Permanent magnet (PM) DC motors for EV applications with testing kit	2,5
6.	Automotive wiring system	Testing facility of automotive wiring system using software /actual EV systems	3
7.	Lithium Ion and Lead-acid Batteries	12V, 7Ah with testing setup.	4
8.	Nickel-based batteries (metal hydride and cadmium battery).	12V, 7Ah with testing setup.	4
9.	Battery tester	For testing battery parameters	4
10.	Battery charger	Battery charger for EV	4
11.	Battery Management System	Training kit or simulation for BMS	4
12.	DC-DC Converter	48V to 12V bidirectional DC-DC Converter	4
13.	Power Analyser	To observe the impacts of G2V and V2G	5
14.	BMS setup	For Demonstration & training	4
15.	DC power supply	0-32V	5
16.	Charging Station Simulator	For Demonstration & training purposes.	5
17.	EC Unit with EV subsystems	Electronic Control Unit Hardware parts/ software for demonstrating the Connection of Electronic Control Unit components with EV subsystems.	6,7
18.	Facility to demonstrate the impact of the Grid on Vehicle Charging and Vehicle Charging on the Grid.	-	7

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Electric Vehicles: And the End of the ICE age	Anupam Singh	Kindle Edition ASIN: B07R3WFR28
2.	Wireless Power Transfer Technologies for Electric Vehicles (Key Technologies on New Energy Vehicles)	Xi Zhang, Chong Zhu, Haitao Song	Springer Verlag, Singapore; 1st ed. 2022 edition (23 January 2022) ISBN-13: 978-9811683473
3.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles	EHSANI	CRC Press; Third edition (1 January 2019) ISBN-13: 978-0367137465
4.	Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles	John G. Hayes, G. Abas Goodarzi	Wiley; 1st edition (26 January 2018) ISBN-13: 978-1119063643
5.	New Perspectives on Electric Vehicles	Marian Găiceanu (Editor)	IntechOpen (30 March 2022) ISBN-13: 978-1839696145
6.	Electric and Hybrid Vehicles,	Tom Denton, Taylor & Francis	2nd Edition (2020) ISBN- 9780429296109
7.	Hybrid Electric Vehicles: Energy Management Strategies	S. Onori, L. Serrao and G. Rizzoni	Springer (2016) ISBN: 978-1-4471-6781-5
8.	Electric & Hybrid Vehicles	A.K. Babu	Khanna Publishing House, New Delhi, 1st Edition (2018) ISBN: 9789386173713, 9386173719
9.	Power Electronics: Circuits, Devices and Applications,	Rashid, M. H.	Pearson, 3rd edition, (2013) ASIN: B07HB3BM1W

(b) Online Educational Resources:

1. <https://www.energy.gov/eere/fuelcells/fuel-cell-systems>
2. <https://powermin.gov.in/en/content/electric-vehicle>
3. <https://www.iea.org/reports/electric-vehicles>
4. <https://www.oercommons.org/search?f.search=Electric+Vehicles>
5. <https://fame2.heavyindustries.gov.in/Index.aspx>

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

(c) Others:

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

- A) **Course Code** : 2400604H (T2400604H/P2400604H/S2400604H)
 B) **Course Title** : Robotics (Advance)
 C) **Pre- requisite Course(s)** : Robotics (Basic)
 D) **Rationale** :

Efficiency and quality are the demands of industry 4.0. Robotics is a constituent of Industry 4.0 which not only provides the former two but also is beneficial for hazardous and similar challenging situations. The use of robotic technology is developing at a very fast rate in all types of industries whether manufacturing, service or tertiary. Engineers should be competent to use the robotic technology for industry and society advantage. This course aims for the diploma engineers to have advanced skills in robotic applications and use in digital manufacturing.

- 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** Plan the use of robots in engineering applications.
CO-2 Elucidate the conceptual place of the robotic components for engineering processes.
CO-3 Use robots for small automatic robotic applications.
CO-4 Compute the economics associated with use of robots in industries.
CO-5 Select appropriate robot for industrial requirements and other 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	-	2		
CO-2	-	2	3	2	-	-	-		
CO-3	3	2	3	-	-	-	2		
CO-4	3	-	-	2	-	-	-		
CO-5	3	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				
2400604H	Robotics (Advance)	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)	
2400604H	Robotics (Advance)	30	70	20	30	20	30	200

Legend:

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

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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: T2400604H**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 1a. Define the need and scope of industrial robots. TSO 1b. Describe the concept of robot dynamics with regards to methods for orientation and location of objects. TSO 1c. Analyse robot direct kinematics for the given 2 DOF planar manipulator. TSO 1d. List types of robots TSO 1e. List safety steps while handling the given robot. TSO 1f. Interface robots with the given welding machine. TSO 1g. Interface robots with the given painting machine. TSO 1h. Interface robots with the given assembly machine.	Unit-1.0 Robot Kinematics, Dynamics and Industrial Applications 1.1 Definition need and scope of Industrial robots 1.2 Robot dynamics – Methods for orientation and location of objects 1.3 Planar Robot Kinematics – Direct and inverse kinematics for 2 Degrees of Freedom. 1.4 Safety while operating and handling robot 1.5 Robot Industrial applications: <ul style="list-style-type: none"> • Welding Robots-Welding Guns, Welding Electrodes, Welding Power Sources, shielding gases, Robot interfacing • Spray painting Robots, assembly operation, cleaning. 	CO2, CO3
TSO 2a. Explain the techniques to control robot motion. TSO 2b. Describe the given robot drive system. TSO 2c. Describe the types of grippers. TSO 2d. Design grippers for specific application. TSO 2e. Test the designed gripper for the application. TSO 2f. Use Bar code technology for robotic applications. TSO 2g. Integrate radio frequency identification technology in robotic applications. TSO 2h. Assemble an automated guided vehicle for the given situation using standard components. TSO 2i. Assemble a simple automated storage and retrieval systems (ASRS) for the given situation using standard components.	Unit– 2.0 Robot Drives, Control and Material Handling 2.1 Controlling the Robot motion. 2.2 Position and velocity sensing devices. 2.3 Drive systems – Hydraulic and Pneumatic drives 2.4 Linear and rotary actuators and control valves 2.5 Electro hydraulic servo valves, electric drives, motors 2.6 End effectors – Vacuum, magnetic and air operated grippers 2.7 Material Handling; automated guided vehicle systems, automated storage and retrieval systems (ASRS) 2.8 Bar code technology 2.9 Radio frequency identification technology.	CO2, CO3
TSO 3a. Differentiate between various work cell layouts. TSO 3b. Select work cell for specific robot with justification. TSO 3c. Analyse robot cycle time. TSO 3d. Explain industrial applications of robotic cell. TSO 3e. Follow safety procedures in robotic cell.	Unit– 3.0 Robot Cell Design and Application 3.1 Robot work cell design, control and safety 3.2 Robot cell layouts 3.3 Multiple Robots and machine interference 3.4 Robot cycle time analysis 3.5 Industrial application of robotic cells	CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
TSO 4a. List different programming languages for the robots TSO 4b. Describe artificial intelligence TSO 4c. Write a programme in the required language to operate a robot for the given task. TSO 4d. Optimise robot programming parameters. TSO 4e. Select a robot on the basis of cycle time analysis. TSO 4f. Conduct an economic analysis for use of robots. TSO 4g. Follow testing methods and acceptance rules for industrial robots.	Unit– 4.0 Robot Programming and Economics of Robotization 4.1 Characteristics of task level languages through programming methods 4.2 Motion interpolation 4.3 Artificial intelligence: Goals of artificial intelligence, AI techniques, problem representation in AI 4.4 Problem reduction and solution techniques. 4.5 Application of AI and KBES in Robots 4.6 Selection of Robots; Factors influencing the choice of a robot, selection of robot components, robot performance testing, work cycle time analysis 4.7 Economics analysis for robotics, cost data required for the analysis 4.8 Methods of economic analysis; Pay back method, equivalent uniform annual cost method, return on investment method. 4.9 Testing methods and acceptance rules for industrial robots	CO1, CO4, CO5
TSO 5m. Describe applications of robots in healthcare and medicine. TSO 5n. Describe applications of robots in Construction industry. TSO 5o. Describe applications of robots in Underground coal mining. TSO 5p. Describe applications of robots in utilities, military & firefighting operations. TSO 5q. Describe applications of robots in undersea and space TSO 5r. Describe applications of robots in brief in logistics, retail and hospitality, and smart cities. TSO 5s. Describe applications of robots in farming and agriculture in brief explain in brief the use of microrobots, nano robots, soft robots, humanoid robots	Unit–5.0 Applications in Non-manufacturing Environments 5.1 Applications of Robots in <ul style="list-style-type: none"> • Healthcare and medicine • Construction industry • Underground coal mines • Utilities, military & firefighting operations • Undersea • Space • Logistics, • Retail and Hospitality • Smart Cities • Farming and Agriculture 5.2 Overview of Microrobots, nano robots, soft robots, humanoid robots	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604H

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 1.1 Identify Wireless Sensor Network. LSO 1.2 Use wireless sensor Network for different robotic applications	1.	Identify different wireless sensor network in robotics viz. ZigBee, LoRa.	CO1, CO3
LSO 2.1 Identify different Radio Frequency (RF) Controlled Wireless LSO 2.2 Use Radio Frequency (RF) Controlled Wireless for different robotic applications.	2.	Use different Radio Frequency (RF) Controlled Wireless Robots.	CO1, CO2
LSO 3.1 Identify the different Voice operated robot with speaker identification technology LSO 3.2 Use different Voice operated robot with speaker identification technology for different robotic applications.	3.	Examine different voice operated robot with speaker identification technology.	CO1, CO3
LSO 4.1 Identify the components required for a computer-controlled pick and place robot (wireless). LSO 4.2 Integrate the components for the required application.	4.	Design a computer-controlled pick and place robot (wireless)	CO1
LSO 5.1 Identify the components required for a Zigbee controlled Boat with wireless video and voice transmission. LSO 5.2 Integrate the components for the required application.	5.	Design a Zigbee controlled Boat with wireless video and voice transmission.	CO2, CO3
LSO 6.1 Identify the components required for a PC controlled wireless Multipurpose robot for engineering applications. LSO 6.2 Integrate the components for the required application.	6.	Design a PC controlled wireless Multipurpose robot for simple engineering applications.	CO2, CO4, CO5
LSO 7.1 Identify the components required for an unmanned arial photography LSO 7.2 Integrate the components for the required application.	7.	Design an unmanned arial photography system.	CO3, CO5
LSO 8.1 Develop a program LSO 8.2 Simulate palletizing and depalletizing operations through robots.	8.	Develop program for real time (online TPP) Palletizing and Depalletizing operations through robots.	CO5
LSO 9.1 Develop a program LSO 9.2 Simulate direction control and step control logic for robotization	9.	Develop TPP / Offline program for vision-based inspection for robots.	CO4, CO5
LSO 10.1 Develop a program LSO 10.2 Simulate robotising an inspection and part assembly.	10.	Program and simulate coordinated identification, inspection and part assembly for robots.	CO1, CO5
LSO 11.1 Develop a program. LSO 11.2 Simulate obstacle avoidance of robots.	11.	Develop obstacle avoidance robot Programming	CO1, CO5
LSO 12.1 PLC programming. LSO 12.2 Simulate robotising of welding operation.	12.	Program and simulate welding operation using robot simulation software.	CO1, CO5
LSO 13.1 Simulate robotising of drilling operation.	13.	TPP / Offline program for drilling operation.	CO1, CO5
LSO 14.1 Develop a program for an industrial application. LSO 14.2 Execute the robot programme.	14.	Program to execute an industrial robot application using a given configuration.	CO1, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 15.1 Use robot simulation software for Direct Kinematic analysis upto 4-axis robots LSO 15.2 Correlate the simulated results with respective mathematical calculations.	15.	Analyse Direct Kinematics of 4-axis robot using available software.	CO2

