

COURSE OUTLINE FOR STUDENTS AT NTU

Academic Year	2023/24	Semester	2
Course Coordinator	Assistant Professor Fan Zheng, David		
Course Code	MA4871		
Course Title	Non-Destructive Testing		
Pre-requisites	MA2079 Engineering Innovation and Design		
No of AUs	3		
Contact Hours	Lectures: 39 hours		
Proposal Date	April 2023		

Course Aims

This course aims to provide a comprehensive overview of NDT techniques currently practiced and those which are on the horizon. It starts with fundamentals of each NDT techniques, including ultrasound, eddy current, magnetic particle, x-ray and optics. Practical cases are then presented for you to select suitable NDT methods. This enables you to better appreciate and utilize techniques for research or industrial applications.

Intended Learning Outcomes (ILO)

Upon completion of the course, you will be able to:

- 1) Explain the need for and the principles of NDT methods. Select the appropriate method for a particular test or inspection.
- 2) Interpret and analyse qualitative and quantitative NDT
- 3) Discuss the need for using more than one NDT tool for a particular application and the need for data fusion for interpretation
- 4) Explain the need for automation in industrial application and methods by which this can be achieved.
- 5) Illustrate the need for visual and optical inspection method.
- 6) Describe the need for on-line monitoring and associated systems and principles.

Course Content

	Topic	Hours
1	Overview of NDT Definition of non-destructive testing (NDT); how does it differ from destructive testing; industry-standard specifications for NDT and acceptance standards. Review of established methods such as Dye Penetrant, Magnetic Particle, Eddy Current, ultrasonic and radiography. NDT application areas in Singapore.	2
2	Ultrasonic, Eddy Current and Visual methods Sound and waves; ultrasonic generation; ultrasonic measurement and applications; signal processing; guided waves; online monitoring; electromagnetic theories; eddy current measurement and applications; visual search; machine vision	18
3	Traditional NDT Methods For each method the following will be discussed. Characteristics of each method; theory & basic principles, Advantages/disadvantages, Selection and comparisons of techniques, materials of parts that can	19

be inspected (fibre reinforced composites, metals and non-metals), physical size and/or shape limitations of parts, economics of the process. Types of defects that can be detected; ability and accuracy, with which defects can be located, sized, and their orientation and shape characteristics determined. Case studies in the Singapore Microelectronics, Aerospace, Shipyard, Railway and Petrochemical Industries.

- Fluid penetrant (3 hrs)
- Magnetic particle (4 hrs)
- X-ray (4 hrs)
- Thermography (4 hrs)
- optical methods (4 hrs)

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team/Individual	Assessment rubrics
1. Continuous Assessment 1 (CA1): quiz	1, 2, 3	EAB SLO a, b, c, d	20%	Individual	
2. Continuous Assessment 2 (CA2): assignment	4, 5, 6	EAB SLO a, b, c	20%	Individual	
3. Final Examination (2.5 hours; Closed book)	1, 2, 3, 4, 5, 6	EAB SLO a, b, c, d	60%	Individual	
Total			100%		

Formative feedback

We will provide formative feedback during the tutorial sessions and after your CA assignments have been graded. We will also give general feedback for your performance in the course review lessons.

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lectures	You will learn the fundamental physics of all NDT methods, as well as their application scenarios and procedures.
Case studies	Different practical cases are presented at various stages of the lecture to enhance the knowledge and inspire applications.
CA 1,2	Two CAs are conducted at different stages. They will motivate you to learn progressively. We will review the solutions and highlight common errors.

Reading and References

Textbook

1. Introduction to Non-Destructive Testing – Paul E. Mix , Wiley , 2005

References

1. Halmshaw, R, Non-Destructive Testing, Edward Arnold, 2nd ed, 1991.
2. Bray, DE and RK Stanley, Non-Destructive Evaluation, New York: McGraw-Hill, c1989.
3. Non-Destructive Testing Handbooks, American Society of Non-Destructive Testing, 2nd ed, 1991.
4. Erf, RK, editor, Holographic Non Destructive Testing, New York, Academic Press, 1974.
5. Sirohi, RS, editor, Speckle Metrology (e-book), New York: Marcel Dekker, c1993.
6. BG Batchelor, DA Hill and DC Hodgson, editor, Automated visual inspection, IFS (Publications) Ltd; Amsterdam, The Netherlands: North-Holland, 1985.
7. Eric Udd, editor, Fiber optic sensors: an introduction for engineers and scientists, New York: Wiley, c1991.

Course Policies and Student Responsibilities

As a student of the course, you are required to abide by both the University Code of Conduct and the Student Code of Conduct. The Codes provide information on the responsibilities of all NTU students, as well as examples of misconduct and details about how students can report suspected misconduct. The university also has the Student Mental Health Policy. The Policy states the University's commitment to providing a supportive environment for the holistic development of students, including the improvement of mental health and wellbeing.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the [academic integrity website](#) for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Prof Fan Zheng, David	N3-02c-92	6790 6826	ZFAN@ntu.edu.sg
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Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to NDE Sound and waves	1	Lecture notes and Textbook Chapter 1
2	Ultrasound generation	1, 2	Lecture notes and Textbook Chapter 11
3	Ultrasonic measurement and applications,	1, 2	Lecture notes and Textbook Chapter 11
4	Ultrasonic signals	1, 2	Lecture notes and Textbook Chapter 11
5	Ultrasonic guided wave	1, 2	Lecture notes and Textbook Chapter 11
6	Eddy current inspection	1, 2, 3	Lecture notes and Textbook Chapter 3
7	Visual inspection and health monitoring	4, 5, 6	Lecture notes and Textbook Chapter 13

8	Liquid penetrant inspection	1, 2	Lecture notes and Textbook Chapter 6
9	Magnetic particle inspection	1, 2, 3	Lecture notes and Textbook Chapter 7
10	Radiography, automated NDT	2, 3, 4	Lecture notes and Textbook Chapter 9
11	Thermography	2, 3, 4	Lecture notes
12	Optical NDT, Shearography	5	Lecture notes and Textbook Chapter 4
13	Optical NDT, Holography and Speckle	5	Lecture notes and Textbook Chapter 13