GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Plastic Extrusion Technology
(Course Code: 4332304)

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

1. RATIONALE

Plastics extrusion technology is the most widely used processing technique for plastic materials. A polytechnic diploma engineer has to use this technology in the extrusion machines and production process of various extruded products. The knowledge of extrusion technology will also help to understand and develop advance extrusion processes. Hence the course has been designed to develop this competency and its associated cognitive, practical and affective domain learning outcomes.

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 various extrusion plants to obtain production of desired quality (by setting process parameters)

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) Operate extruder machine.
b) Select appropriate material for extrusion process.
c) Troubleshoot problems in extrusion process.
d) Perform post moulding operations in extrusion process.
e) Use auxiliary equipment for extruders.

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	Study of an extruder machine and prepare a report on it.	1	04
2	Prepare specifications of extruder machines available in the laboratory.	1	04
3	Operate pipe extrusion plant with changing various process parameters.	3	08
4	Identify processing problems on an extrusion pipe plant and suggest solutions.	3	04
5	Operate blown film extrusion plant with changing various process parameters.	3	08
6	Identify processing problems on blown film plant and suggest their solutions.	3	04
7	Operate pelletizing plant with changing various process parameters.	3	08
8	Identify processing problems on pelletizing plant and suggest solutions.	3	04
9	Set process parameters on sheet plant and operate it.	3	08
10	Identify processing problems on sheet plant and suggest solutions for it.	3	04
11	Demonstrate various auxiliary equipments used in extrusion plant.	4	04
	Total		**60**

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	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	Blown Film Plant	1,2,5,6
2	Pipe Plant	3,4
3	Pelletizing Plant	7,8
4	Sheet Plant	9,10
5	Vacuum Feed Hopper	11

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 Extruder Machine	1a.Classify extruder machine. 1b. Identify various parts of an extruder machine.	1.1 Machine Specification and glossaryof terms. 1.2 Classification of Extruder Machines. Types, Constructional Features and Function of a) Screw b) Barrel

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
		c) Thrust bearing d) Drive system e) Hopper f) Screen g) Breaker plate 1.3 Heating system of screw and barrel 1.4 Cooling system of screw and barrel
Unit – II ExtrusionProcess	2a.Select appropriatematerial. 2b.Operate an extruder. 2c. Apply extrusion process for various products. 2d.Identify the problems during extrusion process 2e.Identify the problems during extrusion process	2.1 Material characteristics andselection criteria 2.2 Types of Extrusion process: Dryand Wet 2.3 Melting process 2.4 Equation of output 2.5 Process variables 2.6 Start-up and Shut-down of extruder 2.7 Post extrusion techniques 2.8 Trouble shooting of ManufacturingProcess 2.9 Applications – Products ofExtrusions
UNIT III: ExtrusionPlants	3a.Operate various extrusion plants.	Manufacturing Processes and Line Diagram of : 3.1 Film 3.2 Pipe 3.3 Sheet 3.4 Profile 3.5 Wire/cable 3.6 Monofilaments 3.7 Coating-lamination 3.8 Palletizing
UNIT IV: Auxiliary Equipments	4a.Explain working of various auxiliary equipments.	4.1 Automatic feeding 4.2 Automatic Screen 4.3 Rotating Die 4.4 Oscillating haul-off

***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.*

8. 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

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Extruder Machine	16	10	10	08	28
II	ExtrusionProcess	12	10	06	04	20
III	ExtrusionPlants	10	08	04	03	15
IV	Auxiliary Equipments	04	04	03	00	07
Total		**42**	**32**	**23**	**15**	**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.*

9. 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 information related to the experiment through internet.
2. Students will visit nearby Extrusion film and Pipe Plant industry.

10. 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/Extrusion plants.
h) Video/animation films on Principle of different type Extrusion Plant.
i) Video/animation films on different Working principle of Auxiliary Equipment.

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 types of screw.
b) Prepare a chart for Single Screw Extruder Machine.
c) Prepared a chart for Material selection criteria for Extrusion process.
d) Prepare chart for line diagram of various Extrusion plant.
e) Prepared a chart for troubleshooting of various Extrusion Plant.
f) Collect products made by Extrusion Process.

13. SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1.	Extrusion of plastics	E.G. Fisher	The Plastics Institute
2.	Extrusion	Allen Griffith	
3.	Plastics Extrusion technology handbook	S.Levy	Industrial Press Inc., 1989
4.	Handbook of Plastic Processing Technology	D.V.Rosato	Springer
5.	Plastics Extrusion Technology	Fried helm Hence	Hanser Publishers
6.	Polymer Extrusion	Chris Rauwendaal	Hanser Verlag
7.	Plastics Engineering Hand book	J. Fradeos	Van Nostrand Reinhold Company
8.	Plastics Engineering Hand book	M Berins	Springer
9.	Plastic materials and processes	S.S.Schwartz & S.H.Goodman	Van Nostrand Reinhold Company

14. SOFTWARE/LEARNING WEBSITES

1. http://www.bpf.co.uk/
2. http://www.youtube.com
3. http://www.technologystudent.com/
4. http://www.notesandsketches.co.uk/Index.html
5. http://www.paulsontraining.com
6. http://www.traininteractive.com
7. http://en.wikipedia.org/wiki/Plastics_extrusion
8. http://en.wikipedia.org/wiki/Plastics_extrusion

15. PO-COMPETENCY-CO MAPPING

Semester I	Plastic Extrusion Technology (Course Code: 4322304)									
	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 Various Extrusion Plants to obtain production of desire quality (by setting process parameters)	2	2	3	2	3	2	2	2	2	-
Course Outcomes 1 Operate Extruder Machine.	2	2	1	3	2	1	2	3	2	-
2 Select appropriate material for extrusion process.	2	2	3	2	2	2	2	2	2	-
3 Troubleshoot problems in extrusion process.	2	3	1	2	2	1	2	2	2	-
4 Perform post moulding operations in extrusion process.	2	1	1	2	2	1	2	2	1	-
5 Use auxiliary equipment for extruders.	2	2	1	2	2	1	2	2	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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