

Program Name : Diploma in Plastic Engineering
Program Code : PS
Semester : Fourth
Course Title : Plastics Packaging
Course Code : 22454

1. RATIONALE

Applications of plastics in substituting conventional materials used in packaging are increasing at a faster rate. One can start a packaging plant if having a prerequisite knowledge of it. This course intends to prepare the students to apply various packaging methods as per industrial requirement. Plastics diploma engineer (also called technologist) can also opt for career making in this field as an entrepreneur.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Operate plastic packaging machines and equipments.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

- Select suitable plastic material for specific packaging application.
- Operate plant for manufacturing flexible plastic packages.
- Operate plant for manufacturing rigid plastic packages.
- Apply relevant sealing and decorating technique to plastics packages.
- Determine strength of flexible and rigid packages by testing.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
L	T	P		Theory						Practical						
				Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	2	5	3	70	28	30*	00	100	40	25@	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the



course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

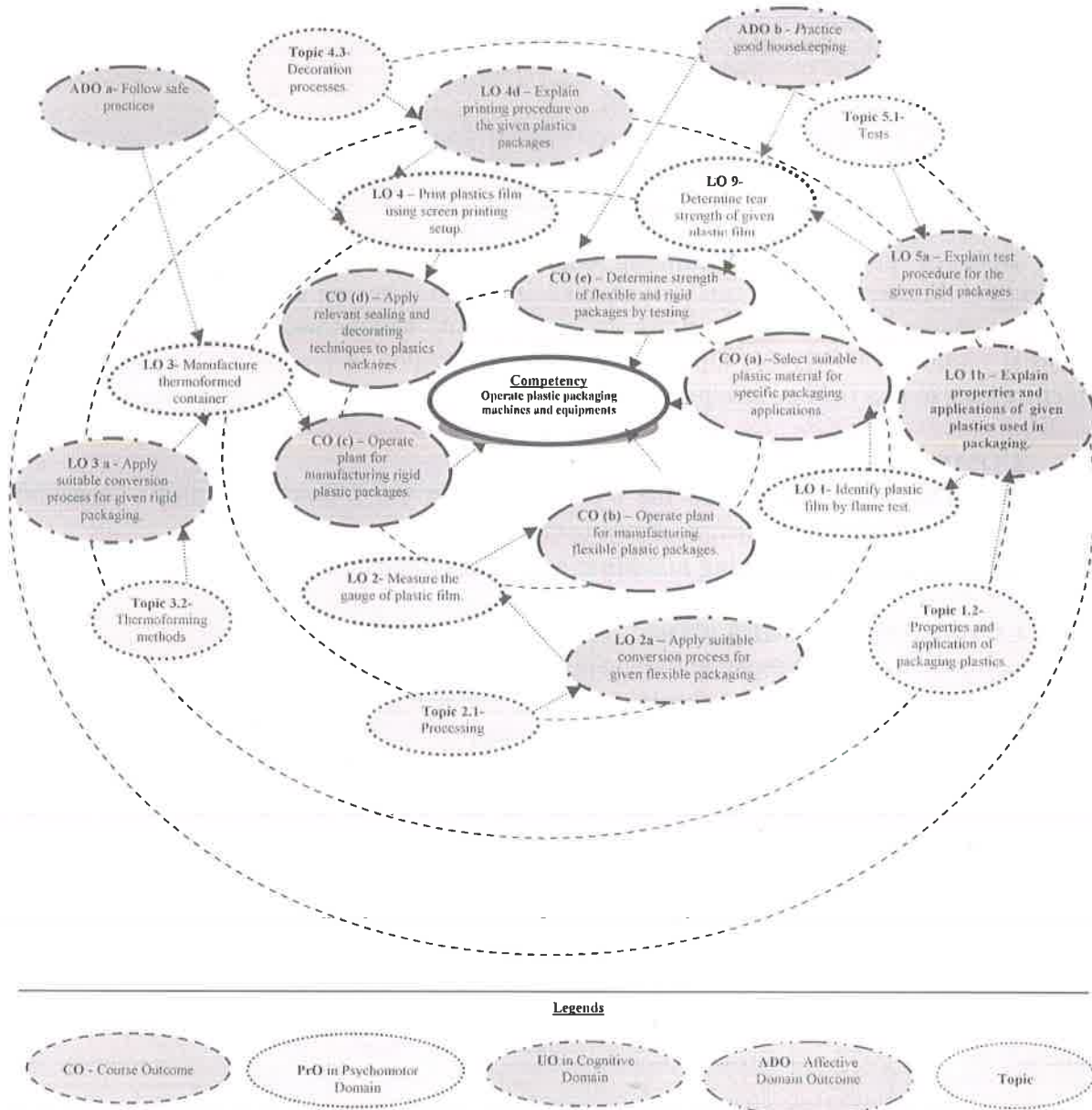


Figure 1 - Course Map

6. SUGGESTED PRACTICALS/EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency

S- No.	Practical Outcomes (PrOs)	Unit No.	Hours.
1	Identify plastic film by flame test.	I	04*
2	Measure the gauge of plastic film.	II	02*
3	Manufacture thermoformed container.	III	02*
4	Print plastics film using screen printing setup.	IV	02*
5	Prepare box strapping of carton packages.	IV	02
6	Shrink pack given product using plastic film and heat gun.	IV	02



