Savitribai Phule Pune University, Pune

Maharashtra, India

Faculty of Science and Technology



National Education Policy (NEP) – 2020 Compliant Curriculum

TE Printing & Packaging Technology (2024 Pattern) in

Honors Course in

Advanced Packaging Technology

(With effect from Academic Year 2026 - 27)

Department of Printing & Packaging Technology

PREFACE

We, the members of the Board of Studies in Printing and Packaging Technology, are pleased to present the third Year Printing and Packaging Technology syllabus, effective from the Academic Year 2026-27. This curriculum will further progress into the Final Year during the Academic Year 2027–28. The printing and packaging industry continues to evolve rapidly, driven by technological innovations, sustainability demands, and advancements in digital printing, smart packaging, and material science. Recognizing the importance of staying aligned with these industry shifts, we have developed this comprehensive syllabus to equip students with both core engineering knowledge and hands-on skills essential to modern printing and packaging applications.

This syllabus has been carefully curated to provide a balanced academic experience, integrating theoretical concepts, laboratory practices, and exposure to emerging technologies. It adheres to the vision and framework of the National Education Policy (NEP) 2020 and aligns with the academic guidelines of Savitribai Phule Pune University, AICTE, UGC, and national accreditation standards. Emphasis has also been placed on interdisciplinary learning, industry relevance, and skill-based education. Students are encouraged to take advantage of self-learning opportunities through online courses, internships, minor projects, and certifications, which will complement their academic growth and enhance employability. The inclusion of value education, ethics, and sustainability also prepares them to meet the global challenges with responsibility and innovation.

We extend our sincere gratitude to the faculty members, students, alumni, industry professionals, and academic stakeholders for their valuable contributions and insights in shaping this forward-looking syllabus. We are confident that this curriculum will lay a strong foundation for students to become future-ready professionals and innovators in the printing and packaging domain.

-Dr. M. M. Bhoomkar,

Chairman and Members of Board of Studies (Printing and Packaging Technology)

Savitribai Phule Pune University

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Guidelines for Examination Scheme

Theory Examination: The theory examination shall be conducted in two different parts Comprehensive Continuous Evaluation (CCE) and End-Semester Examination (ESE).

Comprehensive Continuous Evaluation (CCE):

- CCE of 30 marks based on all the Units of course syllabus to be scheduled and conducted at institute level.
- Case studies included under each unit are intended to support applied learning and are part of Comprehensive Continuous Evaluation
- These case studies will be assessed through internal assessment components such as presentations, assignments, or group discussions. They shall not be included in the End-Semester Theory Examination.
- To design a Comprehensive Continuous Evaluation scheme for a theory subject of 30 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Sr.	Parameters	Marks	Coverage of Units
1	Unit Test	12 Marks	Units 1 & Unit 2 (6 Marks/Unit)
2	Assignments / Case Study	12 Marks	Units 3 & Unit 4 (6 Marks/Unit)
3	Seminar Presentation / Open Book Test/Quiz	06 Marks	Unit 5

Format and Implementation of Comprehensive Continuous Evaluation (CCE)

Unit Test:

Format: Questions designed as per Bloom's Taxonomy guidelines to assess various cognitive levels (Remember, Understand, Apply, Analyze, Evaluate, Create).

Implementation: Schedule the test after completing Units 1 and 2. Ensure the question paper is balanced and covers key concepts and applications.

Assignments / Case Study: Students should submit one assignment or one Case Study Report based on Unit 3 and one assignment or one Case Study Report based on Unit 4.

Format: Problem-solving tasks, theoretical questions, practical exercises, or case studies that require in-depth analysis and application of concepts.
Implementation: Distribute the assignments or case study after covering Units 3 and provide clear guidelines and a rubric for evaluation.

Seminar Presentation:

Format: Oral presentation on a topic from Unit 5, followed by a Q&A session.

Deliverables: Presentation slides, a summary report in 2 to 3 pages, and performance

during the presentation.

Implementation: Schedule the seminar presentations towards the end of the course. Provide students with ample time to prepare and offer guidance on presentation skills.

Open Book Test:

Format: Analytical and application-based questions to assess depth of understanding.

Implementation: Schedule the open book test towards the end of the course, ensuring it covers critical aspects of Unit 5.

Quiz:

Format: Quizzes can help your students practice existing knowledge while stimulating interest in learning about new topic in that course. You can set your quizzes to be completed individually or in small groups.

Implementation: Online tools and software can be used create quiz. Each quiz is made up of a variety of question types including multiple choice, missing words, true or false etc.

Evaluation and Feedback:

Unit Test: Evaluate promptly and provide constructive feedback on strengths and areas for improvement.

Assignments / Case Study: Assess the quality of submissions based on the rubric provided. Offer feedback to help students understand their performance.

Seminar Presentation: Evaluate based on content, delivery, and engagement during the Q&A session. Provide feedback on presentation skills and comprehension of the topic.

Open Book Test: Evaluate based on the depth of analysis and application of concepts. Provide feedback on critical thinking and problem-solving skills.

End-Semester Examination (ESE)

End-Semester Examination (ESE) of 70 marks written theory examination based on all the unit of course syllabus scheduled by university. Question papers will be sent by the University through QPD (Question Paper Delivery). University will schedule and conduct ESE at the end of the semester.

