



GUJARAT TECHNOLOGICAL UNIVERSITY

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

Diploma Engineering Syllabus (Semester VII)

Subject Code : 4372304

Subject Name : Design for Plastic Products

| Diploma programme in which this course is offered | Semester in which offered |
|---|---------------------------|
| Plastics Engineering (Sandwich Pattern) | 7th |

1. RATIONALE

Product designing is related with entire spectrum of materials, processes, testing and technical aspects. In this course, student will learn design considerations to strengthen the product as well as broaden the applications of it. Proper material selection is a key to success of product. Process selection also needs knowledge of variety of processes out of which finding out the best fit for the given product. Wide range of products from different field like Automobile, Telecommunications, Power transmission, Medical etc require continuous efforts in refining design.

2. COMPETENCY

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

- Design various plastic products by choosing best material, process and technical aspects to fulfill end users requirements.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

- Identify the factors which affect product design.
- Draft a design for a plastic product.
- Select a proper material for a product.
- Select an appropriate process to manufacture a product.
- Develop a commercialisable product design.

3. TEACHING AND EXAMINATION SCHEME

| Teaching Scheme (In Hours) | | | Total Credits (L+T/2+P/2) | Examination Scheme | | | | |
|-------------------------------|---|---|------------------------------|--------------------|----|-----------------|----|-------------|
| L | T | P | | Theory Marks | | Practical Marks | | Total Marks |
| | | | CA | ESE | CA | ESE | | |
| 3 | 0 | 2 | 4 | 30* | 70 | 25 | 25 | 150 |

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment 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, CA – Continuous Assessment; ESE – End Semester Examination.



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5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the COs. *Some of the PrOs marked '*' are compulsory, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.*

| Sr. No. | Practical Outcomes (PrOs) | Unit No. | Approx. Hrs. required |
|---------|---|----------|-----------------------|
| 1 | Study and List the factors affecting plastic product design. | 01 | 02 |
| 2 | Prepare a product design flow chart. | 01 | 02 |
| 3 | Study and list product design steps. | 01 | 02 |
| 4 | Prepare a check list for plastic product design. | 02 | 02 |
| 5 | Analyze wall thickness variation in product design. | 02 | 02 |
| 6 | List and signifies technical aspects in plastic product design. | 02 | 04 |
| 7 | Tabulate & compare properties of various plastic materials. | 03 | 04 |
| 8 | Study variety of plastic processing techniques. | 04 | 02 |
| 9 | Design procedure for a product – Disposable cup | 05 | 04 |
| 10 | Design procedure for a product – Overhead water storage tank. | 05 | 04 |
| | Total | | 28 |

Note

- More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

| S. No. | Sample Performance Indicators for the PrOs | Weightage in % |
|--------|--|----------------|
| 1 | Prepare of experimental setup | 20 |



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| S. No. | Sample Performance Indicators for the PrOs | Weightage in % |
|--------------|--|----------------|
| 2 | Operate the equipment setup or circuit | 20 |
| 3 | Follow safe practices measures | 10 |
| 4 | Record observations correctly | 20 |
| 5 | Interpret the result and conclude | 30 |
| Total | | 100 |

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

| S. No. | Equipment Name with Broad Specifications | PrO. No. |
|--------|--|----------|
| 1 | Drawing board | 01-02 |
| 2 | T square / Set square | 02 |
| 3 | UTM machine | 03 |
| 4 | ESCR tester | 05 |
| 5 | Prototype fabricator kit | 03-04-05 |

7. AFFECTIVE DOMAIN OUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the above mentioned COs and PrOs. More could be added to fulfil the development of this competency.

- a) Work as a leader/a team member.
- b) Follow ethical practices.
- c) Practice environmental friendly methods and processes to avoid metal waste.