L) Suggested Term Work and Self Learning: S2400604H

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:** A suggestive list of micro-projects is given here. Similar micro-projects that match the COs could be added by the concerned course teacher. The student should strive to identify eco-friendly or recycled material prior to selection for robotic applications.
 1. Develop coin separating robot.
 2. Develop robot using radio frequency sensors for material handling.
 3. Develop robot for land mine detection.
 4. Develop a robot for car washing.
- c. **Other Activities:**
 1. Seminar Topics: Recent developments in the industrial applications of robotics
 2. Visits: Visit a robotic exhibition.
 3. Case Study: Identify a robotic application in automobiles and present a case study
 4. Download videos related to simple robotic applications in domestic and industrial purposes.
 5. Self-Learning Topics:
 - Robotic component manufacturers

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self- Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	25%	23%	20%	10%	25%	10%	20%
CO-2	20%	23%	20%	10%	25%	20%	20%
CO-3	15%	17%	20%	25%	25%	20%	20%
CO-4	20%	20%	20%	15%	25%	20%	20%
CO-5	20%	17%	20%	40%	--	30%	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 Number and Title	Total Classroom Instruction (CI) Hours	Relevant COs Number (s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Robot Kinematics, Dynamics and Industrial Applications	12	CO2, CO3	16	6	5	5
Unit-2.0 Robot Drives, Control and Material Handling	10	CO2, CO3	16	4	8	4
Unit-3.0 Robot Cell Design and Application	8	CO3	12	2	4	6
Unit-4.0 Robot Programming and Economics of Robotization	10	CO1, CO4, CO5	14	4	4	6
Unit-5.0 Applications in Non-manufacturing Environments	8	CO5	12	4	4	4
Total Marks	48		70	20	25	25

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.	Identify different wireless sensor network in robotics viz. ZigBee, LoRa.	CO1, CO3	40	50	10
2.	Use different Radio Frequency (RF) Controlled Wireless Robots.	CO1, CO2	40	50	10
3.	Examine different voice operated robot with speaker identification technology.	CO1, CO3	40	50	10
4.	Design a computer-controlled pick and place robot (wireless)	CO1, CO4	40	50	10
5.	Design a Zigbee controlled Boat with wireless video and voice transmission.	CO2, CO3	40	50	10
6.	Design a PC controlled wireless Multipurpose robot for simple engineering applications.	CO3, CO4	40	50	10
7.	Design an unmanned arial photography system.	CO3, CO5	40	50	10
8.	Develop program for real time (online TPP) Palletizing and Depalletizing operations through robots.	CO5	40	50	10
9.	Develop TPP / Offline program for vision-based inspection for robots.	CO4, CO5	40	50	10
10.	Program and simulate coordinated identification, inspection and part assembly for robots.	CO1, CO5	40	50	10
11.	Develop Obstacle avoidance robot Programming	CO1, CO5	40	50	10
12.	Program and simulate welding operation using robot simulation software.	CO1, CO5	40	50	10
13.	TPP / Offline program for drilling operation.	CO1, CO5	40	50	10
14.	Program to execute an industrial robot application using a given configuration.	CO1, CO5	40	50	10
15.	Analyse Direct Kinematics of 4-axis robot using available software.	CO2, CO3	40	50	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
1.	6 Axis Articulated Robot (Material Handling)- 1 No	<ul style="list-style-type: none"> • Articulated Type • Controlled axis: 6-axes (J1, J2, J3, J4, J5, J6) • Reach: 717 mm • Installation Floor, Upside-down (Angle mount) • Motion range (Maximum Speed) <ul style="list-style-type: none"> • J1 Axis Rotation 7.85 rad/s • J2 Axis Rotation 6.63 rad/s • J3 Axis Rotation 9.08 rad/s • J4 Axis Rotation 9.60 rad/s • J5 Axis Rotation 9.51 rad/s • J6 Axis Rotation 17.45 rad/s • Max. load capacity Wrist: 4Kg • Allowable Load moment 16.6 N-m at wrist J4 Axis, J5 Axis, J6 Axis • Allowable Load inertia).47 kg-m² at wrist J4 Axis J5 Axis, J6 Axis • Repeatability: +/- 0.05mm • Mass: 21 Kg Minimum • Installation environment: Ambient temperature: 0 – 45°C • Ambient humidity: Normally 75%RH or less. No dew, nor frost allowed. • Vibration Acceleration: 4.9 m/s² (0.5G or less) 	1, 2, 3, 12
2.	6 Axis Articulated Robot (General Purpose-Welding, Assembly, Drilling) - 1 No	<p>Link 1: 300 mm Link 2: 300 mm Joint actuator: DC Stepper Motor Transmission: Timing Belt Drive Position feedback: Proximity Switch Gripper actuator: Pneumatic</p> <p>Weight of robot: 50 Kg. Accuracy: ±0.3 Repeatability: ±0.2 Tip Velocity range: 500 mm / min Pay load capacity: 2 kg (including gripper) J1 - Waist: ± 140° J2 - Shoulder: - 100 - 60° J3 - Elbow: - 70 + 10° J4 - Wrist rotate: ± 70° J5 - Wrist pitch: ± 35° J6 - Wrist roll: ± 180° External I/O 8 Programmable digital inputs 8 Programmable digital outputs</p>	8, 9, 14
3.	A mounted vision system with software (Free open source Robot simulation software)	<p>Integrity Serial Bus System, CAN to Build Intelligent Device Network, Open Hardware Platform, Arduino, to control Robot sub-Systems of motor-sensor, movable Omni Wheel of Omni-Directional, Actuator operation control by DC Encoder Motor, DC-Motor control and operation by Accelerometer, Gyro, Ultrasonic and PSD sensor, Androx Studio; brushless ILM 70×10 Robo Drive DC motor; sensor-actuator units of ARMAR-4; SD-25-160-2A-GR-BB Harmonic Drive reduction gear unit high gear ratio of 160: 1; structural parts (white) are made out of high-strength aluminum, Hollow shaft with strain gauges for torque sensing, motor's magnetic incremental encoder (AMS5306), digital buses (SPI or I2C); Motor interface PCB includes a 13-Bit</p>	3, 4, 5, 11

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/ Practical Number
		temperature-to-digital converter with a temperature range from -40°C to 125°C (Analog Devices ADT7302)	
4.	6-axis Robotics Trainer	Programmable robotic arm with an interactive front panel. Software to demonstrates functioning of the trainer as well as allows a user to develop their own programs. NV330; 8 bit microcontroller to ARM processors; Record and Play capability; Optional interfacing with PLC; Touch operated ON/OFF Switch; Auto set to home position; Applications can be developed; Data acquisition using USB	3, 4, 5, 13
5.	E-Yantra Firebird kit	<ul style="list-style-type: none"> • Fire Bird V 2560 Robot • Spark V Robot • Fire Bird V P89V51RD2 adapter card • Fire Bird V LPC2148 adapter card • LSM303 3 axis digital accelerometer and 3 axes magnetometers • L3G4200 3 axis digital gyroscope • Gyroscope, accelerometer and GPS interfacing module for the robot • GPS receiver • Zigbee Modules 100m range • Zigbee Modules Adapter • Metal-gear Servo Motors • Servo Motor Based Gripper kit for the Fire Bird V robot • Sharp infrared range sensor (10cm to 500cm) • Arduino Uno/Nano • Hexapod • 16 Programming Software (AVR studio, Keil, AVR Boot loader, Flash Magic) 	1, 3, 5, 6, 7, 10
6.	Robot simulator for Robotics	Educational networking licensed Robotic system with simulation software	2, 8, 10
7.	Assorted sensors	Optical encoders, Acoustic sensors ,IR, Potentiometer, RTD, Thermistor, strain gauge, piezoelectric, etc.	4
8.	Vision equipment	Camera, Imaging Components: Point, Line, Planar and Volume Sensors	1, 4, 10
9.	Raspberry Pi kit	1.2GHz quad-core Broadcom BCM2837 CPU with 1GB DDR2 RAM with in-built Wi-Fi & Bluetooth Video Core IV 3D graphics core 40 pin extended pins - with 27 GPIO pins Micro SD slot Multiple ports: Four USB ports, full sized HDMI, four pole stereo output and composite video port, CSI camera port and DSI display port 10/100 BaseT Ethernet Micro-USB, power source 5V, 2A	7, 9

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Introduction to Robotics Mechanics and Control	John Craig	Pearson Education 978-9356062191
2.	Robotics and controls	Mittal R.K., Nagrath I.J.	Tata McGraw Hill Education Pvt. Ltd.; 2017; 978-0070482937
3.	Robotics and Image Processing: An Introduction	Janaki Raman. P. A	Tata McGraw Hill Publishing company Ltd., 1998; 978- 0074621677
4.	Industrial Robotics -Technology, Programming and Applications	Nicholas Odrey, Mitchell Weiss, Mikell Groover Roger Nagel, Ashish Dutta	McGraw Hill Education; 2nd Edition; 978 -1259006210
5.	Robotic Engineering: an integrated approach	Richard D. Klafter, Thomas A. Thomas A. Chmielewski, Michael Negin	Prentice Hall of India, N. Delhi, 2009; 978-8120308428
6.	Industrial Robotics Technology, Programming and Applications	Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey	McGraw-Hill Education, Second Edition, 978-1259006210
7.	Robotics	Appuu Kuttan K. K.	Dreamtech Press, First Edition, 2020, 978-9389583281
8.	Introduction to Robotics: Analysis, Control, Applications	Saeed B. Niku	Wiley; Second Edition, 978-8126533121
9.	Essentials of Robotics Process Automation	S. Mukherjee	Khanna Publication, First Edition, 978-9386173751
10.	Robotics	R R Ghorpade, M M Bhoomkar	Nirali Prakashan 978-9388897020

(b) Online Educational Resources:

- <https://web.iitd.ac.in/~saha/ethiopia/appln.pdf>
- <https://nptel.ac.in/courses/112105249>
- <https://www.robotsscience.com/industrial/industrial-robots-types-applications-benefits-and-future/>
- https://www.marian.ac.in/public/images/uploads/pdf/online-class/MODULE-6%20ROBOTICS%20INDL_APPLNS-converted.pdf
- <https://forcedesign.biz/blog/5-common-industrial-robot-applications>
- <https://www.hitechnectar.com/blogs/top-industrial-robotics-applications-role-of-robots-in-manufacturing/>
- https://en.wikipedia.org/wiki/Industrial_robot
- <https://www.youtube.com/watch?v=fH4VwTgfyRQ>
- https://www.youtube.com/watch?v=aW_BM_S0z4k
- <https://www.automate.org/industry-insights/smarter-robot-grasping-with-sensors-software-the-cloud>
- <https://robots.ieee.org/robots/?t=all>
- https://www.youtube.com/watch?v=fc_Cynqr6jM