Format and Implementation

Question Paper Design: Below structure is to be followed to design an End-Semester Examination (ESE) for a theory subject of 70 marks on all 5 units of the syllabus with questions set as per Bloom's Taxonomy guidelines and 14 marks allocated per unit.

Balanced Coverage: Ensure balanced coverage of all units with questions that assess different cognitive levels of Bloom's Taxonomy: Remember, Understand, Apply, Analyze, Evaluate, and Create. The questions should be structured to cover:

Detailed Scheme for 70 Marks:

Unit-Wise Allocation (14 Marks per Unit): Each unit will have a combination of questions designed to assess different cognitive levels. By following this scheme, you can ensure a comprehensive and fair assessment of students understanding and application of the course material, adhering to Bloom's Taxonomy guidelines for cognitive skills evaluation.

Honors Course in Advanced Packaging Technology

Curriculum Structure

Year	Sem	Course Code	Course Name	Teaching Scheme		Examination Scheme					Credits		
				Theory	Practical	CCE	ESE	Termwork	Oral	Total	Theory	Practical	Total
T. E.	V	HAPT301 PPT	IOT in Printing and Packaging	3		30	70			100	3		3
		HAPT302 PPT	IOT in Printing and Packaging Laboratory		2			25	25	50	0	1	1
T. E.	VI	HAPT351 PPT	Smart Packaging	3		30	70			100	3		3
		HAPT352 PPT	Smart Packaging Laboratory		2			25	25	50	0	1	1
B. E.	VII	HAPT401 PPT	Sustainable Packaging	3		30	70			100	3		3
		HAPT402 PPT	Sustainable Packaging Laboratory		2			25	25	50	0	1	1
B. E.	VIII	HAPT451 PPT	Brand Centric Packaging Design	3		30	70			100	3		3
		HAPT452 PPT	Brand Centric Packaging Design Laboratory		2			25	25	50	0	1	1
		HAPT453 PPT	Honors Project		4			50	50	100		2	2
Total				**12**	**12**	**120**	**280**	**150**	**150**	**700**	**12**	**6**	**18**

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	IOT in Printing and Packaging					Semester	V		
Code	HAPT3 01PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits	3	L	T	P	CCE	ESE	TW	PR	OR
		3			30	70	25	-	25

Course Pre requisites: Digital Electronics, Microprocessors and Microcontrollers

Course Objectives:

1. To introduce fundamentals of Internet of Things and its relevance to printing and packaging industries.
2. To understand sensors, actuators and communication technologies used in industrial IoT.
3. To study IoT architectures, data flow and cloud platforms applicable to smart factories.
4. To analyse real-time monitoring, automation and traceability in printing and packaging processes.
5. To develop basic hands-on skills using low-cost IoT tools and simulations.

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1: Understand IoT concepts, components, and communication models.
CO2: Identify suitable sensors and actuators for printing and packaging applications.
CO3: Analyse IoT-based monitoring and control systems used in smart packaging and smart printing.
CO4: Apply cloud platforms and data visualization techniques for industrial data.
CO5: Demonstrate the ability to analyze, simulate, and document IoT-based monitoring solutions relevant to printing and packaging industries using low-cost tools and platforms.

Syllabus

Course Contents

Unit I	**Introduction to IoT and Industrial Applications**	**(08Hours)**
	Definition of Internet of Things, evolution from automation to Industry 4.0, IoT architecture layers, components of IoT systems, role of IoT in smart manufacturing, overview of printing and packaging industry challenges, need for digitization, benefits of IoT in productivity, quality and waste reduction	
Self Study	Study Industry 4.0 roadmap for printing and packaging industries.	**02Hours**
Unit II	**Sensors and Actuators for Printing and Packaging**	**08Hours**
	Classification of sensors, temperature, humidity, pressure, proximity, optical and gas sensors, actuators such as motors, relays, valves and solenoids, sensor characteristics, interfacing basics, role of sensors in print quality control, ink monitoring, machine condition monitoring and packaging safety.	
Self Study	Explore smart sensors used in high-speed printing machines.	**02Hours**
Unit III	**IoT Communication Technologies & Hardware Platforms**	**08Hour**
	Wired and wireless communication technologies, Wi-Fi, Bluetooth, ZigBee, LoRa and NFC, microcontroller platforms such as Arduino, NodeMCU and ESP32, data transmission models, gateways, power management issues, security basics in IoT networks	
Self Study	Compare Wi-Fi and LoRa for industrial IoT applications.	**02Hours**
Unit IV	**Cloud Platforms, Data Analytics and Visualization**	**06Hour**

	IoT data acquisition and storage, cloud platforms such as ThingSpeak and AWS IoT overview, data dashboards, alerts and real-time monitoring, basics of data analytics, predictive maintenance concept, role of cloud computing in printing plant monitoring.	
Self Study	Study digital dashboards used in smart factories.	**2Hours**
Unit V	**IoT Applications in Printing and Packaging**	**06Hours**
	Smart printing machines, real-time ink and substrate monitoring, predictive maintenance, RFID and IoT integration in packaging, smart labels and connected packaging, cold-chain monitoring, anti-counterfeiting systems, sustainability and waste reduction using IoT	
Self Study	Explore IoT-enabled smart packaging used in pharmaceutical industries.	**2Hours**
	Total	36 hours excluding self study
	Self Study	10 hours

Learning Resources:

Text Books:

[T1] A. Bahga and V. Madisetti, *Internet of Things: A Hands-On Approach*. Hyderabad, India: Universities Press, 2015.

