



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Metallurgy

Subject Code: BE04021021

Subject Name: Testing of Metals and Standards

w.e.f.Academic Year:	2024-25
Semester:	4
Category of the Course:	Professional Core Course

Prerequisite:	Nil
Rationale:	This subject focuses on understanding the different destructive testing methods used to analyze the various mechanical properties. The evaluations of mechanical properties of metals are essential in determining its fitness for the engineering applications. Testing standards are essential in engineering and manufacturing as they ensure that metals and metal products comply with established quality, safety, and performance requirements.

Course Outcomes:

Sr. No.	CO statement	Marks % Weightage
CO-1	Understand the importance of calibration of test equipment's and various metallurgical testing with standards.	10
CO-2	Selection of the mechanical test like hardness, tensile and impact to evaluate material properties and their procedures	60
CO-3	Analyze the fatigue and creep tests to evaluate material performance for long-term loading applications.	30

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	PBL*	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/C A (I)	PBL (I)	ESE (V)	
30	0	60	30	120	4	70	30	20	30	50	200

* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

Content:



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Sr. No.	Content	Total Hrs	% Weightage
1	Material Testing: Importance, Classification: DT and NDT, Selection of testing methods, Importance of instruments calibration, Calibration methods, ASTM and other equivalent standards for various tests.	5	17
2	Hardness Testing: Scratch Hardness, Indentation Hardness, Brinell Hardness Test, Vicker's Hardness Test, Rockwell Hardness Test, Hardness (IS1586, IS1500), Micro Hardness Testing (E384), Dynamic Hardness Testing- Poldi Hardness testing, Advantages and limitations of various hardness tests.	6	20
3	Tensile Testing: Tensile testing (E8 and B557, IS1608), Tensile properties, Engineering stress-strain curve, True stress-strain curve, Factors affecting tensile properties.	6	20
4	Impact Testing: Impact Testing (Izod-ASTM D256, Charpy-ASTM E2248), Notch-bar Impact Test, Variables affecting impact values, Fracture toughness, merits and demerits of impact tests, Ductile-brittle transitions behaviour and its significance.	4	13
5	Fatigue Testing: Stress cycles, S-N curves, Mechanisms of fatigue in metals- Orowan's theory of fatigue and Fatigue Crack growth, variables affecting fatigue.	5	17
6	Creep Testing: Typical creep curve, Equi-cohesive Temperature, Mechanism of creep deformation- Dislocation glide, dislocation creep, Diffusion creep, Grain Boundary sliding, Metallurgical factors affecting creep behaviour, creep resistant materials.	4	13
	Total	30	100

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
30	40	20	10	00	00



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Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

References:

1. Mechanical Metallurgy by George E. Dieter, Publisher: Mc Graw Hill Company
2. Mechanical Behaviour and Testing of Materials , Sharma C. P. & Bhargava A. K., PHI.
3. Materials Science and Engineering: An Introduction: William D Callister and David G. Rethwisch, 10th edition, 2020.
4. Introduction to Physical Metallurgy, Sydney H. Avner, Tata McGraw-Hill.
5. ASM Handbook Volume 8: Mechanical Testing and Evaluation

List of Experiments:

1. To study the importance of material testing and calibration.
2. To perform the hardness test of the given specimen using Brinell Hardness Tester.
3. To perform the hardness test of the given specimen using Rockwell Hardness Tester.
4. To perform the hardness test of the given specimen using Vicker's Hardness Tester.
5. To perform the hardness test of the given specimen using Microhardness Tester.
6. To determine the modulus of elasticity of a materials from the given data set using stress-strain diagram.
7. To study and analyze the impact strength of material using the Izod impact test
8. To study and analyze the impact strength of material using the Charpy impact test
9. To understand the working principle of the fatigue testing machine to predict the fatigue life of the given specimen under cyclic loading conditions.
10. To understand the materials deformation through the Creep Test: A study of time-dependent strain.
11. To study the ductility and formability of materials using the Cupping Test.
12. To write an Industrial/Laboratory visit report.
13. To prepare a poster/chart/power point presentation on curriculum topics.

Major Equipment:

Brinell Hardness Tester, Vicker's Hardness Tester, Rockwell Hardness Tester, Micro hardness tester.

List of Open Source Software/learning website:

<https://archive.nptel.ac.in/courses/113/106/113106101/#>

<https://www.astm.org/Standards/steel-standards.html>

<https://www.doitpoms.ac.uk>



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• **Activities suggested under Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1.	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
2.	Technical Video based learning related to the subject	Duration of video = 5h Report preparation = 5h Total = 10h	Report /presentation based on the video learning outcomes.
3.	Assignment writing. Numericals based assignment is preferable.	5 assignments of 2h each. Total = 10h	Based on the assignment submitted.
4.	Expert Lecture/session	Lecture 2 hr Report 1 hr	Report should contain observation and learning.
5.	Self learning on-line course	Minimum duration of the course should be 10h.	Examination based assessment at the end of course. Based on the certificate produced.
6.	Complex problem solving	Maximum 2 problem. Study of the problem and solution finding, Total = 10h	Based on the depth of the solution submitted.
7	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
8	Discussion on research paper based on relevant subject	5 research paper = 20 h	Summarize research paper and evaluation critical parameters
9.	Poster/chart/power point preparation on technical topics	Duration = 6 h	Based on poster/chart preparation and presentation skills
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation
11	Industrial exposure for 2-3 days to observe	Duration = 15 h for industrial exposure	Based on evaluation of critical problems and solutions



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	and provide tentative solutions on society/environment/health/any other issue	Problem identification and tentative solution = 10 h Total = 20 h	
12	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
13.	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 5h Total = 10h	Based on in-depth study, technical depth, data collected, fact finding, etc.

Note:

1. All the suggested activity should be related to the subject.
2. The number of hours are suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
3. Rubrics for the evaluation can be prepared by the faculty.