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1st year



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- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

| <i>Unit</i> | <i>Unit Outcomes (UOs)</i> (4 to 6 UOs at Application and above level) | <i>Topics and Sub-topics</i> |
|--|--|--|
| Unit – I Introduction To Product Design | 1a. Understand difference between design & drawing 1b. Know the factors affecting product design 1c. Know importance of end user's requirements 1d. Define product design | 1.1 Introduction to product design 1.2 Difference between drawing & design 1.3 Product design flow chart 1.4 Factors affecting product design 1.5 Steps involved in product design |
| Unit – II Product Design Considerations | 2a. Know Preliminary design considerations 2b. Know general design considerations 2c. Evaluate prototype product 2d. Refinement in product design | 2.1 Check list for product design 2.2 Preliminary design considerations 2.2.1 End user's requirements 2.2.2 Drafting preliminary design 2.2.3 Prototyping the design 2.2.4 Testing the design 2.2.5 Taking a second look 2.2.6 Writing meaningful specifications 2.2.7 Setting up production 2.2.8 Assuring the quality 2.3 General design considerations related to 2.3.1 Wall thickness |



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| <i>Unit</i> | <i>Unit Outcomes (UOs)</i> (4 to 6 UOs at Application and above level) | <i>Topics and Sub-topics</i> |
|--|---|--|
| | | 2.3.2 Fillet & Radii 2.3.3 Ribs & Bosses 2.3.4 Undercuts 2.3.5 Taper or Drafts 2.3.6 Holes 2.3.7 External & Internal threads 2.3.8 Inserts 2.3.9 Parting lines 2.3.10 Surface treatments 2.3.11 Molded lettering 2.3.12 Snap fitting |
| UNIT III Material Selection | 3a. Know the available plastic materials 3b. Tabulate properties of available plastic materials 3c. Implement screening method for material selection 3d. Use of compounding to achieve desired properties | 3.1 Concept of Material selection 3.1.1 Listing out available materials 3.1.2 Mapping of properties with end user's requirements 3.1.3 Screening method 3.1.4 Identifying missing properties in selected material 3.1.5 Use of compounding to fulfil missing properties in selected material 3.2 Long term & Short term properties of plastic materials 3.3 Cost effectiveness of selected material |
| UNIT IV: Process Selection | 4a. List out available plastic processing techniques 4b. Mapping out present infrastructure with required 4c. Selection criterion based on production lot size. 4d. Effect of material, size & shape of product on | 4.1 List of variety of plastic processing techniques 4.2 Identifying features of products made by different processes 4.3 Impact of size & shape of product on process selection 4.4 Effect of quantity of products to be made on process selection 4.5 Manual, Semi-automatic & automatic process with respect to |



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| Unit | Unit Outcomes (UOs) (4 to 6 UOs at Application and above level) | Topics and Sub-topics |
|---------------------------------|---|--|
| | process selection. | product design |
| UNIT V: Case Studies | 5a. Design procedure for pipe 5b. Design procedure for overhead tank 5c. Design procedure for contact lens 5d. Design procedure for disposable cup | 5.1 Pipe 5.2 Disposable cup 5.3 Overhead water tank 5.4 Contact lens 5.5 Gear 5.6 Chemical container 5.7 Wind mill blade 5.8 O-ring / Seal 5.9 Food package 5.10 Weather shades |

Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

| Unit No. | Unit Title | Teaching Hours | Distribution of Theory Marks | | | |
|--------------|--------------------------------|----------------|------------------------------|-----------|-----------|-------------|
| | | | R Level | U Level | A Level | Total Marks |
| I | Introduction to product design | 07 | 06 | 04 | 02 | 12 |
| II | Product design considerations | 14 | 06 | 08 | 10 | 24 |
| III | Material selection | 06 | 04 | 04 | 02 | 10 |
| IV | Process selection | 07 | 04 | 06 | 02 | 12 |
| V | Case studies | 08 | 02 | 02 | 08 | 12 |
| Total | | 42 | 22 | 24 | 24 | 70 |

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

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.

10. SUGGESTED STUDENT ACTIVITIES



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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: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

1. Students will collect information related to the experiment through internet.
2. Students will collect different plastic products and evaluate its design concepts.
3. Students will tabulate variety of plastic products and their material and process.