[T2] A. Gilchrist, *Industrial Internet of Things*. Berkeley, CA, USA: Apress, 2016

Reference Books

[R1] R. Kamal, *Internet of Things*. New Delhi, India: McGraw-Hill Education, 2018.

[R2] T. Serrano, *Industry 4.0 and IoT*. Cham, Switzerland: Springer, 2019.

[R3] J. H. Han, *Smart Packaging Technologies*. Boca Raton, FL, USA: CRC Press, 2021.

Online Resources:

NPTEL – Introduction to Internet of Things- https://nptel.ac.in/courses/106/105/106105166/

NPTEL – Industry 4.0 and Industrial IoT - https://nptel.ac.in/courses/112/106/112106296/

Arduino Official Tutorials- https://www.arduino.cc/en/Tutorial/HomePage

NodeMCU & ESP8266 Resources - https://nodemcu.readthedocs.io/

ThingSpeak IoT Cloud Platform - https://thingspeak.com/

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology							
Course	IOT in Printing and Packaging Lab					Semester		V
Code	HAPT30 2PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits	1	L	T	P	CCE	ESE	TW	PR	OR
				4	-	-	25	-	25

Course Pre requisites: Digital Electronics, Microprocessors and Microcontrollers

Course Objectives:

1. **Understand** the Arduino development board and the use of TinkerCAD for IoT prototyping.
2. **Explain** the roles and applications of sensors in IoT systems.
3. **Apply** the interfacing of sensors and actuators with microprocessors.
4. **Implement** Wi-Fi communication by interfacing NodeMCU with IoT applications.
5. **Design and implement** IoT systems by interfacing Arduino with Bluetooth communication and peripheral I/O devices.

Course Outcomes:

After successful completion of the course, the learner will be able to:
On completion of the course, the student will be able to
CO1: Understand the various concepts, terminologies, and architecture of IoT systems
CO2: Compare and use of various development boards Arduino, Raspberry pi
CO3: Implement interfacing of various sensors, actuators to the development boards
CO4: Configure the ESP8266 Wi-Fi module
CO5: Configure the Bluetooth module and Implement the interfacing of I/O devices with IoT.

Tutorial and Term Work: (*Any Ten practical from Sr. No. 1 to 12)*

Term Work shall consist of following experiments:

1. Study of Arduino board.
2. Study of TinkerCAD.
3. Interfacing of Arduino board with temperature sensor
4. Introduction to Node MCU
5. Interfacing of LDR with Arduino and Node MCU
6. Temperature and humidity monitoring using sensor data.
7. Blink and control of LED using Arduino/NodeMCU
8. Sensor data upload and visualization using cloud platform
9. Interfacing of ultrasonic sensor using Arduino/NodeMCU
10. Interfacing of Motors using Arduino/NodeMCU/Rasberry pie
11. Interfacing of Switches using Arduino/NodeMCU/Rasberry pie
12. Interfacing of bluetooth using Arduino/NodeMCU/Rasberry pi

Mini project: *(Any One from Mini Project from Sr. No. 1 and 2)*

1. IoT-Based Environmental Monitoring for Printing and Packaging Units
2. IoT-Based Smart Package Counting and Proximity Detection System

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Smart Packaging						Semester		VI
Code	HAPT351PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits	3	L	T	P	CCE	ESE	TW	PR	OR
		3			30	70			

Course Pre requisites: Packaging Basics, Sensors, Controls

Course Objectives:

The objectives of the course are to enable students to:

1. **Interpret** the concepts, functions, and significance of packaging.
2. **Analyze** the role of absorbent and non-absorbent substrates in packaging applications.
3. **Interpret** the principles and industrial applications of smart packaging.
4. **Apply** RFID technology in packaging applications.
5. **Design and implement** NFC-enabled smart packaging solutions for industrial application

Course Outcomes:

After successful completion of the course, the learner will be able to:

CO1: Interpret the concepts, functions, and basic requirements of packaging.

CO2: Analyze the properties and applications of packaging materials for suitable packaging applications.

CO3: Evaluate the significance and industrial applications of smart packaging technologies.

CO4: Apply RFID technology for packaging, traceability, and supply chain applications.

CO5: Design and implement NFC-enabled smart packaging solutions for food and pharmaceutical applications

Syllabus

Course Contents

Unit I	**Introduction to Packaging**	**(08 Hours)**
	Need & Evolution of Packaging, Definitions of Packaging, Basic Requirements - Protection, Preservation, Containment, Machinability, Communication, Re-use and Recyclability, Types of Packaging, Packaging Hazards – Storage, Transportation, Chemical, Climatic, Biological.	
Self Study	Study the evolution, functions, and hazards of packaging using five commercial products.	**(02 Hours)**
Unit II	**Raw Materials in Packaging**	**(08 Hours)**
	Basic requirements of Packaging, Non-absorbent materials for Packaging such as Cellophane, Polyethylene, Polypropylene, PET A, PET G, Aluminum Foil, PVC, PS, Biodegradable and Eco-friendly Packaging, Absorbent materials such as Paper and Board, Wood, Glass and Metals, Properties, and Applications of the packaging materials.	
Self Study	Collect and compare different packaging materials based on properties, applications, and recyclability	
Unit III	**Basics of Smart Packaging**	**(02 Hours)**

