**Summary**

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| --- | --- | --- | --- | --- | --- |
| Programme:  B. Tech. (ME) | Course Title:  “Non-Destructive Examination”, (NDE) | | | Course Code:  (MME-4222) | |
| Course type:  Program Elective (PE) | Prerequisites  Fundamental knowledge of Physics, Chemistry, and Mathematics | | | Total Hours:  42(L) | |
| Eligibility: III & VI year  V, VI, VII, VIII  Semester | Lecture (L) Hrs./Week = 3 | Tutorial (T)  Hrs./Week = 0 | Practical (P) Hrs./Week = 0 | | Credits  **3-0-0 = 3** |

**Total credits: 3 (L) + 0 (T) + 0 (P) = 3**

**Learning Objective**

Non-Destructive Examination (NDE) / Non-Destructive Evaluation (NDE) / No-Destructive Inspection (NDI) / Non-Destructive Testing (NDT) plays a critical role in the safety of the many products, transportation systems, and infrastructure used around the world. The importance of NDE in avoiding catastrophic failures cannot be overstated. Beyond the important aspects of safety, though, NDE measurements themselves provide an essential validation of the quality of a product and add economic value to the manufacturing process, as well as help manufacturers avoid the costly effects of a poor-quality product reaching the consumer.

NDE / NDE is a marvellous technology. Those involved in NDE, work with a wide range of principles of physics. NDE methods employ the entire electromagnetic spectrum, from radio waves to gamma rays, as well as physical principles based in mechanics, magnetics, fluids, and so on. Those who work in the field of NDE are well versed in many aspects of physics, electronics, mechanics, chemistry, and material science. The application of NDE to validate the fitness-for-service of new products and the continued use of products already in service is a primary thrust of the application of NDE. The NDE measurements themselves are also numeric parameter datasets that serve as a basis for statistical analysis of product quality and consistency, important to manufacturers who value continuous process improvement and control.

“The goal of every engineer is to retire without being blamed for a major catastrophe”, the NDE plays a key role in ensuring that engineers are able to successfully meet that goal.

While ensuring safety by detecting critical-size defects, is an essential function of NDE, the other critical and essential roles are to: ensure product reliability, prevent accidents and save human lives, make a profit for the user (add value), ensure customer satisfaction and to maintain the manufacturer’s “good name”, aid in better product design, control manufacturing processes, lower manufacturing costs, maintain a uniform quality level

An undergraduate course in Non-Destructive Examination (NDE) opens up a world of exciting career prospects. NDE Professionals play a crucial role in ensuring the structural integrity and safety of various assets across industries. The expertise will be sought after in fields such as aerospace, manufacturing, construction, and energy. The field of NDE is on the rise. NDE jobs are estimated to grow by more than 6-7% due to deteriorating infrastructure and increased demand for safety. NDE careers offer stability and growth potential, making it an attractive choice for aspiring professionals. They design and implement NDE procedures, interpret complex data, and ensure safety, Research and Development opportunities, Quality Control and Assurance, Consultancy and Training, Upskilling and Specialization, Continuous Learning, Certifications, Advanced NDT Methods.

**Teaching Methodology**

Lectures have been designed to ensure brainstorming through ‘how & why’, Bloom’s taxonomy levels (1-6), Programme outcomes (1-12) and PSOs (1-3).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Brainstorming through ‘how & why’ | Bloom’s Taxonomy (1-6) | Cos  (1-6) | POs  (1-12) | PSOs  (1-3) |

**CO and Bloom’s level Correlation**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| COs | CO1 | CO2 | CO3 | CO4 | CO5 | CO6 |
| Bloom’s levels (BL) | BL-1 | BL-2 | BL-3 | BL-4 | BL-5 | BL-6 |
| Remembering | Understanding | Applying, | Analysing | Evaluating | Creating |

**Philosophy of Course / Topic Coverage in the Classroom**

1. Introduce topic / title of the lecture.
2. Reason for teaching the particular topic.
3. Relevance to the Industry / Research.
4. Safety and Hazards.
5. The technology.
6. Equipment / consumables / parametric window.
7. Practical understanding of technology through physical observations / mechanical testing / metallurgical investigations / productivity etc. in the Laboratory.
8. Industrial visits.
9. Development of theoretical / empirical relationships with motivation to write a research paper.
10. Application of Digital Manufacturing / Computer Applications (includes CAPP, Expert Systems)
11. Advantages and limitations.
12. Possibility of Innovations.
13. Possibility of Start-ups.
14. Commercial aspects.

