GUJARAT TECHNOLOGICAL UNIVERSITY

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

Diploma Engineering Syllabus (Semester VII)

Subject Code : 4372301

Subject Name : Advance Plastic Processing Techniques

Diploma programme in which this course is offered	Semester in which offered
Plastics Engineering (Sandwich Pattern)	Seventh

1. RATIONALE

The Updation in various processing field make huge impact on production capacity of product. Such advancement is also there in field of plastic processing. The advancement in main processing techniques like injection moulding, Extrusion moulding & Blow moulding are required to learn by students for their knowledge updation in final year. Hence the course is designed to deals with advancement in plastic processing techniques.

2. COMPETENCY

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

- **Operate, set process parameters and control Advanced Injection molding machine, Extrusion plant and Blow molding machine.**

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:

a) Select advance injection moulding techniques for a non-conventional product.
b) Describe Reaction Injection Molding & select process for suitable parts.
c) Appreciate the need of advance features in extruder.
d) Select specialized extrusion processes for non-conventional extrusion product.
e) Select appropriate miscellaneous blow moulding process for various products.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	4	5	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.*

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	Set processing parameters & Operate gas assisted injection molding machine for given product.	I	06
2	Set mold, processing parameters & Operate sandwich injection molding machine for given product.	I	06
3	Operate multi-colour injection molding machine for given product.	I	06
4	Set mold and process parameters for given product of RIM process.	II	04
5	Operate Co extrusion multi-layer film plant with changing process parameters.	III	08
6	Operate Twin screw Extruder for PVC pipe plant.	III	08
7	Study manufacturing of Nylon braided pipes.	IV	02
8	Study manufacturing of Corrugated pipes.	IV	02
9	Set processing parameters & Operate injection stretch blow molding machine for given product.	V	08
10	Perform Neck ring process for given product.	V	06
	Total		**56**

Note

i. *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.*

ii. *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/Equipment	20
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	Gas assisted injection molding machine	1
2	Sandwich injection molding machine	2
3	Multi colour injection molding machine	3
4	Reaction Injection molding machine	4
5	Multi-Layer Film Plant	5
6	Twin Screw Extruder	6
7	Injection stretch blow molding machine	9
8	Extruder	10
9	Neck ring mechanism	10

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
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.

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
Unit – I Advanced Injection Molding Processes	1a. Explain various non-conventional injection molding processes 1b. Make choice of suitable material for advanced injection processes 1c. List merits & demerits of advanced injection processes 1d. Suggest suitable injection molding process for given part	• Material, process, advantages and disadvantages & applications of the following processes: 1.1 Gas-assisted injection molding 1.2 Sandwich injection molding 1.3 Structural foam injection molding 1.4 Flow molding 1.5 Metal filled injection molding 1.6 Multicolour molding 1.7 Injection molding of reinforced

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
		thermoplastics
Unit – II **Reaction Injection Molding (RIM)**	2a. Describe RIM process 2b. Understand variables of RIM process 2c. Select suitable material for RIM 2d. Explain various auxiliary equipments 2e. List merits and demerits of RIM process	2.1 Introduction to RIM process 2.2 Materials and additives 2.3 RIM process and variables 2.4 Flow diagram of RIM process 2.5 Machine & auxiliary equipments 2.6 Merits and demerits of RIM process 2.7 Applications of RIM
UNIT III **Advanced Extrusion Process & Machines**	3a. Understand advanced extruder design 3b. Distinguish between various screw designs 3c. List merits of co-extrusion 3d. Suggest suitable cooling for film plant 3e. Understand uses of adhesive in extrusion	3.1 Co- Extrusion 3.1.1 Co-extrusion structures 3.1.2 Barrier materials & adhesives 3.1.3 Comparison: Feed block die and multi manifold die 3.1.4 Advantages of co-extrusion products. 3.1.5 Applications of Co-Extrusion 3.2 Advanced Extruder Machine 3.2.1 Twin screw Extruder • Intermeshing and non-Intermeshing • Counter rotating and co-rotating • Comparison with single screw 3.2.2 Vented Screw Extruder 3.2.3 Internal Bubble cooling
UNIT IV: Specialized Extrusion Processes	4a. Describe process of braided & hose pipe 4b. Describe process of fishing net	4.1 Nylon braided pipes 4.2 Hose pipe 4.3 Fishing net