	Introduction to smart packaging, concepts of active and intelligent packaging, need of smart packaging and Key features of smart packaging, Advantages of smart packaging, Types of intelligent packaging, interactive packaging, sensors and indicators-based packaging, selection strategies of intelligent packaging, Implementation examples of the smart packaging in various sectors like food packaging, pharma, and retail sectors	
Self Study	Study commercial applications of smart packaging in food, pharmaceutical, and retail sectors.	
Unit IV	**Introduction to RFID**	**(08 Hour)**
	RFID Principles and components, Types of tags, antenna and readers, Role of RFID in smart packaging, Communication in RFID, types of RFID Wireless Sensor Networks: History and Context, Node, Connecting nodes, Networking Nodes, WSN and IoT	
Self Study	Explore RFID applications in packaging and supply chain management through case studies	**(02 Hours)**
Unit V	**Introduction to Near Field Communications**	**(06 Hour)**
	Overview of NFC, Developments of NFC, NFC operating modes, modulation, NFC tag types, data transmission with NFC, programming with NFC, RF measurements, applications of NFC in the printing industry	
Self Study	Study NFC-enabled packaging applications for product authentication and consumer interaction.	**(02 Hours)**
	Total	36 hours excluding self study
	Self Study	10 hours

Text Books:

[T1] A. S. Athayle, (1992), Plastics in Packaging, Tata McGraw-Hill Publication.
[T2] A. S. Athayle, (1992), Plastics in Flexible Packaging, Multi-Tech Publishing.
[T3] S. Natarajan. M. Govindarajan, and B. Kumar, (2009), "Fundamental of Packaging Technology" PHI, New Delhi. [T4] Paul Butler, Joseph Kerry, Smart Packaging Technologies for Fast Moving Consumer Goods, 2008, Willy publisher [T5] Klaus Finkenzeller; Dorte Muller, RFID Handbook: Fundamentals and Applications in Contactless Smart Cards, Radio Frequency Identification and Near-Field Communication,2010, Wily telecom

Reference Books:

[R1] Walter Soroka, (2009), Fundamentals of Packaging Technology, Fourth Edition, Institute of Packaging Professionals.
[R2] Aaron L. Brody, Kenneth S. Marsh, (1997), Encyclopedia of Packaging Technology, 2nd Edition, A Wiley-Interscience Publication.
[R3] Panuwat Suppakul, Intelligent Packaging, Chapter in Handbook of Frozen Food Processing and Packaging, 2012, CRC PRESS, DOI:10.1201/b11204-46
[R4] Sheli McHugh, Near Field Communication: Recent Developments and Library Implications, 2014, Morgan & Claypool

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Smart Packaging Lab						Semester		VI
Code	HAPT352PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits	1	L	T	P	CCE	ESE	TW	PR	OR
				4			25		25

Course Pre requisites:

Course Objectives:

The objectives of the course are to enable students to:

1. **Interpret** the fundamentals, functions, and materials used in packaging.
2. **Analyze** the properties of packaging materials for conventional and smart packaging applications.
3. **Explain** the principles and industrial applications of smart packaging technologies.
4. **Evaluate** RFID and NFC technologies for packaging and supply chain applications.
5. **Develop** smart packaging concepts for food, pharmaceutical, and retail products.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Analyze packaging materials and their suitability for different packaging applications.
CO2: Evaluate conventional and smart packaging systems based on product requirements.
CO3: Demonstrate the principles and applications of RFID and NFC technologies in packaging.
CO4: Design smart packaging concepts for food, pharmaceutical, and retail products.
CO5: Develop a prototype or conceptual smart packaging solution using appropriate identification and communication technologies.

Syllabus

Tutorial and Term Work: (*Any Ten practical from Sr. No. 1 to 12)*

Term Work shall consist of following experiments:

List of Practical's:

1. Study different types of packaging and identify their functions, requirements, and packaging hazards.
2. Identify and compare packaging materials (paper, paperboard, plastics, metals, glass, wood, and biodegradable materials) based on their properties and applications.
3. Develop a material selection chart for a given product considering protection, sustainability, recyclability, and cost.
4. Study active, intelligent, and interactive packaging systems through industrial case studies.
5. Analyze smart packaging solutions used in the food, pharmaceutical, and retail sectors.
6. Study the components and working principles of RFID systems through product demonstrations and case studies.
7. Identify RFID applications in packaging, inventory management, and supply chain tracking.
8. Study NFC technology and demonstrate reading/writing NFC tags using an NFC-enabled smartphone and freely available mobile applications.
9. Compare RFID and NFC technologies based on frequency, communication range, applications, advantages, and limitations.
10. Design a smart packaging concept by integrating RFID/NFC technologies for a selected product.

11. Develop packaging artwork incorporating smart packaging elements such as RFID/NFC labels, QR codes, indicators, and consumer interaction features.
12. Design and present a complete smart packaging solution for a selected food, pharmaceutical, or retail product.