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

(c) Others:**1.Learning Packages:**

- <https://www.edx.org/learn/robotics>
- <https://www.coursera.org/courses?query=robotics>
- <https://www.udemy.com/topic/robotics/>
- <https://library.e.abb.com/public/9a0dacfddec8aa03dc12578ca003bfd2a/Learn%20with%20ABB.%20Robotic%20package%20for%20education.pdf>

2.Users' Guide:

- <https://roboindia.com/store/DIY-do-it-your-self-educational-kits-robotics-embedded-system-electronics>
- <https://www.robomart.com/diy-robotic-kits>
- <https://www.scientechworld.com/robotics>

3.Lab Manuals:

- http://www-cvr.ai.uiuc.edu/Teaching/ece470/docs/ROS_LabManual.pdf
- <https://www.jnec.org/labmanuals/mech/be/sem1/Final%20Year%20B.Tech-ROBOTICS%20LAB%20%20MANUAL.pdf>

- A) **Course Code** : 2400604I(T2400604I/P2400604I/S2400604I)
 B) **Course Title** : Transformer Manufacturing and Repairing (Advanced)
 C) **Pre- requisite Course(s)** : Transformer Manufacturing and Repairing (Basic)
 D) **Rationale** :

Transformers are an essential component in Power systems. They help transmit electrical energy at various voltage and current levels to minimize losses and achieve other technical objectives. They are rated from a few kVA to large MVA. Power systems are growing to meet the increased demand. Hence, the manufacturing of new transformers and repair of existing transformers are vital. This advanced course will help the students understand the concepts of manufacturing and repair of transformers at par with the industries. The knowledge gained through this course will help the students choose their career in transformer manufacturing and repair.

- 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** Analyze the materials used in transformer manufacturing.
CO-2 Assemble the transformer based on specific requirements.
CO-3 Design using software based on specific requirements.
CO-4 Analyze the working conditions of transformers.
CO-5 Apply the concepts for practical use.

- 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		
CO-2	3	3	2	2	2	-	3		
CO-3	3	2	2	2	-	-	3		
CO-4	3	1	1	1	1	-	3		
CO-5	3	2	3	3	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)		Lab Instruction (LI)	Notional Hours (TW+SL)	Total Hours (CI+LI+TW+SL)	Total Credits (C)
		L	T				
2400604	Transformer Manufacturing and Repairing (Advanced)	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)	
2400604	Transformer Manufacturing and Repairing (Advanced)	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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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: T2400604I

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain the use of different materials in transformers.</p> <p><i>TSO 1b.</i> List the various types of materials used in transformers.</p> <p><i>TSO 1c.</i> Explain the insulating materials.</p> <p><i>TSO 1d.</i> Explain the winding material.</p> <p><i>TSO 1e.</i> Explain the magnetic materials.</p>	<p>Unit-1.0 Transformer Materials</p> <p>1.1 Review of basic materials and their processing</p> <p>1.2 Insulating oil, insulating paper, pressboard, wood</p> <p>1.3 Insulated copper conductor for windings, crepe paper, sealing materials</p> <p>1.4 cold-rolled grain oriented electrical steel sheet, structural steel, future trends</p> <p>1.5 Magnetic Circuit Materials</p>	CO1
<p><i>TSO 2a.</i> Explain the basic concept of transformer design.</p> <p><i>TSO 2b.</i> List the various parameters to be considered during design.</p> <p><i>TSO 2c.</i> Choose the number of turns, the core diameter.</p> <p><i>TSO 2d.</i> Select the winding wires and strips.</p> <p><i>TSO 2e.</i> Choose the size of HV and LV conductors.</p>	<p>Unit-2.0 Transformer Design</p> <p>2.1 Basic Concept of Design.</p> <p>2.2 Selection of number of turns.</p> <p>2.3 Selection of core diameter.</p> <p>2.4 Selection of winding wires and strips.</p> <p>2.5 Size HV and LV conductors.</p> <p>2.6 Transposition</p>	CO1, CO2
<p><i>TSO 3a.</i> Explain the concept of computer aided design.</p> <p><i>TSO 3b.</i> Learn the programming skills,</p> <p><i>TSO 3c.</i> Modify the programming considering other aspects.</p> <p><i>TSO 3d.</i> Validate and print the design.</p> <p><i>TSO 3e.</i> Use software to design.</p>	<p>Unit-3.0 Transformer Design – Using CAD</p> <p>3.1 Computer aided design: Basic concept, specification needs.</p> <p>3.2 Computer programming, variable inputs, program convergence.</p> <p>3.3 Design output, design modification, other aspects of design.</p> <p>3.4 Design validation, design package, computer design printout.</p> <p>3.5 Software application for design.</p>	CO3, CO4
<p><i>TSO 4a.</i> Explain the testing of Transformer oil.</p> <p><i>TSO 4b.</i> Use of Transformer oil.</p> <p><i>TSO 4c.</i> List the causes of oil ageing.</p> <p><i>TSO 4d.</i> List the various tests to monitor the working conditions of a transformer.</p>	<p>Unit-4.0 Transformer Condition Monitoring</p> <p>4.1 Transformer oil testing and Interpretation</p> <p>4.2 Introduction, mineral insulating oil.</p> <p>4.3 Four functions of transformer oil.</p> <p>4.4 Causes of oil ageing.</p> <p>4.5 Various tests on transformer oil such as power factor, moisture, neutralization number, interfacial tension, relative density, color, visual examination, breakdown voltage, dissolved gas analysis.</p>	CO3, CO4
<p><i>TSO 5a.</i> Apply the concepts for practical use.</p> <p><i>TSO 5b.</i> Design a practical power transformer.</p>	<p>Unit-5.0 Transformer Design - Practical Applications</p> <p>5.1 Design of a 100 KVA transformer.</p> <p>5.2 Design of 630 KVA transformer.</p> <p>5.3 Design of 5 MVA, 33/11 KV transformer</p>	CO4, CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604I

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.1.</i> Knowledge of knowing the various components of a power transformer. <i>LSO 1.2.</i> Explain the use of those components in the power transformer.	1.	Dismantling a power transformer and understanding various components.	CO1
<i>LSO 2.1.</i> Design a transformer using computer programming considering various aspects.	2.	Designing a transformer using computer programming.	CO1
<i>LSO 3.1.</i> Use of a commercial software to design a transformer.	3.	Application of software for transformer design.	CO1
<i>LSO 4.1.</i> Understand the breakdown voltage (BDV) of transformer oil.	4.	Breakdown voltage test of transformer oil.	CO2
<i>LSO 5.1.</i> Explain the practical applications of power transformers. <i>LSO 5.2.</i> Knowledge of various transformers used in substations.	5.	Substation visit to see the application of power transformers.	CO3, CO4, CO5

L) **Suggested Term Work and Self Learning: S2400604I** 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.

- Explore recent advancements in core material technology.
- Discuss the lifecycle, recycling, and disposal of transformer materials and their environmental footprint.
- Discuss the key parameters and design equations used in transformer design.
- Explore the steps involved in modeling the transformer core using CAD software.
- Use CAD software to simulate different winding configurations and their impact on performance.
- Discuss the advantages of real-time data collection and analysis for proactive maintenance.
- Investigate the different requirements for distribution transformers in urban versus rural settings.

b. **Micro Projects:**

- Compare the performance of different insulating materials used in transformers (e.g., paper, pressboard, Nomex).
- Study the magnetic properties of different core materials (e.g., silicon steel, amorphous steel).
- Evaluate the environmental impact of transformer materials and their disposal methods.
- Build a small-scale transformer to understand the basics of transformer construction and operation.
- Investigate the impact of different winding techniques on transformer efficiency and performance.
- Compare different core materials to determine their effect on transformer performance.
- Design various core shapes (e.g., E-core, toroidal, C-core) using CAD and analyze their magnetic properties.
- Design and optimize different winding layouts to improve efficiency and reduce losses.
- Design a system to monitor and log the temperature of transformer components.
- Monitor transformer vibrations to detect mechanical issues.
- Design a system to monitor the quality of transformer oil.
- Develop a lightweight, portable transformer for powering equipment at outdoor events.

c. Other Activities:

1. Seminar Topics:

- Silicon Steel in Transformer Manufacturing.
- Impact of Environmental Factors on Transformer Design.
- Introduction to CAD in Transformer Design.
- Cost Estimation and Analysis in Transformer Design Using CAD.
- Impact of Environmental Conditions on Transformer Monitoring.
- Oil Quality Analysis in Transformer Maintenance.
- Designing Transformers for Industrial Applications.

a.

2. Visits:

- Visit to nearby transformer manufacturing station. Prepare report of visit with special comments on transformer winding technique, winding material and insulating material used.
- Visit to nearby transformer manufacturing station. Prepare report of visit with manufacturing process, different stages of production, and the quality control measures and technologies involved in transformer manufacturing.

b.

3. Self-learning topics:

- Types of insulation materials used in transformers (e.g., paper, pressboard, synthetic materials, and mineral oil)
- Nanomaterials in Transformer Construction.
- Thermal management in transformer design.
- Vibration of transformer.
- Smart transformer used in smart grid.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	15%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	30%	30%	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 percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

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

Unit Title and Number	Total Classroom Instruction (CI) Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 Transformer Materials	8	CO1	10	3	3	4
Unit-2.0 Transformer Design	12	CO1, CO2	10	3	2	5
Unit-3.0 Transformer Design-Using CAD	12	CO3, CO4	10	5	2	3
Unit-4.0 Transformer Condition Monitoring	8	CO3, CO4	20	5	6	9
Unit-5.0 Transformer Design - Practical Applications	8	CO4, CO5	20	4	6	10
Total	48	-	70	20	19	31

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):

SN	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
1.	Dismantling a power transformer and understanding various components.	CO1	30	60	10
2.	Designing a transformer using computer programming.	CO1	40	50	10
3.	Application of software for transformer design.	CO1	30	60	10
4.	Breakdown voltage test of transformer oil.	CO2	30	60	10
5.	Substation visit to see the application of power transformers.	CO3, CO4, CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, 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.	Transformer, Multi-meter, LCR Meter	3 Phase Transformer, Multi-meter, LCR Meter, Tools to dismantle transformer.	Dismantling a power transformer and understanding various components.
2.	MATLAB, PC	MATLAB Software and Desktop PC (As per requirement).	Designing a transformer using computer programming
3.		Machine Design Software and Desktop PC (As per requirement).	Application of software for transformer design.
4.	Transformer Oil Testing Kit	Transformer oil testing kit, transformer oil,	Breakdown voltage test of transformer oil.
5.	Equipment for a prototype substation	Power transformer, circuit breaker, relay, Insulator, Isolator, Bus-bar, capacitor bank, Fuse, current transformer, potential transformer.	Substation visit to see the application of power transformers

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

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Transformer Engineering Design and Practice	S.V.Kulkarni, S.A.Khaparde	CBS Publishers, 2004 ISBN: 9780824757281, 0824757289
2.	Design of Transformers	Indrajit Dasgupta	Tata McGraw Hill India, 2002 ISBN: 0071331352, 9780071331357
3	Principles of Electrical Machine Design With Computer Programs	S. K. Sen	Oxford & IBH Publishing Company Pvt. Limited, 2006. ISBN: 9788120415218, 8120415213

(b) Online Educational Resources:

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

(c) Others:

- A) **Course Code** : 2400604J(T2400604J/P2400604J/S2400604J)
 B) **Course Title** : Optical Fiber and 5G Communication (Advance)
 C) **Pre- requisite Course(s)** : Optical Fiber and 5G Communication (Basics)
 D) **Rationale** :

A course on Optical Fiber and 5G Communication (Advance) is essential to understand the modern high-speed data transmission, which is crucial for supporting the growing demand for fast and reliable internet services. It equips students with the knowledge to design and implement 5G networks, which is going to be an integral part of the wireless communication infrastructures fields, students gain comprehensive insights into how advanced communication systems operate and interact, preparing them for careers in telecommunications and networking.