Unit	*Unit Outcomes (UOs)* (4 to 6 UOs at Application and above level)	*Topics and Sub-topics*
	4c. Describe process of shrink film & cling film 4d.Describe process of Corrugated sheets and pipes	4.4 Heat shrink film 4.5 Cling film 4.6 Corrugated sheets and pipes
UNIT V: Advanced Blow Molding Processes	5a. Understand the stretch blow molding process 5b. Differentiate various process 5c. Identify co extrusion blow molding 5d. Understand various miscellaneous blow molding techniques 5e. Suggest suitable blow molding process for given part	5.1 Stretch Blow Molding 5.1.1 Introduction 5.1.2 Single stage & two stage processes and its comparison 5.1.3 Orientation and stretch ratio 5.1.4 Pre-forming 5.1.5 Extrusion stretch blow molding 5.1.6 Injection orientation blow molding 5.2 Co-Extrusion Blow Molding 5.2.1 Co-extrusion equipment 5.2.2 Process 5.3 Miscellaneous Blow Molding Processes 5.3.1 Neck ring process 5.3.2 Drape process 5.3.3 Dip / displacement processes 5.3.4 Blow molding of irregular shaped parts

***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	Advanced Injection Molding Processes	12	8	8	4	20

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
II	Reaction Injection Molding (RIM)	06	4	4	2	10
III	Advanced Extrusion Process & Machines	08	4	4	6	14
IV	Specialized Extrusion Processes	06	4	4	2	10
V	Advanced Blow Molding Processes	10	4	8	4	16
Total		**42**	**24**	**28**	**18**	**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

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 various plastic articles & analyze for its process.
2. Students will visit nearby process industry related to advance plastic processing.
3. Students will read various papers on internet regarding various processes.

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 Advance injection molding, RIM, Advance extrusion & Blow molding.

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 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:

a) Prepare a chart for different advanced plastic processes.
b) Collect products made up of advance injection molding.
c) Collect products made up of advance extrusion molding.
d) Collect products made up of advance blow molding.
e) Make model for sandwich injection mold.
f) Make model for RIM.
g) Prepare report on various process variables for advance plastic processes.
h) Make display for various product prepared by advance plastic processes.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN

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1.	Injection molding handbook	Dominick V. Rosato, Donald V. Rosato, Marlene G. Rosato	Publication: Springer Science & Business Media, LLC Publication Year:2000 ISBN: 978-1-4613-7077-2, 978-1-4615-4597-2
2.	Reaction injection moulding	Walter E. Becker	Publication: DA Information Services Publication Year: 1979 ISBN: 0442206313, 978-0442206314
3.	Injection Molding Alternatives: A Guide for Designers and Product Engineers	Jack Avery	Publication: Hanser Pub Inc Publication Year: 1998 ISBN: 1569902518, 978-1569902516
4.	Plastics Extrusion technology handbook	Sidney Levy & James F. Curley	Publication: Industrial Press Inc., Publication Year: 1989 ISBN: 0-8311-1185-2
5.	Extrusion of plastics	E G Fisher	Publication: Plastics and Rubber Institute Publication Year: 1976 ISBN: 0470150122, 9780470150122
6.	Plastic Extrusion Technology	Hensen Friedhelm	Publication: Hanser Gardener Publishers, NewYork Publication Year: 1989 ISBN: 9780195207606
7	Blow Moulding of Plastics	E G Fisher	Publication: Butterworth-Heinemann Publication Year: 1971 ISBN: 9780592054384
8.	Plastic Blow Moulding Handbook	N.C. Lee	Publication: Springer Dordrecht Publication Year: 2012 ISBN: 9789401169905

14. SOFTWARE/LEARNING WEBSITES

1. https://www.bpf.co.uk/plastipedia/processes/Default.aspx#injectionmouldinggasassisted
2. https://www.bpf.co.uk/plastipedia/processes/Default.aspx#injectionstretchblowmoulding
3. https://www.hanserpublications.com/SampleChapters/9781569906033_9781569906033_LPR.pdf

4. https://www.scribd.com/presentation/481496088/Advanced-Injection-Moulding
5. https://www.youtube.com/watch?v=pcwyCvwDp1U
6. https://www.youtube.com/watch?v=so9OyGGlCv4
7. https://www.youtube.com/watch?v=AAvOYz7qOsw
8. https://www.youtube.com/watch?v=vGhGxuAGOIo
9. https://www.youtube.com/watch?v=qtweiXnnFMg

15. PO-COMPETENCY-CO MAPPING

Semester VII	Advance Plastic Processing Techniques (Course Code: 4372303)									
	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 **Operate, set process parameters and control Advanced Injection molding machine, Extrusion plant and Blow molding machine.**	3	2	2	3	2	1	2	3	2	-
Course Outcomes 1. Select advance injection moulding techniques for a non-conventional product.	3	1	1	2	2	1	2	3	2	-
2. Describe Reaction Injection Molding & select process for suitable parts.	2	1	1	2	2	1	1	2	2	-
3. Appreciate the	2	1	1	3	2	1	2	3	2	-

need of advance features in extruder.										
4. Select specialized extrusion processes for non-conventional extrusion product.	3	2	2	2	2	1	2	3	2	-
5. Select appropriate miscellaneous blow moulding process for various products.	2	1	1	2	2	1	2	3	2	-

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

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