Mini Project: Design and present a complete smart packaging solution for a selected product including:

- Packaging material selection
- Packaging structure
- Smart feature selection
- RFID/NFC integration concept
- Sustainability considerations
- Consumer interaction flow
- Packaging artwork

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Sustainable Packaging						Semester		VII
Code	HAPT401PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits		L	T	P	CCE	ESE	TW	PR	OR
		3			30	70			

Course Pre requisites: Introduction to Packaging Concepts, Packaging Materials, and Processes

Course Objectives:

The objectives of the course are to enable students to:

1. **Interpret** the properties of packaging materials and various recycling methods.
2. **Explain** the principles and goals of sustainable packaging.
3. **Design** sustainable packaging solutions based on environmental and functional requirements.
4. **Analyze** the concepts and applications of the circular economy in packaging.
5. **Evaluate** the packaging life cycle and **recommend** appropriate sustainability communication and marketing strategies.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Analyze the properties of rigid and flexible packaging materials and their recycling techniques.
CO2: Develop sustainable packaging goals, products, and strategies for sustainability.
CO3: Evaluate different approaches to sustainable packaging design.
CO4: Apply the principles of the **3Rs (Reduce, Reuse, Recycle)** and the circular economy for waste reduction.
CO5: Calculate and **evaluate** the carbon footprint of packaging to assess its environmental impact

Syllabus

Course Contents

Unit I	**Packaging and Recycling**	**(08 Hours)**
	Defining Flexible Packaging, Flexible Packaging Categories, Selection Criteria of Flexible Packaging, Benefits of Flexible Plastic Packaging, Flexible Packaging versus Rigid Packaging, Limitations of Flexible Plastic Packaging, Issues with Multi-layer Plastic Packaging, Aluminum, Steel, Glass, Paper and Board, Metals, Recycling, Types of Recycling	
Self Study	Study the recycling process of different packaging materials and prepare a comparison of recyclable and non-recyclable packaging.	**(02 Hours)**
Unit II	**Sustainable Packaging**	**(08 Hours)**
	Introduction, Sustainable Goals, Packaging Materials in the Food Industry, Bio-Based and Biodegradable Food Packaging Materials, Renewable Packaging Materials, Edible Food Packaging Materials, Bio-Composites Materials, Food Packaging Sustainability, Sustainable Product Development, Strategy for Sustainability, Corporate and Brand Positioning, Supply Chain Management,	
Self Study	Explore sustainable packaging solutions adopted by leading food brands and prepare a brief case study.	**(02 Hours)**
Unit III	**Designing for Sustainability**	**(08 Hours)**

	Introduction, Effective Packaging, Efficient Packaging, Cyclic Packaging, Safe Packaging, Designing for Effective Packaging, Designing for Efficient Packaging, Designing for Cyclic Packaging, Designing for Safety, Material Selection, Compostable Packaging, Marketing Strategy for Sustainability, Understand and Engage with Stakeholders, Understand and Engage with Consumers, Communicating the Messages, Environmental Claims, ISO 14040, ISO 14044, ISO 14064, ISO 14065, ISO 14066	
Self Study	Analyze a commercial package based on sustainable packaging design principles and relevant environmental claims.	**(02 Hours)**
Unit IV	**Circular Economy**	**(06 Hours)**
	Key Concepts and Terminology, Linear Economy, Introduction, Need for Circular Economy, Benefits of Circular Economy, 3R's of Circular Economy, Negative Impacts of Plastics, Disposal, and Post-disposal, Waste Management, Plastics in Circular Economy, Business Models, Industry 4.0, and Circular Economy	
Self Study	Study the implementation of circular economy principles in the packaging industry through a real-world example.	**(02 Hours)**
Unit V	**Life Cycle Assessment in Packaging**	**(06 Hours)**
	Introduction, Need for Life Cycle Assessment, Need for Life Cycle Assessment, Green Packaging, Functions of LCA, Types of Packaging for LCA, Phases, and Processes in LCA, Levels of LCA, Life Cycle Assessment Tools, Issues related to Air Pollution, Landfills, and Marine Pollution, Life Cycle Assessment for Packaging Materials and Food Packaging, Green House Gas Emissions, Carbon Footprint Assessment, Future of LCA,	**(02 Hours)**
Self Study	Perform a basic life cycle assessment (LCA) of a selected packaging material and identify opportunities for reducing its carbon footprint.	
	Self Study	36 hours excluding self study
	Total	10 hours

Text Books:

[T1] Karli Verghese, Helen Lewis, Leanne Fitzpatrick, (2012), Packaging for Sustainability, Springer.
[T2] Wendy Jedlica, (2009), Packaging Sustainability, John Wiley and Sons

References:

[R 1] Ricardo Barra, Sunday A. Leonard, (2018), Plastics and Circular Economy
[R 2] Subramanian SenthilKannan Muthu, (2021), Sustainable Packaging, Springer
[R 3] McKinsey Center for Business and Environment, (2016), The circular economy: Moving from theory to practice
[R 4] Jon Dettling and Olivier Jolliet, (2010), Life Cycle Assessment and Packaging, PaperCon 2010, TAPPI
[R 5] Umberto Arena, Maria Laura Mastellone and Floriana Perugini, (2003), Life Cycle Assessment of a Plastic Packaging Recycling System, Plastic Packaging Recycling
[R 6] Kun-Mo Lee and Atsushi Inaba, (2006), Life Cycle Assessment Best Practices of ISO 14040 Series