**The course takes care of aspirations of the students in terms of EMPLOYABILITY, SKILL DEVELOPMENT, ENTREPRENEURSHIP, TEACHING and R&D.**

**Course outcomes (COs):**

|  |  |  |
| --- | --- | --- |
| On completion of this course, the students will have the ability to: | | Bloom’s Level |
| CO-1 | Recognize, Remember and understand the basic concept and application of various NDE techniques used. | 2 |
| CO-2 | Recognize, Understand and analyze the basic principles of physics used during NDE | 4 |
| CO-3 | Recognize, Understand and analyze the industrial applications of various NDE techniques with technical considerations. | 4 |
| CO-4 | Develop, Analyze, Evaluate and Correlate Discontinuities origins and classification | 5 |
| CO-5 | Develop, Analyze, Evaluate and Correlate and Create the fundamentals of radiography technique, radio sources used, procedures and precautions, safety standards as laid down by BARC. | 6 |
| CO-6 | Develop, Analyze, Evaluate, Correlate and Create the fundamentals of ultrasonic technique, principle used, procedures, precautions, limitations, safety standards as ASNT. | 6 |

**LECTURE SCHEDULE**

|  |  |  |  |
| --- | --- | --- | --- |
| S. No. | Topics | Lecture | CO |
|  | Introduction to NDE | 2 | 2 |
|  | Basic principles of physics used in NDE | 5 | 4 |
|  | Discontinuities origins and classification | 6 | 5 |
|  | Industrial applications of various NDE techniques with technical considerations. | 3 | 4 |
|  | Visual Testing | 2 | 4 |
|  | Penetrant Testing | 2 | 4 |
|  | Magnetic Particle Testing | 2 | 4 |
|  | Eddy Current Testing | 2 | 4 |
|  | Thermal Infrared Testing | 2 | 4 |
|  | Acoustic Testing | 2 | 4 |
|  | Fundamentals of Radiographic Testing | 5 | 6 |
|  | Fundamentals of Ultrasonic Testing | 5 | 6 |
|  | Scope of Standards | 2 | 4 |
|  | Case studies related to space programmes, ship building, aerospace, cross country pipelines, off shore structures etc. | 2 | 2 |
| **Total** | | **42** |  |

**Recommended Books**

|  |  |  |  |
| --- | --- | --- | --- |
| S. No. | Title | Author(s) | Publisher |
|  | Handbook of Nondestructive Evaluation | Charles J. Hellier | Mc GRAW HILL, New Delhi |
|  | Practical Non-destructive Testing (2007) | Baldev Raj, T. Jayakumar, M. Thavasimuthu | Narosa Pub. House, New Delhi |
|  | Non-Destructive Testing Inspector’s Handbook (2002) | Contact Information  Keoke526@hotmail.com  ndthandbook.zapto.org |  |
|  | Nondestructive Testing Handbook, Volumes 1 and 2 1959 | Robert C. McMaster | Ronald Phillips Ltd. |

**Additional Resources:** NPTEL, MIT Video Lectures, Web resources etc.

Students are free to refer to any other book of choice on the subject. Assessment will be done only on the basis of quality of technical content, relevant sketches, explanation and analysis.

**Evaluation**

|  |  |  |
| --- | --- | --- |
| Event | Weightage (%) | COs |
| Mid Term Examination | 25 | 1-6 |
| Mid Term Brainstorming (Content covered up to the previous day). | 25 | 1-6 |
| End Term Brainstorming (Content covered up to the previous day) | 25 | 1-6 |
| End Term Examination | 25 | 1-6 |
| **TOTAL ASSESSMENT** | **100** |  |

**CO and PO Correlation Matrix (MME)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| CO2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| CO3 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| CO4 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | 1 | 1 | 3 | 3 | 3 |
| CO5 | 1 | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 2 | 1 | 1 | 2 | 2 | 2 |
| CO-6 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | 1 | 3 | 3 | 3 |

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**Last Update:** 01/01/2025

**Approved by:**