- 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-6 Analyze various 5G radio-access technologies.
 CO-7 Identify different components of GSM architecture.
 CO-8 Describe the channel and channel behavior of the wireless channel.
 CO-9 Analyze different mitigation techniques.
 CO-10 Summarize different emerging technologies for next generation communication networks.

- 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	2	2	2	2	-		
CO-3	3	2	2	2	3	2	-		
CO-4	3	3	-	2	-	-	-		
CO-5	3	-	3	3	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				

2400604J	Optical Fiber and 5G Communication (Advance)	03	-	04	02	09	06
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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)	
2400604J	Optical Fiber and 5G Communication (Advance)	30	70	20	30	20	30	200

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:

- Separate passing is must for progressive and end semester assessment for both theory and practical.
- 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.

II) 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: T2400604J

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1f.</i> Highlight the need for 5G communication system.</p> <p><i>TSO 1g.</i> Describe the radio spectrum and channel model with the help of suitable sketch and tables.</p> <p><i>TSO 1h.</i> Describe the working of the 5G physical layer with the help of a suitable sketch.</p> <p><i>TSO 1i.</i> Describe 5G network slicing with an example.</p> <p><i>TSO 1j.</i> Explain the mobility and hands-off management in 5G environment.</p>	<p>Unit-1.0 5G Radio Access Technology</p> <p>1.6 5G Radio Spectrum</p> <p>1.7 5G Channel Model</p> <p>1.8 Radio Interface Architecture</p> <p>1.9 5G Physical Layer</p> <p>1.10 5G Radio-Access Technologies</p> <p>1.11 Introduction To 5G Network Slicing</p> <p>1.12 Mobility and Handoff Management In 5G</p>	CO1
<p><i>TSO 2f.</i> Describe the architecture and key components of basic GSM (Global System for Mobile Communications) networks.</p> <p><i>TSO 2g.</i> List the components of the GSM(LTE) system.</p> <p><i>TSO 2h.</i> Describe the working of the various components and their functions of the given type of wireless communication network</p> <p><i>TSO 2i.</i> Analyze the functions of base station subsystems (BS)</p>	<p>Unit-2.0 Study of GSM Architecture</p> <p>2.7 GSM System Architecture (LTE)</p> <p>2.8 Explain the different components of Wireless Communication Network</p> <p>2.9 Operation of base station (BS) subsystems</p>	CO2
<p><i>TSO 3f.</i> Explain different principles and various factors affecting radio wave propagation in different environments.</p> <p><i>TSO 3g.</i> Apply the free space propagation model to estimate signal strength and coverage.</p> <p><i>TSO 3h.</i> Explain how reflection, scattering, and diffraction impact radio wave behaviour and signal quality.</p> <p><i>TSO 3i.</i> Use the given type of path loss models to predict signal degradation over distance.</p> <p><i>TSO 3j.</i> Differentiate between large-scale and small-scale fading and their effects on wireless communication.</p> <p><i>TSO 3k.</i> Analyze the characteristics and behaviour of wireless channels, including their impact on signal transmission.</p> <p><i>TSO 3l.</i> List the noise sources present in the wireless channel.</p> <p><i>TSO 3m.</i> Describe the effects of noise on signal propagation through wireless channels and its impact on signal quality.</p> <p><i>TSO 3n.</i> Calculate the capacity of channels with Additive White Gaussian Noise (AWGN).</p>	<p>Unit-3.0 Channel and channel behavior</p> <p>3.6 Analysis of radio wave propagation</p> <p>3.7 Free Space Propagation Model</p> <p>3.8 Reflection, Scattering, Diffraction of Radio Waves</p> <p>3.9 Path Loss Models</p> <p>3.10 Study of Fading (Large, small-scale fading)</p> <p>3.11 Analysis of Wireless Channel</p> <p>3.12 Analysis of Noise, types of noise</p> <p>3.13 Capacity of AWGN and Fading Channel (only formula and its variable parameters)</p>	CO3
<p><i>TSO 4e.</i> Describe various diversity techniques to improve signal reliability and performance in wireless communication.</p> <p><i>TSO 4f.</i> Describe receiver diversity methods and their impact on enhancing signal quality and reducing errors.</p> <p><i>TSO 4g.</i> Describe transmitter diversity techniques and their role in mitigating fading and improving communication robustness.</p> <p><i>TSO 4h.</i> Describe the principles and applications of Multiple Input Multiple Output (MIMO) technology.</p> <p><i>TSO 4i.</i> Suggest the techniques to correct distortions and mitigate inter-symbol interference in wireless communication systems.</p>	<p>Unit-4.0 Mitigation Techniques</p> <p>4.6 Diversity techniques</p> <p>4.7 Analysis of various receiver diversity techniques</p> <p>4.8 Analysis of various transmitter diversity techniques</p> <p>4.9 MIMO technology advantages in communication systems</p> <p>4.10 Equalization techniques and their importance in communication systems</p>	CO4

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 5c.</i> Discuss the various types of dispersion in optical fibre design</p> <p><i>TSO 5d.</i> Explain the optimization technique of single mode fibre.</p> <p><i>TSO 5e.</i> Describe the working and characteristics of different optical networks.</p> <p><i>TSO 5f.</i> Explain the nonlinear effect on network performance of optical fibre systems.</p> <p><i>TSO 5g.</i> Explain multicarrier modulation techniques to enhance data transmission and system performance.</p> <p><i>TSO 5h.</i> Describe the principles and advantages of Orthogonal Frequency Division Multiplexing (OFDM) in improving bandwidth efficiency and reducing interference.</p> <p><i>TSO 5i.</i> Analyze given emerging technologies.</p>	<p>Unit-5.0 Advanced Optical Fiber Communication and Emerging Technologies</p> <p>5.4 Advanced Optical Fiber: Dispersion issues, Dispersion shifted, Dispersion flattened, Dispersion Compensating fibre</p> <p>5.5 Design and optimization of single-mode fibers</p> <p>5.6 Optical Networks- Basic Networks SONET, SDH-wavelength-routed networks</p> <p>5.7 Nonlinear effect on Network Performance, performance of various systems (WDM, DWDM + SOA)</p> <p>5.8 Multicarrier Modulation Technique</p> <p>5.9 Orthogonal Frequency Division Multiplexing (OFDM)</p> <p>5.10 Emerging Technology: Green Communication network, Vehicle 2 everything (V2X), Aerial Communication, Satellite Communication (LEO), Tactile Internet (TI), Free Space Optics (FSO), Near Field Communication, Quantum Communication, Molecular Communication</p>	CO5

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400604J

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<i>LSO 1.3.</i> Noise Modelling and its effect on Wireless Data Transmission	1.	Characterization and Impact of Noise on Wireless Data Transmission: A Comprehensive	CO1
<i>LSO 2.2.</i> Effect of fading on wireless data transmission in terms of outage probability	2.	Evaluating Fading Effects on Wireless Data Transmission: Outage Probability Analysis	CO2
<i>LSO 3.2.</i> Capacity of Wireless Channel (AWGN v/s Fading)	3.	Comparative Study of Channel Capacity: AWGN versus Fading Channels	CO3
<i>LSO 4.2.</i> Implementation of receiver diversity technique.	4.	Practical Implementation and Evaluation of Receiver Diversity Techniques in Wireless Communication	CO4
<i>LSO 5.3.</i> Implementation of transmitter diversity technique.	5.	Practical Implementation and Performance Analysis of Transmitter Diversity Techniques	CO4
<i>LSO 6.1</i> Implement the (2X2) of MIMO system.	6.	Design and Implementation of MIMO Technology	CO4
<i>LSO 7.1</i> Implement of OFDM system and test the performance.	7.	Performance Evaluation of Orthogonal Frequency Division Multiplexing (OFDM) in Wireless Systems	CO5

L) **Suggested Term Work and Self Learning: S2400604J** Some sample suggested assignments, micro project and other activities are mentioned here for reference.

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

d. **Micro Projects:**

Here are five micro projects that can be included in an optical fiber and 5G communication course to give students hands-on experience with practical applications of the concepts learned:

1. Design of solar cell enabled Base Station for Green Communication Network

Task: Conduct a feasibility study on integrating solar cells with base stations, design a prototype solar-powered base station, simulate its energy efficiency and environmental impact, evaluate its carbon footprint reduction, and document the design and performance outcomes.

2. Path loss models for Aerial Communication Network

Task: Research and adapt existing path loss models for aerial networks, develop tailored models for scenarios like drones, validate with field or simulation data, compare model performance, and document findings with recommendations for network design.

3. Resource allocation for 5G communication Network

Task: Identify challenges in 5G resource allocation, develop an optimization strategy, simulate the strategy's effectiveness, implement it in a test environment, and analyze results to enhance resource allocation and network performance.

4. LEO Satellite based IoT communication

Task: Research LEO satellite technologies for IoT, design a communication system using LEO satellites, simulate system performance, conduct a cost-benefit analysis compared to other methods and prepare a brief report of the same.

5. QoS requirements for Tactile Internet

Task: Define QoS requirements for tactile internet applications, develop a QoS framework, test the framework in various scenarios, evaluate its performance, and prepare a report with recommendations for meeting QoS standards in tactile internet networks.

e. Other Activities:

f. Seminar Topics: Some of the suggested seminar topics are

- i. "Advancements in 5G Technology and beyond"
- ii. "The Future of Wireless Communication: 5G and Beyond"
- iii. "Integrating Haptics with 5G Networks: Opportunities and Challenges"
- iv. "Security Strategies for 5G Networks: Ensuring Robust Protection"
- v. "AR/VR-enabled Systems in 5G: Innovations and Implementation"

g.

h. Visits: Visit nearby telephone exchanges or wireless communication-related companies

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
Assignments			Micro Projects	Other Activities*			
CO-1	15%	15%	15%	-	-	20%	20%
CO-2	10%	10%	10%	25%	-	10%	20%
CO-3	15%	15%	15%	25%	33%	15%	20%
CO-4	30%	30%	30%	25%	33%	15%	20%
CO-5	30%	30%	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 percentage given are approximate
- In case of Micro Projects and End Laboratory Assessment (ELA), the achieved marks will be equally divided in all those COs mapped with total experiments.
- For CO attainment calculation indirect assessment tools like course exit survey need to be used which comprises of questions related to achievement of each COs.