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Sustainable Packaging Laboratory						Semester		VII
Code	HAPT402PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
		L	T	P	CCE	ESE	TW	PR	OR
Credits	1			2			25		25

Course Pre requisites: Introduction to Packaging Concepts, Packaging Materials, and Processes

Course Objectives:

The objectives of the course are to enable students to:

1. **Design** different types of packaging for diverse product applications.
2. **Analyze** the factors influencing the sustainability of packaging systems.
3. **Develop** sustainable packaging solutions based on product and environmental requirements.
4. **Plan** efficient packaging distribution systems to ensure product protection and logistics optimization.
5. **Evaluate** the packaging life cycle and its environmental impact and interpret sustainability marketing and communication strategies for packaging applications.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Design primary, secondary, and tertiary packaging for a given product.
CO2: Analyze the factors affecting the sustainability of packaging for a specific product.
CO3: Develop rigid or flexible sustainable packaging solutions based on application requirements.
CO4: Analyze packaging distribution systems to optimize product protection and logistics.
CO5: Evaluate the packaging life cycle for specific packaging applications and calculate the carbon footprint to quantify the environmental impact of a packaging life cycle

Syllabus

Guidelines for Laboratory Work:

The student shall complete the following hands-on activities as a Term Work under the guidance of the concerned faculty member.

Term Work:

The learner shall complete the following activities as a part of Term-Work:

1. Design a Primary Package for a given product with software such as Solid Works
2. Design a Secondary Package for a given product with software such as Solid Works
3. Design a Tertiary Package for a given product with software such as Solid Works
4. Package comparison of the same product based on sustainability criteria
5. Design a sustainable package for a given product with software such as Solid Works
6. Strategy for distribution system for a package with software such as TOPS or CAPE
7. Assessment of Packaging Life Cycle for a given application
8. Calculation of greenhouse gas emissions for a product

9. Estimate Emissions for Printing and Packaging
10. Presentation on Bio-degradable and Bio-compostable material

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Brand Centric Packaging Design						Semester		VIII
Code	HAPT45 1PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits	3	L	T	P	CCE	ESE	TW	PR	OR
		3			30	70			

Course Pre requisites:

Print package Layout Design, Advanced Print Package Design Layout, Material Science in Printing and Packaging, Introduction to Packaging Concepts, Advertising, and Multimedia

Course Objectives:

The objectives of the course are to enable students to:

1. Interpret the fundamental concepts of Brand-Centric Packaging Design.
2. Explain the need and significance of Brand-Centric Packaging Design.
3. Analyze the requirements for developing Brand-Centric Packaging Design solutions.
4. Develop a design-thinking approach for creating Brand-Centric Packaging Design solutions.
5. Evaluate the role of brand strategy and branding principles in developing effective packaging design solutions.

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Apply brand strategy principles to packaging design.
CO2: Analyze the parameters required to develop Brand-Centric Packaging Design solutions.
CO3: Evaluate Brand-Centric Packaging Design parameters for effective package development.
CO4: Develop Brand-Centric Packaging Design solutions using a design-thinking approach.
CO5: Integrate branding principles and brand strategy to create effective packaging design solutions.

Syllabus

Course Contents

Unit I	**Branding**	**(08Hours)**
	Introduction, Brand Strategy, consider overall business strategy, develop brand positioning, develop messaging strategy, develop brand name, logo, and tagline. Develop brand visual language. Develop Brand manual.	
Self Study	Study the branding strategy of a well-known product and identify its brand name, logo, tagline, and positioning	**02Hours**
Unit II	**Brand Manual**	**08Hours**
	What is a brand manual? Why is a brand manual important? The brand manual defines - the use of all graphic signs and their interpretations, such as color, size, typographies, icons, patterns, and textures associated with a brand. It helps establish a strong brand tone of voice (that resonates with the audience, essential for building brand awareness	
Self Study	Collect and analyze the brand manual of a popular company and summarize its key design guidelines.	**(02 Hours)**
Unit III	**Visual Language**	**(08 Hours)**
	What is a Visual Language? How to create a visual language? First, understand the Brand, Get to Know the customer, Identify the Key	

	Attributes that the brand wants to communicate, create signature design elements and design principles	
Self Study	Analyze the visual language of a selected brand by identifying its colours, typography, icons, patterns, and design elements	**(02 Hours)**
Unit IV	**Packaging Design Brief**	**(06 Hours)**
	Introduction to the packaging design brief: - Key Elements to a professional packaging design brief: - Understand the client's requirements. Audience Demographics and psychography understanding. The Scope of the Project. Category & Competitor Analysis. Deliverables & Deadlines, Mandatories.	
Self Study	Prepare a packaging design brief for a selected product, including target audience, competitor analysis, and project requirements.	**(02 Hours)**
Unit V	**Design-Thinking**	**(06 Hours)**
	Five Stages of Design Thinking methodology; Stage 1: Empathize—research consumers' needs. Stage 2: Define—analyze needs and problems. Stage 3: Ideate—explore creative ideas. Stage 4: Prototype—Create mockups. Stage 5: Test—with prospective consumers your Packaging design Solutions	**(02 Hours)**
Self Study	Apply the five stages of Design Thinking to develop a conceptual packaging design for a selected consumer product	
	Self Study	36 hours excluding self study
	Total	10 hours

Reference Books:

[R 1] Natarajan, S., Govindarajan, M., & Kumar, B. (2014). Fundamentals of Packaging Technology. PHI Learning Pvt. Ltd.

