GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Metallurgy Engineering

Subject Code: DI04021051

Subject Name: Destructive Testing

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Professional Elective - I

Prerequisite:	Students need a foundational understanding of basic science, mathematics, and engineering principles. Sometimes with specific requirements for subjects like Physics, Chemistry, and Mathematics.
Rationale:	In manufacturing and design, materials are exposed to various mechanical loads and environmental conditions that may lead to failure. Understanding material behavior through destructive testing (DT) is essential to ensure reliability, safety, and quality. This course develops students' ability to select, perform, and interpret destructive tests such as tensile, hardness, impact, fatigue, and creep tests. In alignment with the Green Curriculum Initiative, students also learn to minimize waste, promote sample reuse, and adopt energy-efficient testing practices, fostering sustainable laboratory culture.
Competency	The course content should be taught and implemented with the aim to develop the following competency: Select and perform suitable destructive testing methods for determining material properties while ensuring safe and sustainable testing practices.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Understand the principles, types, and standards of destructive testing for materials.	U
02	Apply different destructive testing techniques to determine mechanical properties of materials and analyze results.	A
03	Evaluate materials' performance under various loading conditions considering sustainable and eco-friendly practices.	A

**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)	
2	0	4	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Introduction to Destructive Testing** 1.1.Overview of material testing: destructive vs non-destructive 1.2.Mechanical properties of materials 1.3.Merits and Limitations in Destructive Testing. 1.4.Standards and codes (ASTM, ISO, BIS) 1.5.Green Technology Aspect: Eco-friendly testing methods, waste reduction in lab experiments	06	14%
2.	**Strength and Hardness Testing** 2.1.Stress-strain relationship, true and engineering stress 2.2.Tensile, compression, and shear testing methods 2.3.Hardness testing – Brinell, Rockwell, Vickers, Micro-hardness 2.4.Hardness conversion and selection criteria.	08	30%
3.	**Impact, Fatigue, and Creep Testing** 3.1.Izod and Charpy impact tests – principle, setup, comparison 3.2.Fatigue mechanism, S–N curve, endurance limit. 3.3.Creep mechanism, features of creep curve, influencing factors.	08	30%
4.	**Wear, Bend, Green Testing Practices with Sustainability** 4.1. Wear and bending tests – importance and procedure 4.2. Introduction to green testing labs – waste minimization, recycling of specimens, and efficient use of energy. 4.3. Role of testing data in sustainable design and material selection.	08	26%
	Total	**30**	**100%**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
31	**40**	**29**	**0**	**0**	**0**

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

Unit No.	Unit Title	Teaching Hours	R Level	U Level	A Level	Total Marks
I	Introduction to Destructive Testing	6	4	4	2	10
II	Strength and Hardness Testing	8	7	8	6	21
III	Impact, Fatigue, and Creep Testing	8	7	8	6	21
IV	Wear, Bend, Green Testing Practices with Sustainability	8	4	8	6	18
Total		30	22	28	20	**70**

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author / Editor	Publication & Details
1	*Mechanical Metallurgy*	G. E. Dieter	McGraw-Hill, ISBN: 9780071004060
2	*Testing of Metallic Materials*	A. V. K. Suryanarayana	BS Publications, ISBN: 9352300378
3	*Metals Handbook: Mechanical Testing* (Vol. 8)	ASM Handbook Committee	ASM International, ISBN: 0-87170-389-0

Sr. No.	Title of Book	Author / Editor	Publication & Details
4	*Mechanical Testing of Metals and Alloys*	P. Field Foster	Cousens Press, 2007
5	*Principles of Metallographic Laboratory Practice*	George L. Kehl	McGraw-Hill, ISBN: 007033479X

(b) Open source software and website:

- https://vlabs.iitb.ac.in
- https://www.nde-ed.org
- https://rtlabs.nitk.ac.in
- https://greentechlearning.com

Suggested Course Practical List:

Sr. No.	Practical Title	Unit No.	Approx. Hours
1.	Determine tensile strength of various ferrous and non-ferrous specimens using Universal Testing Machine (UTM).	I, II	6
2.	Perform compression and shear tests using UTM and compare results.	II	6
3.	Determine hardness of given materials using Brinell, Rockwell, and Vickers testers.	II	6
4.	Conduct impact tests (Izod and Charpy) and evaluate toughness.	III	6
5.	Study and determine fatigue strength using fatigue testing machine.	III	6
6.	Plot creep curve from given data and interpret the stages of creep.	III	4
7.	Perform wear test using pin-on-disc machine and determine wear rate.	IV	4

Sr. No.	Practical Title	Unit No.	Approx. Hours
8.	Perform bend test and determine modulus of rupture.	IV	4
9.	Study safety precautions and environmental management in DT laboratory.	IV	4
10.	Implement "Green Lab Practices" – waste segregation, material reuse, and energy-efficient testing.	IV	6
11.	Mini-project: Prepare a report on sustainable and safe material testing setup.	All	8
	Total		**60 Hours**

List of Laboratory/Learning Resources Required:

Sr. No.	Equipment Name with Broad Specifications
1	Universal Testing Machine (Analogue/Digital)
2	Rockwell, Brinell, and Vickers Hardness Testers
3	Impact Testing Machine (Izod & Charpy)
4	Fatigue Testing Machine
5	Creep Testing Machine
6	Wear Testing Apparatus (Pin-on-Disc Type)
7	Bend Test Setup

Additional suggested project list:

1. Visit a material testing laboratory and study industrial testing procedures.
2. Prepare a checklist for safety and environmental protection in a testing lab.
3. Develop posters on "Green Practices in Testing Laboratories."
4. Conduct micro-projects on sustainable material usage or testing equipment reuse.

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