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:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) Guide student(s) in undertaking micro-projects.
- c) '**L**' in **section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- d) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- e) With respect to **section No.11**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- f) Guide students on how to address issues on environment and sustainability.
- g) Visit to nearby industries/workshops
- h) Video/animation films on Principle of plastic product design.
- i) Video/animation films on various technical features of plastic products.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably 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. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in



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fact, an integration of PrOs, UOs and ADOs. 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. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- Prepare a chart for different types of plastics materials available.
- Prepare a chart for variety of plastic processing techniques.
- Prepare chart for features of products made by different processing techniques.
- Collect products made with ribs & bosses.
- Collect products made with fillets & radii.
- Collect various types of products with wall thickness variations.

13. SUGGESTED LEARNING RESOURCES

| Sr. No. | Title of Book | Author | Publication with place, year and ISBN |
|---------|--|-------------------------------------|---------------------------------------|
| 1. | Product design with plastics | J.B.Dym | Industrial press inc. New York |
| 2. | Plastic product design Handbook | Edward Miller | Marcel Dekker Inc. New York |
| 3. | Plastic product design | R.D.Back | |
| 4. | Plastic product design engg. Hand book | Levy & Dubois | Van Nostrand Reinhold |
| 5. | Plastics Engineered Product Design | Dominick V.Rosato & Donald V.Rosato | Elsevier Advance Technology U.K. |
| 6. | Plastics: Product Design and Process Engineering | Harold Balofsky | Hanser Publications |
| 7. | The Complete Part Design Handbook | E. Alfredo Campo | Hanser Publications |
| 8. | Understanding Product Design for Injection Molding | Herbert Rees | Hanser Publications |

14. SOFTWARE/LEARNING WEBSITES

- <https://www.apisolution.com/plastic-design-guide.php>



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2. <https://idsys.com/plastic-product-design/>
3. <https://www.youtube.com/watch?v=kd72OheMI18>
4. <https://www.youtube.com/watch?v=hMNIwnXL5ko>
5. <https://www.youtube.com/watch?v=RK0J5hNbZUw>

15. PO-COMPETENCY-CO MAPPING

| Semester VII | Plastic Product Design (Course Code: 4372304) | | | | | | | | | |
|---|---|--------------------------|---|--|---|----------------------------|----------------------------|--|---|----------------------|
| | POs and PSOs | | | | | | | | | |
| Competency & Course Outcomes | PO 1 Basic & Discipline specific knowledge | PO 2 Problem Analysis | PO 3 Design/development of solutions | PO 4 Engineering Tools, Experimentation & Testing | PO 5 Engineering practices for society, sustainability & environment | PO 6 Project Management | PO 7 Life-long learning | PSO 1 An ability to apply principles of material selection, product & mold/die design and development in plastic engineering. | PSO 2 An ability to conduct safe and environment friendly manufacturing and recycling of plastic products. | PSO 3 (If needed) |
| Competency <i>Design various plastic products by choosing best material, process and technical aspects to fulfill end users requirements.</i> | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | - |
| Course Outcomes | | | | | | | | | | |
| 1. Identify the factors which affect product design. | 1 | 3 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | - |
| 2. Draft a design for a plastic product. | 1 | 2 | 3 | 2 | 2 | 1 | 2 | 2 | 1 | - |
| 3. Select a proper material for a product. | 1 | 2 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | - |
| 4. Select an appropriate process to manufacture a product. | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | - |



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| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 5. Develop a commercialisable product design. | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | - |
|---|---|---|---|---|---|---|---|---|---|---|

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

| Sr. No. | Name and Designation | Institute | Contact No. | Email |
|---------|---|--------------------|-------------|-------------------------|
| 1 | Shri Dharmendra M. Makwana Head of Plastic Engineering | G.P., Valsad | 9426359006 | 1224dmm@gmail.com |
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| 3 | Shri Darshan B Joshi Lecturer in Plastic Engineering | G.P., Ahmedabad | 9426346240 | dbjoshi15469@gmail.com |
| 4 | Shri Ajaykumar S. Amin Lecturer in Plastic Engineering | G.P., Valsad | 9426044254 | ajayamin@gpvalsad.ac.in |