[R 2] Klimchuk, M. R., & Krasovec, S. A. (2013). Packaging design: Successful product branding from concept to shelf. John Wiley & Sons.

[R 3] Brown, S. (2016). Brands and Branding. Sage.

[R 4] DuPuis, S., & Silva, J. (2008). Package Design Workbook: The art and science of successful packaging. Rockport Publishers.

[R 5] Kapferer, J. N. (2012). The New Strategic Brand Management: Advanced Insights and Strategic Thinking. Kogan page publishers.

[R 6] Miller, D. (2017). Building a Story Brand: Clarify your message so customers will listen. HarperCollins Leadership.

[R 7] Szaky, T. (2019). The Future of Packaging: From Linear to Circular. Berrett-Koehler Publishers.

[R 8] Yayici, E. (2016). Design Thinking Methodology Book. Art Biz Tech.

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Brand Centric Packaging Design Laboratory						Semester		VIII
Code	HAPT4 52PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
Credits	1	L	T	P	CCE	ESE	TW	PR	OR
				2			25		25

Course Pre requisites: Design , Software tools

Course Objectives:

The objectives of the course are to enable students to:

1. Interpret the principles of branding and their role in packaging design.
2. Analyze brand identity elements and visual language for packaging applications.
3. Develop brand manuals and packaging design briefs based on industry requirements.
4. Design brand-centric packaging solutions using design-thinking principles.
5. Evaluate packaging designs for brand consistency, functionality, and market effectiveness

Course Outcomes:

On successful completion of the course, the student will be able to:

CO1: Develop a brand identity including brand name, logo, tagline, and visual language.
CO2: Prepare a comprehensive brand manual for packaging applications.
CO3: Analyze customer requirements, competitor products, and packaging design briefs.
CO4: Design brand-centric packaging solutions aligned with brand strategy.
CO5: Evaluate packaging designs for branding effectiveness, sustainability, and consumer appeal.

Syllabus

Guidelines for Laboratory Work:

The student shall complete the following hands-on activities as a Term Work under the guidance of the concerned faculty member.

Term Work:

1. Study and analyze branding elements (brand name, logo, tagline, colour palette, typography, and packaging identity) of successful Indian and global brands.
2. Develop a Brand Strategy Canvas for a selected product, including brand vision, mission, positioning, target audience, and value proposition.
3. Design a brand identity consisting of a brand name, logo, tagline, colour palette, and typography using graphic design software.
4. Create a Visual Language Board incorporating icons, patterns, textures, illustrations, imagery, and design principles for the selected brand.
5. Prepare a Brand Manual specifying logo usage, colour standards, typography, spacing, imagery, iconography, and brand communication guidelines.
6. Develop customer personas and perform demographic and psychographic analysis for the selected product.
7. Conduct category and competitor analysis of packaging and prepare a benchmarking report highlighting strengths and improvement opportunities.
8. Prepare a professional Packaging Design Brief including client requirements, project scope, target audience, mandatory information, deliverables, and project timeline.
9. Develop multiple packaging design concepts, mood boards, and rough sketches based on the

approved packaging design brief.

10. Create the final packaging artwork (label, carton, pouch, or box) using Adobe Illustrator or CorelDRAW following the approved brand guidelines.
11. Develop 2D and 3D digital packaging mock-ups using Adobe Dimension or Blender and evaluate brand consistency and visual appeal.
12. Present a complete Brand-Centric Packaging Design project incorporating the Brand Strategy, Brand Manual, Packaging Design Brief, Packaging Artwork, and 3D Packaging Mock-up

Program	Savitribai Phule Pune University Honors Course in Advanced Packaging Technology								
Course	Honors Project						Semester		VIII
Code	HAPT4 53PPT	Teaching Scheme (Hrs/Week)			Theory Examination Scheme		Laboratory Examination Scheme		
		L	T	P	CCE	ESE	TW	PR	OR
Credits	4			4			50		50

Course Objectives

1. To integrate knowledge gained from the Advanced Packaging Honors courses to address real-world printing and packaging problems.
2. To develop innovative packaging solutions through material selection, structural and graphic design, prototyping, digital tools, experimentation, or system integration.
3. To apply smart/connected packaging, IoT, sustainability, and brand-centric design principles as appropriate to the selected problem.
4. To promote literature review, interdisciplinary teamwork, project planning, industry interaction, research, and technical communication.
5. To evaluate packaging performance considering functionality, cost, consumer needs, safety, environmental impact, and professional ethics.

Course Outcomes

Upon successful completion of this course, the students will be able to:

CO1. Identify and formulate an industry-relevant problem in advanced packaging through literature review and needs assessment.

CO2. Design and develop a feasible packaging material, structure, prototype, or connected packaging solution using suitable tools and techniques.

CO3. Analyze experimental data and testing results to evaluate the functional, quality, sustainability, or consumer-related performance of packaging solutions.

CO4. Apply project management, teamwork, technical documentation, prototype demonstration, and oral presentation skills during project execution.

CO5. Recommend technically justified and responsible packaging solutions considering cost, usability, brand value, safety, and environmental aspects.