7	Stretch wrap given product using plastic film.	IV	02
8	Prepare 2/3 side sealed pouch by thermal sealing of plastic film.	IV	04*
9	Determine tear strength of given plastic film.	V	04
10	Test plastics container for burst resistance using drop tester.	V	02*
11	Test plastics pouch for burst resistance using drop tester.	V	02*
12	Test vibration resistance of plastics bottles using vibration tester.	V	04

Note

- i. A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicious mix of minimum 24 or more practical LOs/tutorials needs to be performed, out of which, the practicals marked as “*” are compulsory, so that the student reach the ‘Precision Level’ of Dave’s ‘Psychomotor Domain Taxonomy’ as generally required by the industry.
- ii. Hence, the ‘Process’ and ‘Product’ related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and recording	10
5	Interpretation of result and conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		100

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

- a. Follow safe practices
- b. Practice good housekeeping
- c. Practice energy conservation
- d. Demonstrate working as a leader/a team member
- e. Maintain tools and equipment
- f. Follow ethical practices

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl’s ‘Affective Domain Taxonomy’ should gradually increase as planned below:

- ‘Valuing Level’ in 1st year
- ‘Organising Level’ in 2nd year
- ‘Characterising Level’ in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will use in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.



S. No.	Equipment Name with Broad Specifications	Expt. No.
1	Burner	1
2	Dial thickness gauge (Measuring Range 0-10mm, Resolution 0.001mm)	2
3	Vacuum forming machine- (Max. Forming area: - 508X600mm.,Max. Deep draw: - 100mm.,Max. Stroke length: -100mm,Max. Sheet width: - 640mm,Max. Sheet thickness: -1.2mm, Max. Reel dia.: - 400mm, Heating unit – 1, Heating zone – 4, Total heating capacity: - 9kw (14 no's X 650 watts- IR heater,) Vacuum pump: - 1hp-300l/min.)	3
4	Screen printing setup (print area- 15"x 20", electrical power- 1kw)	4
5	Box strapping clips and clamps.	5
6	Shrink tunnel (machine diameter L- 35, W-22, H-53, Chamber diameter- L- 20, W-16, H-6)	6
7	Stretch wrapping machine (Provides smooth, easy, noiseless release for use in busy, high-volume shipping departments, Size- 12"w x 1, 500 ft)	7
8	Heat sealing machine (Temperature zone: Two, Controller: Auto tuned PID controller with temperature range up to 200 deg C having resolution of 0.1 degree centigrade, Clamping Jaws : One fixed and second movable by pneumatic action, Day light: 50 mm , Sealing dimensions : Length 150 mm x Width 20 mm, Mounting: Table top, Power requirement : 230 Volts, 60 Hz, Single phase – 15 ampere)	8
9	Tear tester (Capacity-1600 g (can be increased to 3200/6400 gm),Clamping surfaces of each clamp 36 mm wide x 16 mm high, Distance between clamps- 2.8 mm,Tearing distance -43 mm, Scale reading 0 - 100% of range)	9
10	Drop tester for plastics container (1.2m adjustable equipped with motor mounting panel vertically movable)	10
11	Drop tester for plastics pouch (1.5m adjustable equipped with motor mounting panel vertically movable)	11
12	Vibration tester for plastics container (amplitude-120mm, frequency-180-360rpm,3-6 Hz, 3 phase, 2kw as per IS 27981998)	12

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics are to be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit-I Plastics in Packaging	1a. Compare the given plastics packaging technique with conventional one. 1b. Explain the properties and applications of the given plastics used in packaging. 1c. Identify the material of packaging.	1.1 Plastics packaging: Advantages, Functions, special requirements of food and medical packaging. 1.2 Properties and application of packaging plastics: PE, PP, PS, PVC, PET, PVAI, PVDC, EVA, EVOH, PA, PC, Fluoropolymers. 1.3 Selection criteria for packaging materials.
Unit-II Flexible	2a. Apply suitable conversion process for the given flexible	2.1 Processing: Cast film and blown film extrusion, multilayer film.



Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
packaging	packaging. 2b. Explain limitations of the given packaging. 2c. Explain the given specialised food packaging products.	Extrusion and adhesive lamination, Extrusion coating. 2.2 Advantages of flexible packaging. 2.3 Flexible packaging products and specialized packaging for food products (Aseptic and vacuum/modified atmosphere packaging).
Unit-III Rigid packaging	3a. Apply suitable conversion process for the given rigid packaging. 3b. Explain limitations of the given rigid packaging. 3c. Describe processing of foams for the given packaging.	3.1 Blow moulding: Extrusion and injection blow moulding. 3.2 Thermoforming methods: drape forming, pressure forming, vacuum forming, plug-assist forming, bubble forming, vacuum snap-back forming, matched mould forming, scrap-less thermoforming, dual sheet forming, melt- to- mould thermoforming, skin packaging, blister packaging and thermoform-fill-seal system. 3.3 Packaging Foams: PS (expanded, moulded and extruded), PU.
Unit- IV Conversion Processes	4a. Differentiate among the given conversion processes. 4b. Describe applications of the given conversion processes. 4c. Select suitable sealing method for the given packages. 4d. Explain printing procedure on the given plastics packages.	4.1 Skin, Shrink and Blister packaging, Stretch Wrapping, Pouching, Bag making. 4.2 Sealing methods: Bar, Band, Impulse, Wire, Ultrasonic, Friction, Gas, Contact, Hot melt, Dielectric, Induction and solvent sealing. 4.3 Decoration processes: Hot stamping, Screen printing, Pad printing, Flexographic printing, Rotogravure printing, In-mould decoration, Labelling, Vacuum metallization. 4.4 Form-Fill-Seal: vertical and horizontal
Unit -V Testing	5a. Explain test procedure for the given rigid packages. 5b. Explain test methods for the given flexible packages. 5c. Describe packaging hazards for the given plastic industry. 5d. Interpret result for the given package tests.	5.1 Tests: Compatibility. Product loss, stress crack resistance, migration test, stack load test, drop test and vibration test. 5.2 Packaging hazards and their controls.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.



9. SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title SUGGESTED	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Plastics in Packaging	08	04	04	04	12
II	Flexible packaging	10	02	06	06	14
III	Rigid packaging	12	04	04	08	16
IV	Conversion Processes	12	04	06	08	18
V	Testing	06	02	04	04	10
Total		48	16	24	30	70

Legends: R–Remember, U–Understand, A=Apply and above (Bloom's Revised taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of ULOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

- Collect information on advances in plastics packaging and sealing.
- Collect samples of plastics pouches and different containers.
- Collect IS standards for Plastics used in food packaging.
- Prepare list of flexible packaging with examples.
- Prepare list of rigid packaging with examples.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- 'L' in item No. 4 does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
- About **15-20% of the topics/sub-topics** which is relatively simpler or descriptive in nature is to be given to the students for **self-directed learning** and assess the development of the COs through classroom presentations (see implementation guideline for details).
- With respect to item No.10, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Use Flash/Animations to explain various topics in packaging technology.
- Guide student(s) in undertaking micro-projects

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work



and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty. Students should conduct following activities in group and prepare reports of about 4 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews.

- a. **Presentation:** Collect the information about government regulations and norms for plastics packaging material and prepare power point presentation.
- b. **Report writing:** Prepare a report of industrial visit to packaging industry.
- c. **Video Show:** Download videos of package conversion, decoration processes and show in front of the class.
- d. **Chart Preparation:** Prepare a chart on recycling of plastic packaging materials.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Handbook of Packaging- Plastics	Athaley, A. S.	Multi-Tech Publishing Company, 1999 ISBN: 9788187070023
2	Plastics Packaging: Properties, Processing, Applications and Regulations	Selke, S. L.; Hernandez, R. J.; Culter, J.	Hanser Gardner Publications, 2005 ISBN: 978-1569903728
3	Food Packaging Science and Technology	Lee, D.S.; Yam, K.L.; Piergiovanni, L.	CRC Press, 2008 ISBN: 978-0824727796
4	Plastic Films in Food Packaging	Bristoll, J.	Elsevier Publications, 2012 ISBN: 9781455731121

14. SOFTWARE/LEARNING WEBSITES

1. www.popularplastics.com
2. www.omnexus.com
3. www.plasticspackaging.com
4. www.abc.net.au/btn/story/s4422480.htm
5. www.ippopress.org/global-trends-in-plastics-packaging-tokyo-pack-2014/
6. www.sonoco.com/productsandservices/flexibles/flexiblepackagingbenefits.aspx
7. www.plasticstoday.com/content/slippery-coating-inside-plastic-packaging-enables-viscous-liquids-slide-easily/60248992820880/page/0/1
8. www.ndl.iitkgp.ac.in