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

Unit Title and Number	Total Classroom Instruction (CI)Hours	Relevant COs Number(s)	Total Marks	ETA (Marks)		
				Remember (R)	Understanding (U)	Application & above (A)
Unit-1.0 5G Radio Access Technology	8	CO1	12	4	4	4
Unit-2.0 Study of GSM Architecture	8	CO2	12	4	4	4
Unit-3.0 Channel and channel behavior	8	CO3	12	4	4	4
Unit-4.0 Mitigation Techniques	12	CO3	14	4	4	6
Unit-5.0 Advanced Optical Fiber Communication and Emerging Technologies	12	CO2	20	6	6	8
Total	48	-	70	22	22	26

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

O) Suggested Assessment Table for Laboratory (Practical): Kindly change this table as per the list of experiment in the above list

Sl. No	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
6.	Characterization and Impact of Noise on Wireless Data Transmission: A Comprehensive	CO1	30	60	10
7.	Evaluating Fading Effects on Wireless Data Transmission: Outage Probability Analysis	CO2	40	50	10
8.	Comparative Study of Channel Capacity: AWGN versus Fading Channels	CO3	30	60	10
9.	Practical Implementation and Evaluation of Receiver Diversity Techniques in Wireless Communication	CO4	30	60	10
10.	Practical Implementation and Performance Analysis of Transmitter Diversity Techniques	CO4	30	60	10
11.	Design and Implementation of MIMO Technology	CO4	30	60	10
12.	Development and Performance Evaluation of Orthogonal Frequency Division Multiplexing (OFDM) in Wireless Systems	CO5	30	60	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

P) Suggested Instructional/Implementation Strategies: Different Instructional/ Implementation Strategies may be appropriately selected, as per the requirement of the content/outcome. Some of them are Improved Lecture, Tutorial, Case Method, Group Discussion, Industrial visits, Industrial Training, 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:

Please insert laboratory equipment in this format

Sl. No.	Name of Equipment,Tools, and Software	Relevant Experiment/ Practical Number
1.	Software-Defined Radio (SDR) kit : Allows for the implementation and testing of 5G communication protocols.	All
2.	5G NR Testbed: Complete test setups for developing and testing 5G NR systems.	All
3.	Vector Signal Analyzer (VSA) and Vector Signal Generator (VSG): For generating and analyzing complex modulated signals used in 5G communication.	All
4.	MIMO (Multiple Input Multiple Output) Test System (2X2, and more): For testing MIMO technology, which is essential for 5G networks.	All
5.	MATLAB/Mathematica	All

R) Suggested Learning Resources:

(a) Books

Here are some essential books for Optical Fiber and 5G Communication.

Sl. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Millimeter Wave Wireless Communications	Theodore S. Rappaport, Robert W. Heath Jr., Robert C. Daniels, and James N. Murdock	Cambridge University Press, 2024. ISBN 9781009489836
2.	5G NR: The Next Generation Wireless Access Technology	Erik Dahlman, Stefan Parkvall, and Johan Skold	Academic Press, 2020. ISBN-10. 0128143231; ISBN-13. 978-0128143230
3.	Wireless Communications	Andreas F. Molisch,	John Wiley & Sons, 2012. ISBN: 8126542322
4.	Wireless Communications	Andrea Goldsmith	Cambridge University Press, 2005. ISBN: 9780511841224

(b) Online Educational Resources:

Here are some valuable online references for a course in Optical Fiber and 5G Communication:

1. Prof. Aditya K. Jagannatham– NPTEL **Principles of Modern CDMA/ MIMO/ OFDM Wireless Communications**
2. **Coursera** - Post Graduate Certificate in 5G Technology and IoT: This program covers the essentials of 4G and 5G systems, including key technical advancements and challenges. It also delves into topics such as massive MIMO, OFDM, and mm Wave communication, providing a solid foundation in modern wireless communication (Coursera).
3. **Coursera** - 5G and Beyond Wireless Technologies: This course provides an in-depth understanding of 5G New Radio standards, beam management, cell-free massive MIMO, and intelligent reflecting surfaces, making it an excellent resource for those looking to explore the cutting-edge aspects of 5G technology (Coursera).
4. **Coursera** - 5G for Everyone: Gain an in-depth understanding of how 5G is revolutionizing the way we do business in the 2020s with technologies that make 5G possible, including mm Wave, Massive MIMO, RAN, and more. Learn how companies can use 5G Private Networks and Industrial IoT to transform the way they operate daily. Gain the base-level knowledge of 5G you need to continue your wireless education and advance in the rapidly growing field of wireless technology.

MIT OCW - Principles of Wireless Communications: This course is an introduction to the design, analysis, and fundamental limits of wireless transmission systems. Topics to be covered include: wireless channel and system models; fading and diversity; resource management and power control; multiple-antenna and MIMO systems; space-time codes and decoding algorithms; multiple-access techniques and multiuser detection; broadcast codes and precoding; cellular and ad-hoc network topologies; OFDM and ultrawideband systems; and architectural issues.

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: In this section provide the software name (if any) data sheet according to this course.

- a. Operating / Manufacturers' Manuals
- b. Lab Manuals

- A) **Course Code** : 2451605 (P2451605/S2451605)
B) **Course Title** : Major Project
C) **Pre- requisite Course(s)** :
D) **Rationale** :

Project work plays a very important role in engineering education in developing core technical skills, soft skills and higher level of cognitive, psychomotor and affective domain skills. Major Project work is normally done when students have acquired sufficient knowledge, skills and attitude and are able to integrate all these, entirely in new situation or task to solve the problems of the industries/field agencies/etc. Through major project work, students get direct exposure to the world of work in their relevant field. They are intrinsically motivated to explore new things, new methods, new design, many more ideas and also develop out of the box thinking abilities, creative and innovative capabilities. It also develops many soft skills like confidence, communication skills, creative ability, inquisitiveness, learning to learn skills, lifelong learning skills, problem solving skills, management skills, positive attitude, ethics etc.

Normally in a curriculum document, there is a mention of project work indifferent context. In situation one, project work is reflected as micro project under each and every course curricular detailing, in the form of sessional work mentioned under different semesters. These projects are normally related to the developing skills in respective course of the specific programme.

In the context of diploma programme in Bihar, minor project work will be carried out in Semester 5 with emphasis on project planning.

Major project work is reflected as a course in the total programme structure, normally at 6th semester depending on the requirement of the programme. Through major project, students try to bring the industrial/real world problems in institutional setting, may be in collaboration/ networking with industries/field agencies/enterprises as per the requirement of different diploma programmes.

- E) **Course Outcomes:** After completion of the major project work, students will be able to –

- CO-1** Integrate the knowledge (K), skills (S), attitudes (A) developed, in a new task or problem identified in the form of project work.
- CO-2** Develop higher level of cognitive, psychomotor and affective domain skills relevant to the course/programme.
- CO-3** Solve the industrial/real world problems/tasks by Integrating the generic skills/soft skills/employable skills with relevant technical skills.
- CO-4** Develop the capabilities and skills of innovativeness, creativity, resourcefulness, time management, problem solving abilities, interpersonal skills, pro-activeness, cost effectiveness, environment consideration and sustainability.
- CO-5** Prepare the project report.

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	-	-	-	1		
CO-2	3	-	3	-	-	-	1		
CO-3	3	-	3	3	-	-	1		
CO-4	3	2	3	-	2	2	1		
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				
2451605	Major Project	-	-	08	04	12	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)	
2451605	Major Project	-	-	20	30	50	100	200

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) Suggested Implementation of Major Project:

Under the minor project in fifth semester, project planning is almost over. The projects are identified and allocated to students. Teacher's role is important as they act as guide, facilitator, catalyser, motivator to promote brain storming, thinking, creativity, initiativeness and many other skills in the students. Teachers should help or guide continually to monitor whether the students are proceeding in the right direction as per outcomes to be attained.

It is also suggested that teachers are not supposed to guide and plan each and every step from the point of view of execution of the project, otherwise it will curb the creativity or thinking process of the students. Teachers have to see that he or she is able to create think tank for this fast-technological world of work for the growth of our country. Following points should be taken into consideration while implementing the major project work.

The following steps are undertaken under the major project-

1. Design, Development and Execution of the Major Project.
2. Quality of Project Report Writing and its Presentation.

1.0 Design, Development and Execution of Major Project:

Projects design, development, execution is done by the students under the guidance and feedback by respective teachers for attainment of courses specific outcomes, POs and PSOs.

Continual Monitoring, feedback and assessment mechanism on weekly progress/updates on action taken on different criteria and sub-criteria of the project work need to be planned for individual and team of students. Path breaking teachers who think out of the box are required to guide, monitor and evaluate the project work.

1.1 Unique Features of Major Project:

Following important characteristic features of project need to be given special emphasis during the implementation and evaluation of the major project work-

- Innovativeness
- Creativity
- Originality
- Pro-activeness
- Initiativensness
- Cost Effectiveness
- Resourcefulness
- Development of Soft Skills/Generic Skills
- Ethical Issues
- Environmental Considerations
- Simulated/Automated Industry's/Improvised Process
- Application or Utility in the World of Work.
- Relevance to the Curriculum
- Mapping of Outcomes of Project with Pos and PSOs (if applicable)
- Feasibility of Implementation of the Project

2.0 Quality of Project Report Writing and its Presentation:

Following points need to be taken care of during report writing, its implementation and evaluation-

- Report writing as per prescribed format
- Clarity of outcomes
- Innovativeness
- Presentation of Data
- Data Analysis, Interpretation and Result
- Quality of Product/Prototype

2.1 Project Report Writing:

The suggested format of the project report is mentioned below for teacher's and students' reference:

- i. Problem Statement/ Project Title
- ii. Abstract
- iii. Literature Review
- iv. Outcomes of the Project
- v. Project Planning, Design and Development
- vi. Methodology
- vii. Implementation and Testing
- viii. Result and its Interpretation
- ix. Summary
- x. References / Bibliography

2.2 Presentation & Discussion:

Quality of presentation of data need to be ensured using the following criteria -

- Clarity in Communication and Presentation
- Voice Audibility
- Use of Media and Methods
- Satisfying the Queries of Audience
- Attainment of Outcomes

2.3 Project's Potential:

Futuristic scope and recommendation for further studies related to project may be assessed from the following criteria -

- Papers Published or Award Received
- Exhibition or Display or Showcase of Project in Competition or Exhibition or Tech Fest
- Evaluation of Working/Testing of Projects or Prototype
- Relevance and Applications in the World of Work
- Recognition in any Form
- Related Areas/Sub Areas for Further Studies

J) Assessment of the Major Project:

For objective, valid and reliable assessment, different tools of assessment such as a checklist, rating scale, assessment rubric, observation schedule, portfolio assessment, incidental records etc. need to be prepared. Even the students may be encouraged to adopt self-assessment techniques using the assessment rubrics.

The students need to be assessed continuously based on the suggested below mentioned assessment criteria at project planning stage. The project guide must prepare detailed rubric(s) for each criterion to have more valid and reliable assessment. Criteria of assessment of major project work are mentioned below.

