GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Diploma

Branch: Plastics Engineering

Course Code : DI03023051

Course Name : Plastic Materials and Additives

w. e. f. Academic Year:	2024-25
Semester:	3rd
Category of the Course:	PCC

Prerequisite:	**Basic Polymer Chemistry & Polymer Chemistry**
Rationale:	The course deals with structures, properties & applications of plastic materials prepared by various polymerization techniques. This course also deals with various additives used in plastic materials to alter their properties & compounding of them. The course will help students to understand uses of plastic materials for various applications, various kind of additives & their compounding in different industries as well as replacement of other engineering materials. It will also help to understand advance plastic materials and plastic product design in future.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand rheological properties of plastic materials.	U
02	Co-relate structure with properties of plastic materials.	R
03	Compare various plastic materials & use appropriate plastic materials in various fields.	R
04	Select the proper plastic materials to meet end use requirement for a given plastic product.	A
05	Understand applications of additives & compounding techniques for various Polymers.	U

**Revised Bloom's Taxonomy (RBT)*

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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA(M)	PA(I)	ESE (V)	
3	0	0	3	70	30	00	00	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage

UNIT – I	**Flow Characteristics**
	• Definitions- Rheology, Viscosity, Absolute viscosity, viscoelasticity
	• Types of flow
	  ○ Newtonian
	  ○ Non-Newtonian
	  ○ Pseudo-plastic
	  ○ Dilatants
	  ○ Bingham.
	• Temperature viscosity relation
		04	10%
			(7 Marks)

UNIT– II	**Thermoplastic materials** • Structure, properties and applications of the following Thermoplastic materials a. Olefins: Polyethylene(LDPE,HDPE), Polypropylene (PP) b. Vinyls : Polyvinyl chloride (PVC), Polyvinyl Alcohol(PVA) c. Styrenics :Polystyrene (PS),Styrene acrylonitrile(SAN), Acrylonitrile butadiene styrene(ABS) d. Acrylics :Polymethyl methacrylate (PMMA) e. Cellulosics: Cellulose acetate (CA)	10	22% (15 Marks)

UNIT– III	**Thermoset materials** • Structure, properties and applications of fallowing Thermo set materials a. Phenol formaldehyde(PF) b. Melamine formaldehyde(MF) c. Urea formaldehyde(UF) d. Epoxy e. Silicones f. Polyesters g. Polyurethane resin(PUR)	09	20% (15 Marks)
UNIT – IV	**Engineering Plastics & High Performance Plastics** • Structure, its related properties and applications of fallowing engineering plastic materials: a. Polyamides(nylon-6) b. Polytetrafluoroethylene(PTFE) c. Polyesters(PET) d. Acetal(POM) e. Polycarbonate(PC) • Structure, its related properties and applications of fallowing high performance plastic materials: a. Polyetherketones(PEK) b. Polyetheretherketones(PEEK) d. Polyethersulfone(PES) e. Polyphenylene sulfide (PPS) f. Polyphenylene Oxide(PPO)	12	26% (18 Marks)
UNIT – V	**Additives & Compounding** • Objectives of additives & compounding • Types & functions of following additives ○ Plasticizers ○ Lubricants ○ Fillers ○ Blowing agents- physical & chemical ○ Heat stabilizers ○ UV stabilizers ○ Colorants-powders, pigment & master batch ○ Flame retardants • Constructional details & process for following compounding equipments	10	22% (15 Marks)

	○ High speed mixer ○ Ban burry mixer ○ Two roll mill		
	Total	**45**	**100% (70 Marks)**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
50%	**30%**	**20%**	**-**	**-**	**-**

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:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Plastics Material	J A Brydson	Publisher: Elsevier Science, London Year: 1999 ISBN: 978-0-7506-4132-6
2	Plastics Material and Processes	S. S. Schwartz	Publisher: Van Nostrand Reinhold, New York Year: 1982 ISBN: 978-0442227777
3	Engineering Plastics Handbook	James Margolis	Publisher: Mcgraw-hill, Michigan Year:2006 ISBN:9780071457675
4	Polymer Science	Govariker V.R	Publisher: New Age International Pub, Delhi Year: 2019 ISBN: 9788122438130
5	Thermoplastic Materials: Properties, Manufacturing Methods, and Applications	Christopher C. Ibeh	Publisher: CRC Press, Delhi Year: 2011 ISBN: 1420093835

6	Plastics Materials Properties and Applications	A. W. Birley, R. J. Heath	Publisher: Springer US, New York Year: 2012 ISBN: 9781461536642
7	Plastics Additives Handbook	Zweifel H., Ralph D.M, SchillerM.	Publisher: Hanser Publications Year: 2009 ISBN: 9781569904305
8	Plastics Compounding and Polymer Processing	Kohlgruber K., Bierdel M & Rust H.	Publisher: Hanser Publications Year: 2021 ISBN: 9781569908372

(b) Open source software and website:

1. https://www.slideshare.net/AsadRiaz31/newtonian-and-non-newtonian-fluids- 76588937
2. http://www.curbellplastics.com/technical-resources/pdf/plastic-materialselection.pdf
3. https://www.sciencedirect.com/
4. https://omnexus.specialchem.com/selection-guides
5. https://www.bpf.co.uk/plastipedia/Default.aspx
6. https://www.engineeringenotes.com/engineering/thermoplastic-materials/list-ofthermoplastic-materials-engineering/42255
7. https://www.polyplastics.com/en/pavilion/beginners/04-03-3.html
8. https://www.youtube.com/watch?v=NPH2xMO86mc
9. https://www.youtube.com/watch?v=Cd4m5qmNZP0
10. https://www.degruyter.com/document/doi/10.1515/psr-2016-0130/html?lang=en

Suggested Project List:

1. Prepare a chart for types of plastic materials
2. Collect products made by commodity plastics
3. Prepare model for Maxwell's model
4. Prepare chart for crystalline, semi-crystalline and amorphous plastic materials
5. Collect products made by thermoset materials
6. Collect products made by engineering plastics
7. Make working model of compounding equipment
8. Prepare a chart for types additives with their functions
9. Collect samples of various additives from industries

Suggested Activities for Students:

1. Assignments
2. Technical Quiz/MCQ Test

3. Presentation on some course topic
4. I-net based assignments
5. Students are encouraged to register themselves in various MOOCS such as: Swayam, edx, Coursera, Udemy etc. to further enhance their learning.
6. Students will visit nearby industry.
7. Students will visit nearby plastic raw material supplier's shop/traders.

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