SEMESTER: S8

FAILURE ANALYSIS OF POLYMERS

Course Code	PEPOT867	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	Previous Coursework in Materials Failure Analysis, Fracture Mechanics, Or Polymer Degradation.	Course Type	Theory

Course Objectives:

1. After the completion of this course, students should achieve sufficient knowledge about the fundamental principles and mechanisms of polymer failure, including degradation, fracture, and fatigue

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SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Fundamentals of Fracture**– molecular failure process. Failure modes: brittle failure, ductile failure, ductile-brittle transitions, toughened polymers, mechanisms of rubber toughening, failure of highly filled systems/composites. Fracture mechanics: linear elastic fracture mechanics (LEFM), fracture predictions based on stress concentration and stress intensity factor, fracture predictions based on an energy balance	9
2	**Fracture Mechanics**– Short term and long-term test methods and analysis: impact strength, impact failure, creep rupture, fatigue, friction and wear	9
3	**Failure analysis and degradation of polymers**– Identification of strategic weakness, stability of polymer structures, environmental effect on polymer failure - weather, thermal, photo and oxidation	9
4	**Degradation Mechanisms**- Ionizing radiation, hydrolysis, environmental stress cracking-crazing and cracking, electrical treeing and water treeing,	9

	chemical degradation, electrochemical degradation, biodegradation, physical ageing.	

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

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In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 =24marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 sub divisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Illustrate the different modes of failure occurring in polymers and composites	**K2**
CO2	Explain the fracture mechanics during impact tests and in long-term tests	**K2**
CO3	Evaluate the effect of various environmental factors on the degradation behaviour of polymers	**K5**
CO4	Analyze the environmental stress cracking phenomenon in polymers	**K4**
CO5	Discuss degradation mechanisms in polymers	**K6**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table:

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**			**1**						**1**	**1**
CO2	**2**	**1**		**3**		**1**						**1**
CO3	**2**	**1**			**2**							**1**
CO4	**2**	**1**		**2**							**2**	**1**
CO5	**1**	**3**		**1**		**1**	**1**					**1**

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Failure of Plastics and Rubber Products	David C. Wright	RAPRA Technology Ltd	2001
2	Material Science of Polymers for Engineers	Tim A. Osswald, Georg Menges	Hanser Publications	3rd Edn 2012

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Introduction to Polymers	R. J. Young, P. A. Lovell	CRC Press	3rd Edn 2011
2	Plastics Engineering	R.J. Crawford	Elsevier Butterworth-Heinmann	3rd Edn 2002
3	Handbook of plastics testing and failure analysis	Shah, V.	John Wiley & Sons	2007

Video Links (NPTEL, SWAYAM…)	
Module No.	**Link ID**
1	https://youtu.be/ZoIVHEgV164?si=Sn_73C1xh0tO_Xlw
2	https://youtu.be/WJydAz0g1nM?si=8aXeekxQgLhmcpcb
3	https://youtu.be/uQuj77gRTbo?si=Ya5c0upxG-v-TJA-
4	https://youtu.be/Db9OCPIgZRY?si=XJznldG1RiZi4I3j

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