MNE3063: MATERIAL ANALYSIS FOR PRODUCT QUALITY

Effective Term
Semester A 2023/24

Part I Course Overview

Course Title
Material Analysis for Product Quality

Subject Code
MNE - Mechanical Engineering
Course Number
3063

Academic Unit
Mechanical Engineering (MNE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
MBE2110/MNE2110 Engineering Materials and
MNE3118 Mechanics of Materials

Precursors
Nil

Equivalent Courses
MBE3063 Material Analysis for Product Quality

Exclusive Courses
Nil

Additional Information
#Prerequisites which are not part of the Major Requirement are waived for students admitted with Advanced Standing.

Part II Course Details

Abstract

This course aims to provide the basic concepts and principles in qualitative and quantitative analysis of physical, mechanical, and thermal properties of products made of metals, ceramics, polymers or composites. The students will receive training and guidance on some fundamental methods to test the reliability and safety of raw materials, components and products, and therefore they should be able to identify and specify appropriate analytic techniques required in given quality engineering problems, particularly in the manufacturing process, quality control, and product testing, and apply them to solve the problems.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Recognize the importance of material analysis techniques for manufacturing process control, product reliability and quality assurance.			x	
2	Identify the fundamental principles and techniques of material analysis of physical, mechanical, and thermal properties.			x	
3	Design the appropriate testing and analysis process to test material/product performance in reliability, health, safety and environment aspects, with respect to manufacturing process requirements and product standards and regulations.			x	x
4	Interpret the experimental results obtained through testing to evaluate the product risks and to solve quality engineering problems.			x	

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	This includes typical lectures on different topics of analysis techniques and applications accompanied by in-class activities.	1, 2, 3	3hrs/week

2	Laboratory Work	Students are asked to work on laboratory exercises on different topics of testing techniques and applications. They have to do laboratory experiments on the measurement of raw materials, components and products with different instruments and techniques, and then summarize and discuss their testing results.	2, 3, 4	3hrs/week for 3 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tests	2, 3	20	
2	Laboratory Work Reporting	2, 3, 4	20	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Assessment Rubrics (AR)

Assessment Task

1. Tests

Criterion

Ability to describe fundamental concepts and techniques of material analysis about product/material quality.

Excellent (A+, A, A-)

75%-100%

Good (B+, B, B-)

60%-74%

Fair (C+, C, C-)

45%-59%

Marginal (D)

40%-44%

Failure (F)
<40%

Assessment Task
2. Laboratory Work Reporting

Criterion
Ability to explain the methodology and procedure and to analyse the lab data, as evidenced through the submitted reports.

Excellent (A+, A, A-)
Strong evidence of critical thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge of the experimental matters concerned.

Good (B+, B, B-)
Evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with experiment.

Fair (C+, C, C-)
Student who is profiting from the laboratory class; understanding of the subject; ability to develop solutions to concerning the experiment.

Marginal (D)
Sufficient familiarity with the laboratory content to enable the student to move onto other laboratory materials.

Failure (F)
Little evidence of familiarity with the laboratory class materials; weakness in critical and analytic skills; limited, or irrelevant use of data.

Assessment Task
3. Examination

Criterion
Ability to explain the fundamental concepts and techniques of material analysis about product quality.

Excellent (A+, A, A-)
Strong evidence of original thinking; good organization, capacity to analyse and synthesize; superior grasp of subject matter; evidence of extensive knowledge base.

Good (B+, B, B-)
Significant evidence of grasp of subject, some evidence of critical capacity and analytic ability; reasonable understanding of issues; evidence of familiarity with course matter.

Fair (C+, C, C-)
Student is profiting from the university experience; understanding of the mechanics; ability to develop solutions to simple problems in the course.

Marginal (D)
Basic familiarity with the subject matter to enable the student to progress without repeating the course.

Failure (F)
Little evidence of familiarity with the subject matter; weakness in critical and analytic skills; very limited demonstration of correct use knowledge in mechanics.

Additional Information for AR

Note: For a student to pass the course, at least 30% of the maximum mark for both coursework and examination should be obtained.

Part III Other Information

Keyword Syllabus

- Product quality testing for reliability, health, safety and environment
- Microstructural and chemical characterization

  Scanning electron microscopy (SEM), Atomic force microscopy (AFM), Energy dispersive X-ray (EDX), Ultraviolet-visible (UV/Vis) spectroscopy, Mass spectrometry
- Mechanical testing
  Mechanical properties, Tensile testing, Compression testing, Impact testing, Bend testing, Torsion testing, Hardness testing, Microhardness testing, Nanoindentation, Hydrostatic testing.
- Thermal analysis
  Thermal properties, Introduction to thermal analysis, Thermogravimetric analysis (TGA), Differential thermal analysis (DTA), Differential scanning calorimetry (DSC)

Reading List

Compulsory Readings

	Title
1	William D. Callister Jr., David G. Rethwisch, "Materials Science and Engineering: An Introduction," 10th Edition, 2018, Wiley. ISBN: 978-1-119-40549-8

Additional Readings

	Title
1	Douglas E. Adams, "Health monitoring of structural materials and components: methods with applications", John Wiley & Sons. (TA645.A253 2007).
2	Norman E. Dowling, "Mechanical behavior of materials: engineering methods for deformation, fracture, and fatigue", Prentice Hall. (TA404.8 .D68), latest edition.
3	Michael E. Brown (ed.), "Introduction to thermal analysis: techniques and applications", 2nd ed, Kluwer Academic Publishers. (QD79.T38 B76 2001).
4	Francis Rouessac and Annick Rouessac, "Chemical analysis: modern instrumentation methods and techniques", 2nd ed, Wiley. (QD79.I5 R6813 2007).
5	J.P. Eberhart, "Structural and chemical analysis of materials: X-ray, electron and neutron diffraction; X-ray, electron and ion spectrometry; electron microscopy", Wiley. (TA417.23 .E2413), latest edition.
6	Online Resources: Online learning material is provided via University computer network.