Suggested Project Domains

- Development of an IoT-based monitoring system for temperature and humidity in packaging storage or transport.
- Design of an intelligent package with temperature, freshness, tamper-evidence, or handling-status indication.
- Development of NFC/QR-enabled interactive packaging for product information, authentication, or consumer engagement.
- Design and evaluation of a low-cost RFID-based packaging traceability system.
- Prototype of a printed sensor or indicator for an advanced packaging application.

- Development of a sustainable mono-material packaging solution for a selected product.
- Comparative performance assessment of recyclable, compostable, bio-based, and conventional packaging materials.
- Design of reusable/returnable secondary packaging for a selected supply chain.
- Packaging redesign to reduce material consumption while maintaining protection and functionality.
- Lifecycle assessment or carbon-footprint comparison of alternative packaging formats.
- Design of brand-centric packaging using consumer research, visual identity, typography, and structural design.
- Redesign of food, personal-care, or consumer-product packaging for accessibility and improved user experience.
- Development of innovative protective or cushioning packaging and evaluation through physical testing.
- Investigation of packaging shelf-life performance using barrier and seal-property testing.
- Development of an e-commerce packaging design focusing on product protection, unboxing, and waste reduction.
- Design and prototyping of a folding carton, rigid box, label, or flexible package for a specific product.
- Data-based analysis of packaging defects, wastage, or quality parameters in a packaging line.
- Design of a packaging concept integrating smart features, sustainability, and branding.

Project Deliverables

- Literature Review and Problem Formulation: Review technical literature, product requirements, standards, and market or industry needs; state objectives and measurable performance criteria.
- Concept Development and System/Package Design: Present concept alternatives, material and process selection, specifications, drawings, artwork, architecture, or models, as applicable.
- Prototype, Simulation and/or Experimental Work: Develop a physical/digital package prototype, IoT setup, design model, or experimental study appropriate to the chosen project.
- Testing and Performance Evaluation: Carry out relevant measurements, material or package tests, consumer/functional evaluation, comparative analysis, and interpretation of results.
- Sustainability and Feasibility Assessment: Assess material efficiency, end-of-life considerations, cost, manufacturability, and applicable regulatory or safety constraints.
- Technical Report: Submit a comprehensive report covering literature review, objectives, methodology, design, observations, results, discussion, conclusions, references, and future scope.
- Demonstration and Presentation: Present the prototype/model, poster or presentation, and defend the work during oral evaluation.

- Supporting Documents: Submit design files, artwork, drawings, data sheets, test results, code, simulation files, photographs, and project logbook wherever applicable.

Project Guidelines

- The Honors Project may be carried out individually or in a group of not more than four students.
- The project shall be undertaken under the guidance of a faculty member from the Department of Printing and Packaging Technology. Co-guidance from industry or related disciplines may be considered.
- The project should demonstrate meaningful application or integration of knowledge from IoT in Printing and Packaging, Smart Packaging, Sustainable Packaging, and/or Brand Centric Packaging Design.
- Project work may involve packaging design, material development or selection, modelling, prototyping, software/IoT implementation, testing, experimentation, consumer study, process improvement, or case-study-based evaluation.
- Students should select a clearly defined, industry-relevant, innovative, socially useful, or sustainable problem and identify measurable success criteria at the proposal stage.
- Appropriate tools may include CAD/3D packaging design software, graphic design tools, spreadsheet/data analysis, Arduino/ESP32/NodeMCU-based IoT platforms, simulation tools, and suitable packaging test equipment, as relevant and available.
- Testing may include dimensions, compression, drop resistance, seal strength, barrier properties, optical/print quality, sensor response, usability, or other suitable tests. The test plan must match the project objectives and available facilities.
- Students shall maintain a weekly project diary/logbook documenting progress, reviews, design changes, observations, and individual contributions.
- Each group shall submit the report in the prescribed institute/university format along with prototypes and supporting documents, wherever applicable.
- The project shall culminate in a seminar or poster presentation, demonstration, and viva-voce before an evaluation committee.
- Projects shall follow professional ethics, laboratory safety, intellectual property rights, proper citation practices, and applicable packaging/food-contact requirements where relevant.
- Preference may be given to problems reflecting measurable technical improvement, realistic manufacturability, responsible material selection, and value for the packaging industry.

Learning Resources

1. Text Books / Reference Books

[R1] W. Soroka, Fundamentals of Packaging Technology, Institute of Packaging Professionals.

[R2] S. Emblem and H. Emblem (Eds.), Packaging Technology: Fundamentals, Materials and Processes, Woodhead Publishing.

[R3] G. L. Robertson, Food Packaging: Principles and Practice, CRC Press.

[R4] J. H. Han (Ed.), Innovations in Food Packaging, Academic Press.

[R5] R. Coles, D. McDowell, and M. J. Kirwan (Eds.), Food Packaging Technology, Blackwell Publishing.

2. Online / Technical Resources

[M1] National Programme on Technology Enhanced Learning (NPTEL): https://nptel.ac.in/

[M2] Bureau of Indian Standards: https://www.bis.gov.in/

[M3] Indian Institute of Packaging: https://www.iip-in.com/

[M4] GS1 India (identification and traceability): https://www.gs1india.org/

[M5] Sustainable Packaging Coalition: https://sustainablepackaging.org/

Note: Suggested domains, tests, and resources are illustrative; actual selection shall depend on the approved project scope and facilities available.