Assessment Scheme for Major Project

S. No.	Suggested Assessment Criteria	Suggested Weightage (%)
1.	Project Planning during Minor Project Work 1.1 Identification of Area/Problem Statement 1.2 Literature Survey 1.3 Formulation of Project Title 1.4 Clarity in Formulation of Outcomes of The Project 1.5 Preparation of Synopsis 1.6 Presentation of Synopsis	30
2.	Design, Development and Execution of the Project. 2.1 Unique Features of Major Project	45
3.	Quality of Report Writing and Presentation. 3.1 Report Writing 3.2 Presentation & Discussion 3.3 Project's Potential	25
	TOTAL	100

- B) **Course Code** : 2400505 (P2400505/S2400505)
- C) **Course Title** : Entrepreneurship Development & Start-ups
(Common for all Programmes)
- D) **Pre-requisite Course(s)** :
- E) **Rationale** :

A fast-growing economy provides ample opportunities for diploma engineers to succeed in entrepreneurship and start-ups. Start-up ecosystem and Entrepreneurship Development skills are fully developed providing many opportunities to the youths. Diploma engineers can be their own masters and provide jobs to others by starting their service-industry / assembly/marketing/consultancy/manufacturing enterprises. Entrepreneurship requires a distinct set of skills that will be developed in this course. This course aims at developing competencies in the diploma engineer for becoming an intrapreneur, a successful entrepreneur, or a startup Co-Founder. After successfully completing this course students who develop the qualities of a successful entrepreneur can establish their own manufacturing industry/business startup or be self-employed. Those who prefer jobs can become intrapreneurs and share profits with their company.

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

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

- CO-1** Demonstrate traits of a successful intrapreneur/ entrepreneur/ start-up co-founder.
- CO-2** Innovate products and services using creativity and innovation techniques.
- CO-3** Manage critical resources from support institutions.
- CO-4** Prepare sustainable small business plans.

- G) **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	3	2		
CO-3	3	3	3	-	2	3	2		
CO-4	3	3	-	-	2	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.

H) 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				
2400505	Entrepreneurship Development & Startups	-	-	04	02	06	03

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.

I) 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)	
2400505	Entrepreneurship Development & Startups	-	-	20	30	20	30	100

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: (Not Applicable)

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2400505

Practical/Lab Session Outcomes (LSOs)		S. No.	Laboratory Experiment / Practical Titles	Relevant Cos Number(s)
LSO1.1	Identify the skills of a Successful Entrepreneur.	1.	Profile summary (about 500 words) of a successful entrepreneur indicating milestone achievements.	CO1
LSO1.2	Determine the charms of entrepreneurship and start-ups	2.	Discussion session with your institute's pass-out students who are successful entrepreneurs.	CO1
LSO1.3	Perform strength, weakness, opportunity, and threat analysis.	3.	SWOT analysis to arrive at your business idea of a product/service.	CO1
LSO1.4	Develop sales & marketing skills	4.	Sale of products to different customers	CO1
LSO2.1	Use creativity and put up a stall in a funfair and write a report of profit/loss.	5.	Creativity and Innovation in Business	CO2
LSO2.2	Innovate a point of sale for a product.	6.	Exhibition cum sale of products prepared out of waste.	CO2
LSO2.3	Generate different business opportunities.	7.	Business ideas (product/service) for intrapreneurial and entrepreneurial opportunities through brainstorming.	CO2
LSO1.5	Discover entrepreneurial potential.	8.	Self-assessment test to discover entrepreneurial traits.	CO1
LSO2.4	Classify domain-specific industries on business parameters.	9.	Survey industries (your stream), and grade them according to the level of scale of production, investment, turnover, and pollution to prepare a report on it.	CO2
LSO3.1	Identify entrepreneurship support institutions beneficial for the enterprise.	10.	Compile the information from the government agencies that will help you set up your business enterprise.	CO3
LSO3.2	Select a suitable funding scheme for the enterprise.	11.	Visit a bank / financial institution to enquire about various funding schemes for small-scale enterprises.	CO3
LSO3.3	Analyze the assessment procedure of bank loans.	12.	Collect loan application forms of nationalized banks / other financial institutions.	CO3
LSO3.4	Compute the financial needs of the business enterprise	13.	Compile the information from financial agencies that will help you set up your business enterprise.	CO3
LSO2.5	Select a business opportunity.	14.	Identify the business opportunity suitable for you.	CO2
LSO3.5	Carry-out market survey for a product.	15.	Market Survey for an Enterprise	CO3

Practical/Lab Session Outcomes (LSOs)		S. No.	Laboratory Experiment / Practical Titles	Relevant Cos Number(s)
LSO4.1	Find out rates of industrial lands and buildings in different industrial areas.	16.	Industrial land and building for Entrepreneurship.	CO4
LSO4.2	Craft a vision statement and enabling mission statements for your chosen enterprise.	17.	Vision statement and mission statement for a Startup.	CO4
LSO4.3	Select a suitable name and brand for the business enterprise.	18.	Branding for a product and a Company.	CO4
LSO4.4	Design a logo, letterhead, and visiting card for the business.	19.	Marketing communication for business.	CO4
LSO4.5	Prepare a techno-feasibility report	20.	A techno-feasibility report of a chosen product/service.	CO4
LSO4.6	Prepare a business plan for the enterprise.	21.	Business plan for the enterprise.	CO4
LSO4.7	Develop a website for the business	22.	Online Marketing for Business.	CO4
LSO3.6	Prepare a set of short-term, medium, and long-term goals for starting a chosen small-scale enterprise.	23.	Goal setting for an enterprise.	CO3
LSO3.7	Prepare an advertising campaign for your chosen product/service.	24.	Marketing management for an enterprise.	CO3
LSO3.8	Establish a supply chain network for the enterprise.	25.	Supply Chain Management	CO3
LSO3.9	Establish a Market intelligence mechanism.	26.	Market Intelligence for Entrepreneurship	CO3
LSO4.8	Compile information about various insurance schemes covering different risk factors.	27.	Risks in business	CO4
LSO4.9	Calculate the breakeven point for the business idea chosen by you.	28.	Breakeven point for a business	CO4

L) Suggested Term Work and Self-Learning: S2400505

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 inline with the targeted COs.

- i. Prepare a list of successful Entrepreneurs in the city.
 - ii. Prepare a list of startups in the city.
 - iii. Prepare a list of the nearest incubators.
 - iv. Prepare a list of Angel Investors and Venture Capitalists.
-
- i. Choose any product and study its supply chain.
 - ii. Arrange brainstorming sessions for improvement of any product.
 - iii. Choose any advertisement and analyse its good and bad points.
 - iv. Visit industrial exhibitions, trade fairs and observe nitty-gritty of business.
 - v. Study schemes for entrepreneurship promotion of any bank.

b. Micro Projects:

- i. Interview successful entrepreneurs and startup co-founders in the city and innovate their products/services, pricing, packaging, advertisements, propositions, etc.
- ii. Identify different entrepreneurship support institutions in the city.
- iii. Prepare a collage for specific entrepreneurship development institutions.
- iv. Conduct a market survey for a specific product idea.

c. Other Activities:**1. Seminar Topics:**

- Charms of entrepreneurship.
- Challenges of entrepreneurship.
- Startup ecosystem in India.
- One district one product scheme
- Setting up of a business.
- Market study of specified business.
- Prepare a business plan for your chosen small scale enterprise.
- Business opportunity suitable for you.

2. Visits: Visit DIC, MSME, NSIC, NABARD, KVIC, IDBI, SBI, State Consultancy Organization, Industrial Development Center, Trade Exhibitions, Export Fairs, Trade Shows, etc.

Visit nearby tool room/industry and learn to prepare budget of that industry. Also learn to grow low scale business and marketing. Prepare list of advertisement to grow business.

3. Self-Learning Topics:

- Achievement Motivation.
- Need for achievement.
- Calculated risk.
- CSR (Corporate Social Responsibility)
- MSME Development Institute.
- Marketing their business.
- Growing their business.
- Financial management.
- Dealing with the pressure and stress

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	-	-	30%	-	-	30%	25%
CO-2	-	-	10%	25%	-	10%	25%
CO-3	-	-	30%	25%	50%	30%	25%
CO-4	-	-	30%	50%	50%	30%	25%
Total Marks	-	-	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: (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.	Profile summary (about 500 words) of a successful entrepreneur indicating milestone achievements.	CO1	50	40	10
2.	Discussion session with your institute's pass-out students who are successful entrepreneurs.	CO1	50	40	10
3.	SWOT analysis to arrive at your business idea of a product/service.	CO1	50	40	10
4.	Sale of products to different customers	CO1	50	40	10
5.	Creativity and Innovation in Business	CO2	50	40	10
6.	Exhibition cum sale of products prepared out of waste.	CO2	50	40	10
7.	Business ideas (product/service) for intrapreneurial and entrepreneurial opportunities through brainstorming.	CO2	50	40	10
8.	Self-assessment test to discover entrepreneurial traits.	CO1	50	40	10
9.	Survey industries (your stream), and grade them according to the level of scale of production, investment, turnover, and pollution to prepare a	CO2	50	40	10

S. No.	Laboratory Practical Titles	Relevant Cos Number (s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
	report on it.				
10.	Compile the information from the government agencies that will help you set up your business enterprise.	CO3	50	40	10
11.	Visit a bank / financial institution to enquire about various funding schemes for small-scale enterprises.	CO3	50	40	10
12.	Collect loan application forms of nationalized banks / other financial institutions.	CO3	50	40	10
13.	Compile the information from financial agencies that will help you set up your business enterprise.	CO3	50	40	10
14.	Identify the business opportunity suitable for you.	CO2	50	40	10
15.	Market Survey for an Enterprise	CO3	50	40	10
16.	Industrial land and building for Entrepreneurship.	CO4	50	40	10
17.	Vision statement and mission statement for a Startup.	CO4	50	40	10
18.	Branding for a product and a Company.	CO4	50	40	10
19.	Marketing communication for business.	CO4	50	40	10
20.	A techno-feasibility report of a chosen product/service.	CO4	50	40	10
21.	Business plan for the enterprise.	CO4	50	40	10
22.	Online Marketing for Business.	CO4	50	40	10
23.	Goal setting for an enterprise.	CO3	50	40	10
24.	Marketing management for an enterprise.	CO3	50	40	10
25.	Supply Chain Management	CO3	50	40	10
26.	Market Intelligence for Entrepreneurship	CO3	50	40	10
27.	Risks in business	CO4	50	40	10
28.	Breakeven point for a business	CO4	50	40	10

Legend:

PRA*: Process Assessment

PDA**: Product Assessment

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

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

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

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Entrepreneurial Development	Khanka S.S. (2006)	S. Chand Publishing, 20068121918014,
2.	Un-Boxing Entrepreneurship Your self-help guide to setup a successful business	Dr. Nishith Dubey Aditya Vyas, AnnuSoman, AnupamSingh, CharulChaturvedi, Praveen Shukla	Indra Publishing House, 2023, ISBN- 978-93-93577-70-2
3.	Skill Development and Entrepreneurship in India	Rameshwari Pandya	Ingram 2016, 8177084186
4.	Production and Operations Management	SV Deshmukh, A K Chitale and Nishith Rajaram Dubey,	Archers & Elevators Publishing House, Bangalore ISBN 9789386501197
5.	Entrepreneurship Development	Sapna Jarial	New India Publishing Agency- Nipa 2022, 9395319240
6.	The Entrepreneurial Instinct: How Everyone Has the Innate Ability to Start a Successful Small Business	Monica Mehta	Tata McGraw Hill Education, New Delhi, 2012, ISBN 978-0-07-179742-9
7.	The Learn Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses	Eric Ries	Penguin UK ISBN-978-0670921607
8.	Entrepreneurship and Start-ups	Ekta Sharma	FPH
9.	The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business	Clayton M. Christensen	Harvard business ISBN: 978-142219602

(b) Online Educational Resources:

1. Coir Board <http://coirboard.gov.in/>
2. National Institute for Micro, Small and Medium Enterprises (ni-msme) <https://www.nimsme.org/>
3. MSME / Udyam Registration <https://udyamregistration.gov.in/Government-India/Ministry-MSME-registration.htm>
4. CHAMPIONS <https://champions.gov.in/Government-India/Ministry-MSME-Portal-handholding/msme-problem-complaint-welcome.htm>

5. Prime Minister Employment Generation Programme and Other Credit Support Schemes
<https://msme.gov.in/prime-minister-employment-generation-programme-and-other-credit-support-schemes>
6. Marketing Promotion Schemes <https://msme.gov.in/marketing-promotion-schemes>
7. Start-up India <https://www.startupindia.gov.in/>
8. DPIIT Recognition <https://www.startupindia.gov.in/content/sih/en/startup-scheme.html>
9. Startup India Seed Fund Scheme <https://seedfund.startupindia.gov.in/>
10. STARTUP INDIA INVESTOR CONNECT <https://investorconnect.startupindia.gov.in/>
11. Startup Funding <https://www.startupindia.gov.in/content/sih/en/funding.html>
12. Women Entrepreneurship in India
https://www.startupindia.gov.in/content/sih/en/women_entrepreneurs.html
13. Incubators <https://www.startupindia.gov.in/content/sih/en/incubator-framework.html>
14. Start-up Mentors
<https://www.startupindia.gov.in/content/sih/en/search.html?roles=Mentor&page=0>
15. NEN <https://nen.org/>
16. TIE <https://tie.org/>
17. MoE Innovation Cell <https://www.mic.gov.in/>
18. <https://youtu.be/8iKsZZYv90k>
19. <https://youtu.be/Tzzfd6168jk>
20. <https://youtu.be/9-O15gDqebg>

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

(c) Others: -

- A) **Course Code** : 2451606 (P2451606/S2451606)
 B) **Course Title** : Computer Aided Design in Fashion and Clothing.
 C) **Pre- requisite Course(s)** : Basics of Computers
 D) **Rationale** :

Computer Aided Design in Fashion and Clothing is the use of software to assist in the understanding, application, creation, modification, analysis or optimization of fashionable outfit design. CAD software is used to increase the productivity of the designers and to improve the quality of their visualized designs. CAD provides an opportunity to understand the importance of incorporating technology with creativity. The knowledge gained through this course successfully blends creativity and technology, grooming students to be successful Fashion Designers, Costume Designers for Films/Theater, Bridal wear Designer, Textile Designer, Illustrator, Pattern Maker or Grader, Stylist, Retail Merchandising and Visual Display Artist.

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

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

CO-1. Identify the various software applications in fashion and clothing designing.

CO-2. Use various graphic packages: Corel draw, Adobe photo shop, Adobe illustrator, Computer aided fashion designing and pattern making softwares like Jindex, clo 3D, TUKA 3D, MAYA, Thino etc.

CO-3. Construct basic designs for men, women and children using CAD softwares.

CO-4. Symphonize different types of patterns with their gradations.

CO-5. Creating designs for traditional and western outfits using different textures and colour combinations.

- 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	3	3	-	-	-		
CO-3	3	2	3	3	3	2	-		
CO-4	3	2	3	3	3	2	-		
CO-5	3	-	3	3	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				
2451606	CAD in FCT	-	-	04	02	06	03

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)	
2451606	CAD in FCT	-	-	20	30	20	30	100

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:**

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
<p><i>TSO 1a.</i> Explain CAD in fashion and related terminologies.</p> <p><i>TSO 1b.</i> Identify the Hardware and software requirement of CAD- Design process.</p> <p><i>TSO 1c.</i> Classify Computer aided fashion design and pattern making for the given sample.</p> <p><i>TSO 1d.</i> Explain the applications and end uses of Softwares.</p> <p><i>TSO 1e.</i> List the advantages of Computer Aided designing, pattern making, cutting and sewing over conventional manufacturing processes.</p>	<p>Unit-1.0 Introduction to CAD Software for Fashion Designers.</p> <p>1.1 Introduction to various fashion designing softwares.</p> <p>1.2 Hardware and software requirement of CAD- Design process.</p> <p>1.3 Applications and end uses of Softwares – Adobe Photoshop/Illustrator or Corel draw or Open Source.</p> <p>1.4 Benefits of Computer Aided design.</p>	CO1, CO2
<p><i>TSO 2a.</i> Use the different tools in Photoshop to manipulate, edit, and adjust the given images.</p> <p><i>TSO 2b.</i> Apply layer effects and filters to create special effects, including lighting and texture effects.</p> <p><i>TSO 2c.</i> Generate special effects and quality artworks using painting tools and blending modes.</p> <p><i>TSO 2d.</i> Perform color correction and restoration of the given photographs and images.</p>	<p>Unit-2.0 Design using Adobe Photoshop/ Illustrator</p> <p>2.1 Introduction to Adobe Photoshop,</p> <p>2.2 Operational principles of various tools for woven, knitted & Printed design.</p> <p>2.3 Photo Retouching and Color Correction, The Red Eye Tool, The Clone Stamp Tool, The Patch Tool & the Healing Brush Tool, The Spot Healing Brush Tool, The Color Replacement Tool, Adjusting Levels, Adjust Curves, Non-Destructively, with Adjustment Layers</p> <p>2.4 Editing Foreground color and Background color, Using the Color ramp, Setting the CMYK Color gamut, Creating Special Effects, Getting Started with Photoshop Filters, Smart Filters, Creating Text Effects, Applying Gradients to text.</p>	CO1, CO2, CO3
<p><i>TSO 3a.</i> Identify various CorelDraw advanced text, color, layout, latter style, and template techniques for the given sample.</p> <p><i>TSO 3b.</i> Apply layer effects and filters to create special effects, including lighting and texture effects.</p> <p><i>TSO 3c.</i> Generate special effects and quality artworks using painting tools and blending modes.</p> <p><i>TSO 3d.</i> Design brochures, pamphlets, magazine cover pages, cards, logos and advertisements etc. using the given software.</p>	<p>Unit-3.0 Design using CorelDraw</p> <p>3.1 Introduction to CorelDraw, Creation and manipulation, Drawing and Shaping Tools, Using the Freehand Tool, Drawing Lines and Polylines, Working with Special Effects and Texts, Drawing with the Artistic Media Tool, Blending Two Objects,</p> <p>3.2 Setting Outline and Fill Defaults, Arranging Objects, Grouping and Ungrouping Objects, Using Snap To, Aligning Objects, Group and Child Objects, Combining and Breaking Objects, Using Intersection.</p> <p>3.3 Working with Paragraph, Importing and Sizing Paragraph Text, Flowing Text Between Frames, Formatting Paragraph Frames, Wrapping</p>	CO1, CO2, CO3

Major Theory Session Outcomes (TSOs)	Units	Relevant COs Number(s)
	Paragraph Text Around Objects, Applying Drop Caps, Typing Text into Objects, Special Text Effects, Color Palettes, Eyedropper Tool Smart Fill. 3.4 Deleting Objects, Sizing Objects, Transforming Objects, Mirroring Objects, Rotating and Skewing Objects, Typing Text into Objects, Converting Text to Curves, Creating Blended Text Shadows, Using Symbols and Clipart, Inserting Text Symbols, Adding Clipart, Modifying Clipart, Working with Bitmaps, what is a Bitmap, Importing Bitmap Options	
<p><i>TSO 4a.</i> Create quality artworks and graphics utilizing the given tool(s).</p> <p><i>TSO 4b.</i> Apply text and typography, Color, image manipulation and basic layout for a print-based output for the given multimedia.</p> <p><i>TSO 4c.</i> Design page layout, image capture and manipulation, logo for the given sample.</p> <p><i>TSO 4d.</i> Create garment cost & Specification Sheet for the given designed fabric.</p> <p><i>TSO 4e.</i> Explain E-Style & Sketch Studio in fashion.</p> <p><i>TSO 4f.</i> Differentiate between colour way/draping studio.</p>	<p>Unit-4.0 3D Fashion & Textile Designing Software</p> <p>4.1 Software Tool for 3D simulation of fabric, 3D product visualization,</p> <p>4.2 Adding laces, defining different kinds of stitch effects, design repeat, color ways, Color Reduction, color communication and spec creation of garment styles using fashion software.</p> <p>4.3 Fabric Designing (Dobby weave), creating garment cost & Specification Sheet.</p> <p>4.4 Texture mapping, realistic texture creation, texture table, create woven material, set canvas, edit Image.</p> <p>4.5 E-Style & Sketch Studio</p> <p>4.6 Colour way Studio</p> <p>4.7 Draping Studio</p>	<p>CO1, CO2, CO3, CO4, CO5</p>
<p><i>TSO 5a.</i> Create Basic skirt Pattern/ Trouser Pattern – Notches, Orientation, Tools using the given CAD tools.</p> <p><i>TSO 5b.</i> Develop Basic bodice Block – Modifications and variations, Shirt/ Jacket</p> <p><i>TSO 5c.</i> Explain Nesting in Fashion.</p> <p><i>TSO 5d.</i> Explain the importance of Grading System in Fashion.</p> <p><i>TSO 5e.</i> Differentiate between the given type(s) of grading techniques.</p> <p><i>TSO 5f.</i> Prepare Grading of the given Bodice Block/ Shirt/ Jacket/ skirt/ Trouser.</p> <p><i>TSO 5g.</i> Explain Lay Planning, marker making of the given skirt/ trouser using CAD tool.</p> <p><i>TSO 5h.</i> Analyze Marker Making Bodice, shirt / jacket using the given Cad Tool.</p>	<p>Unit-5.0 Apparel CAD Pattern making Software:</p> <p>5.1 Pattern making, Marker planning, Marker Efficiency for the all types of garments.</p> <p>5.2 Nesting: Seam less joint in modules, Group adjusting the curves among front and back or pieces.</p> <p>5.3 Pattern design system: Open dart, transfer dart and dart edge smoothening, Pleat, cut away, mirror, modify and copy tool.</p> <p>5.4 Grading system: Digitizing and modify pattern details, Ultra grading brief: point grading, line grading, memory grading body grading, auto grading.</p> <p>5.5 Marking and cut plan CAD.</p>	<p>CO1, CO2, CO3, CO4, CO5</p>

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

K) Suggested Laboratory (Practical) Session Outcomes (LSOs) and List of Practical: P2451606

