GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering
Level: Undergraduate
Branch: Plastic Technology
Subject Code: BE05023071
Subject Name: Plastics Process Analysis, Instrumentation, and Control

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Elective Course - 2

Prerequisite:	Students should understand basic voltage, resistance, and how electrical signals are generated and measured. Students should also understand how to control parameters on "plastic processing machines", students should be familiar with the basic operation of core machinery (e.g., Injection Molding, Extrusion).
Rationale:	The parameters of various plastic processing machines are controlled with the help of pressure & temperature measuring instruments. Knowledge and functioning of these instruments are essential for a plastic technologist. At the end of this course the student will be able to know the operation of these instruments.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes
01	Understand various pressure & Temperature measuring instrument.
02	Explain and Analyse various process controls related to Injection Molding.
03	Explain and analyse various process controls related to Extrusion Molding.
04	Explain and analyse various process controls related to Blow Molding.

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL	TH		ESE (E)	PA (M)	PA/ (I)	TW/ SL(I)	ESE (V)	
45	00	30	15	90	03	70	30	20	30	50	200

Where L = Lecture, T= Tutorial, P= Practical, PBL = Problem Based Learning, TH = Total Hours, ESE = End- Semester Examination, PA = Progressive Assessment

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Introduction:** Process control and its importance; need for instrumentation; need for controllers; terminology **[A] Measurements:** Role of instruments, range, error, accuracy, precision, sensitivity, resolution, block diagram of instrumentation system. **[B] Pressure measurement**: Pneumatic pressure transducers; Mechanical Consideration, Specifications, Comparison of different transudes BIS Standard- IS 3624: Pressure and Vacuum Gauges — Specification **[C] Temperature measurements**: Methods of temp measurement. Barrel temp Measurement; Stock temp measurement. Ultrasound transmission line. **[D] Other measurements**: Power measurement.; Rotational speed measurement.; Extrudate thickness.; Extrudate surface condition	5	15
2.	**Controllers:** • Temp controllers-analog & digital. • Power controllers. • Dual output controllers. **Time temp characteristics:** • Thermal characteristics of systems. • Temp. Characteristics. **Tuning of the controller parameters:** • Performance criteria. • Effect of PID parameters. • Pre tuned temp controllers. • Self tuning temp controllers.	10	20
3.	**Injection molding process controls:** • Mould cycles –Machinery used-parts and functions-starts-up and shut down procedures-cylinder nozzles-press capacity projected area • On machine monitor• Temperature control of barrel and melt • PID in pre controller• Relating process control to process parameters • Adaptive ROM programmable• Simplified approach to undesirable process control• Process control techniques• Total injection molding proc. Control.	10	25
4.	**Extrusion molding process controls:** • Instrumentation requirements, most important parameters	10	20

	• General features of extruders viz. barrel, screw, types of screws, drive mechanism, specifications, heating and cooling systems, • Pressure measurements: Importance of melt process, different types of pressure transducers, mechanical consideration, specifications, comparison of different transducers • Temperature measurements: method of temp. Measurements, barrel temp. measurements, stock temp measurements • Other measurements: Power measurements, rotational speed, Extrudate thickness, Extrudate surface conditions • Temp. Control: On Off Control, Proportional control- controllers – time temp. characteristics – tuning of controller parameters • Total process control: True total extrusion process control		
5.	**Blow molding process controls:** • Controls for blow molding • Machine controls: Temperature, Placement of sensors, Dual sensors • Control characteristics: On/off, Proportional controls, Automatic reset. • Types of sensors: Thermocouple, Resistance temp. detectors (RTD)• Automatic tuning• RPM speed regulation Timing and sequencing • **Process controls:** Melt temp process control, melt pressure, melt pump, parison programming, parison length control, product control, weight control, thickness controls, Plant wide control and management • **Screw and Plunger Systems** – Cross head die design – Blow moulding machine features and operation including hydraulic and electrical control systems-faults, causes and remedies• Parison programming, blow mould construction, cooling methods, mould venting, blow moulding of difficult articles like fuel tanks, odd shaped containers with handles.	10	20
	Total	45	**100**

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15	20	15	7	8	5

Suggested Specification Table with Marks (Theory):

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Injection molding Handbook: Rosato and Rosato
2. Polymer Extrusion: Rauwendaal
3. Blow molding handbook: Rosato
4. Industrial instrumentation & control: S.P.Singh :
5. Measurement & control: P.D. Roberts
6. Handbook of controls & instrumentation: J.D.Lenk

(b) Open-source software and website:

1) https://nptel.ac.in/

Suggested Course Practical List: If any

Practical based on above topics.

Sustainable Development Goal:

The Plastics Process Analysis, Instrumentation, and Control course aligns with SDG 9 (Industry, Innovation, and Infrastructure) and SDG 12 (Responsible Consumption and Production) by fostering technical innovation and resource-efficient manufacturing through precise process monitoring. Additionally, the emphasis on power measurement and optimized thermal characteristics supports SDG 13 (Climate Action) through energy conservation, while enhancing overall industrial productivity in line with SDG 8 (Decent Work and Economic Growth).

- **Suggested Activities for Problem Based Learning**

Sr. No.	Activity	No. of hours	Total hours claimed	Evaluation Criteria
1	Seminar based on technical topics	Duration- 10 hrs	10	Based on content, report preparation and presentation
2	Mini project	Duration-10 hrs	10	Based on content, literature review, report preparation and presentation
3	Micro project	Duration-05 hrs	05	Based on content, literature review, report preparation and presentation

4	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h	10	Based on report submitted.
5	Poster/chart/power point preparation on technical topics	Duration = 10 h	10	Based on Poster/Chart/PPT preparation and presentation skills
6	Assignment writing.	5 assignments of 2h each.	10	Based on the assignment submitted.
7	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h	10	Report /presentation based on the video learning outcomes.
8	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	--	Based on performance in group discussion, technical depth, knowledge etc.
9	Attending Expert Lecture/Webinar/Seminar	Duration- 1hr each	--	Based on Short report
10	Self-learning on-line course	Minimum duration of the course should be 10h.	10	Examination based assessment at the end of course. Based on the certificate produced
11	Exhibition/ Conference/ Trade Fair/ Industrial exposure for 2-3 days	Visit- 15 hr Report preparation- 5 hr	20	Based on learning, observations and short report.
12	Working model on technical topics	Working = 15 h	15	Based on design, understanding & presentation of the model
13	Non-working model on technical topics	Non- working = 5 h	5	Based on design, understanding & presentation of the model
14	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h	10	Based on report submitted

Above activities are suggestive, faculty can choose any of these activities and cover up the Problem based learning hours.. The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, the total number of hours is fixed.

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