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
<p><i>LSO1.1</i> Develop Elements of designs using the given CAD software.</p> <p><i>LSO1.2</i> Generate motif on computers / motif for border, motif for the given all over design.</p>	1.	<p>Motif generation on computer</p> <ul style="list-style-type: none"> • for border • for all over design. 	CO1, CO3, CO5
<p><i>LSO2.1</i> Use of Adobe Photoshop - Functions of Tools & Working on layers.</p> <p><i>LSO2.2</i> Use Photo-editing for manipulation in the given sample.</p> <p><i>LSO2.3</i> Use of Mode conversation through editing for the given sample.</p> <p><i>LSO2.4</i> Prepare Rendering & filter effects along tutorials for the given sample.</p>	2.	Study of Photoshop tools in detailing, enhancing images & pixels, types of file formats, edit tools: transform, fill, brush tool, Layers & filters.	CO1, CO2
<p><i>LSO 3.1.</i> Use the given CAD tool for the given sample.</p> <p><i>LSO 3.2.</i> Generate Figure Drawing - Block figure and Flesh figure using Cad tools for the given sample.</p> <p><i>LSO 3.3.</i> Set for Working with layouts/special effects for the given sample.</p> <p><i>LSO 3.4.</i> Create Prints and textures applying given Cad tools.</p>	3.	Learning basic tools of Coral Draw. Working with Text, Lines, Shapes & Objects, Outlines &fills, applying fill, outlines, special effects, shaping objects.	CO1, CO2
<p><i>LSO 4.1.</i> Use the given software for woven, knitted and printed design(s).</p> <p><i>LSO 4.2.</i> Create Weave simulation for the given sample.</p>	4.	Development of basic weave design & their derivation through CAD.	CO3
<p><i>LSO 5.1.</i> Use the available software.</p> <p><i>LSO 5.2.</i> Develop the given Men's/ Women's/ Kids's croqui figure with different hair styles using CAD.</p>	5.	Developing Croqui figures and flat sketches for men, women and children using Photoshop/ CorelDraw/CAD.	CO1, CO2, CO3
<p><i>LSO 6.1</i> Develop the given Men's wear/ womenswear/ kids wear garment using CAD.</p>	6.	Draping of garments on men's, women's& children casual, party, night, sports, office/formal wears using Fashion Studio software / Photoshop / CorelDraw.	CO1, CO2, CO3
<p><i>LSO 7.1</i> Visualize the garment similar to a real-world object for the given sample.</p> <p><i>LSO 7.2</i> Prepare same garment(s) with different Textures using CAD software.</p>	7.	3D imaging on CAD and Texture mapping.	CO1, CO3, CO5
<p><i>LSO 8.1.</i> Identify all construction details of the given garment.</p> <p><i>LSO 8.2.</i> List various components for total cost of the given product.</p>	8.	Creating specification sheets, cost sheets for each garment using Fashion Studio software / Photoshop / CorelDraw.	CO1, CO2,
<p><i>LSO 9.1.</i> Prepare patterns of the given basic bodice block with labelling using CAD.</p>	9.	Study of principles of pattern making using CAD and preparing patterns for basic blocks (Top, Skirt, Sleeve).	CO4, CO5
<p><i>LSO 10.1.</i> Prepare different size pattern from the given basic block with gradation techniques.</p> <p><i>LSO 10.2.</i> Select Efficient use of markers for cutting wrt optimal usage/ wastage/ cost.</p>	10.	<p>Grading of the above pattern. Marker planning</p> <ul style="list-style-type: none"> • for women's wear like: Top/Skirt/ • for Men's Shirt/Trouser/Kurtha. 	CO4, CO5

Practical/Lab Session Outcomes (LSOs)	S. No.	Laboratory Experiment/Practical Titles	Relevant COs Number(s)
LSO 11.1. Use of different type(s) of computerized cutting and sewing machines available.	11.	Use computerized cutting & sewing tools and equipments.	CO1

K) Suggested Term Work and Self Learning: S2451606

Some sample suggested assignments, micro project and other activities are mentioned here for reference.

a. Assignments:

- i. Identify the Hardware and software requirement of CAD- Design process.
- ii. Explain the applications and end uses of Softwares.
- iii. Use the different tools in Photoshop to manipulate, edit, and adjust the given images.
- iv. Identify various CorelDraw advanced text, color, layout, latter style, and template techniques.
- v. Design brochures, pamphlets, magazine cover pages, cards, logos and advertisements etc. using the given software.
- vi. Create quality artworks and graphics utilizing the given tool(s).
- vii. Create Basic skirt Pattern/ Trouser Pattern – Notches, Orientation, Tools using the given CAD tools.
- viii. Explain Lay Planning, marker making of the given skirt/ trouser using CAD tool.

b. Micro Projects:

1. Make a list of Various logistics softwares available in fashion and textile designing with multiple functionalities.
2. Career opportunity in Computer Aided Design in Fashion and Clothing.
3. Prepare the Mini marker and print the same for the following Garments with different fabric texture
 - Yoke Frock
 - Nehru Shirt
 - Salwar Kameez
 - Trousers
 - Any coats

c. Other Activities:

1. Seminar Topics:

- Commercially available Computer Aided Fashion design software.
- Clo 3D software.
- Artificial Intelligence in fashion designing.
- Introduction to 3D CAD.

2. **Visits:** Visit nearby toolroom/industry with 3D Fashion CAD facilities. Prepare report of visit with special comments of 3D Fashion CAD technique used, material used, single component/batch production/mass production and cost of printed component.

3. Self-Learning Topics:

- Create different traditional designs using CAD software.
- Create different Western designs using CAD software.
- Make different patterns of different types of garments using CAD software.
- Prepare spec sheets and cost sheets of prepared designs using CAD software.

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

COs	Course Evaluation Matrix						
	Theory Assessment (TA)**		Term Work Assessment (TWA)			Lab Assessment (LA)#	
	Progressive Theory Assessment (PTA) Class/Mid Sem Test	End Theory Assessment (ETA)	Term Work & Self Learning Assessment			Progressive Lab Assessment (PLA)	End Laboratory Assessment (ELA)
			Assignments	Micro Projects	Other Activities*		
CO-1	-	-	15%	-	-	20%	20%
CO-2	-	-	10%	25%	-	10%	20%
CO-3	-	-	15%	25%	33%	15%	20%
CO-4	-	-	30%	25%	33%	15%	20%
CO-5	-	-	30%	25%	34%	40%	20%
Total Marks	-	-	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: (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.	Motif generation on computer for border, for all over design.	CO1, CO3, CO5	30	60	10
2.	Study of Photoshop tools in detail, enhancing images & pixels, types of file formats, edit tools: transform, fill, brush tool, Layers & filters.	CO1, CO2	40	50	10
3.	Learning basic tools of Coral Draw. Working with Text, Lines, Shapes & Objects, Outlines &fills, Applying fill, outlines, special effects, shaping objects.	CO1, CO2	30	60	10

S. No.	Laboratory Practical Titles	Relevant COs Number(s)	PLA/ELA		
			Performance		Viva-Voce (%)
			PRA* (%)	PDA** (%)	
4.	Development of basic weave design & their derivation through CAD.	CO3	30	60	10
5.	Developing Croqui figures and flat sketches for men, women and children using Photoshop/ CorelDraw/CAD.	CO1, CO2, CO3	30	60	10
6.	Draping of garments on mens', womens' & children casual, party, night, sports, office/formal wears using Fashion Studio software / Photoshop / CorelDraw.	CO1, CO2, CO3	30	60	10
7.	3D imaging on CAD and Texture mapping	CO1, CO3, CO5	30	60	10
8.	Creating specification sheets, cost sheets for each garment using Fashion Studio software / Photoshop / CorelDraw.	CO1, CO2	30	60	10
9.	Study of principles of pattern making using CAD and preparing.	CO4, CO5	40	50	10
10.	Grading of the above pattern. Marker planning for womens' wear like: Top/Skirt/ Mens' Shirt/Trouser/Kurta.	CO4, CO5	40	50	10
11.	Study of principles of computerized cutting & sewing.	CO1	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.	High end computers	Processor Intel Core i7 with Open GL Graphics Card, RAM 32 GB, DDR3/DDR4, HDD 500 GB, Graphics Card NVIDIA OpenGL 4 GB, OS Windows 10	All
2.	Adobe photoshop /ILLUSTRATOR software	Version CS (27.5), Performance improvements to Smart Guides and Live Editing.	1,2,5,6
3.	Corel draw software	VERSION (24.3) Includes new curve-editing tools, updated Pantone support, and bug fixes. Additional design templates were added for subscription users, while the one-time purchase option was reinstated.	1,3,5,6

S. No.	Name of Equipment, Tools and Software	Broad Specifications	Relevant Experiment/Practical Number
4.	Computer Aided Fashion Design software	Software Tool for 3D Product Visualization, adding laces, defining different kinds of stitch effects, Color ways, Color Reduction, Fabric Designing (Dobby weave), Spec Sheet Creation and Virtual Prototyping. Features Modules Included 1. E-Style & Sketch Studio 2. Color way Studio 3. Draping Studio	4,6,7,
5.	Computer Aided pattern making software	Pattern making, Grading Marker planning, Marker Efficiency for the all types of garments. With video lesson. Features Modules Included 1. DGS (Design and Grading System) 2. GMS (Garment Marker system)	8,9,10,11

R) Suggested Learning Resources:

(a) Books:

S. No.	Titles	Author(s)	Publisher and Edition with ISBN
1.	Clothing and Textiles	Winifred Aldrich	Hanser Publisher ISBN: 156990507X, 9781569905074
2.	Corel DRAW Studio Techniques	David Huss, Gary W. Priester	Khanna Publishing House, Delhi ISBN: 9789386173768
3.	CorelDraw 10 for Windows: Visual Quick Start Guide.	Steven A. Schwartz Steven A. Schwartz	Peachpit Press ISBN- 0201773511
4.	The Photoshop Cs/Cs2 Wow!	Linnea Dayton, Cristen Gillespie	World Scientific, 2017 ISBN: 9789813146754
5.	Getting Started with 3D Printing: A Hands-on Guide to the Hardware, Software, and Services Behind the New Manufacturing Revolution	Liza Wallach Kloski, Nick Kloski	Make Community, LLC; 2nd edition, 2021 ISBN: 9781680450200

(b) Online Educational Resources:

1. Illustrated Encyclopedia of Costume and Fashion,
2. Jill B. Treadwell, Edited: Donald Treadwell, Public Relations Writing: Principles in Practice, SAGE, 2004
3. Donald, Illustrated Encyclopedia of Costume and Fashion Public Relations Writing: Principles Practice
4. https://www.coreldraw.com/static/cdgs/product_content/cdgs/2020/product-guide/cdgs2020-product-guide-en.pdf
5. <https://www.sculpteo.com/en/3d-learning-hub/3d-printing-software/best-cad-fashion-design-software/>

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. Corel Draw 11 for Windows: Visual Quick Start Guide
2. From Sue Chastain, your guide to Graphics software
3. David Huss, Gary W. Priester, Corel Draw Studio Techniques.
4. Corel Draw 10 for Windows: Visual Quick Start Guide.

5. Linnea Dayton, Cristen Gillespie, The Photoshop Cs/Cs2 Wow!
