ADVANCED NON-DESTRUCTIVE TESTING TECHNIQUES
(Professional Elective -IV)

II Semester

Course Code: 19ME2161

L	P	C
3	0	3

Course Outcomes: At the end of the course, the student will be able to
CO1: Identify various surface flaws by using LPI and MPI.
CO2: Apply the systematic understanding of knowledge on radiography and ultrasonic techniques.
CO3: Demonstrate comprehensive understanding of acoustic emission techniques.
CO4: Summarize conceptual understanding of principles of thermograph.
CO5: Summarize the various techniques of optical holography and speckle metrology.

UNIT-I **(10-Lectures)**

LPI: Characteristics of liquid penetrants - different washable systems, developers- applications
MPI: Methods of production of magnetic fields- principles of operation of magnetic particle test- applications-advantages and limitations.
Learning outcomes:

1. Select different kinds of developers to be used in LPI. (L5)
2. Explain the methods of production of magnetic fields. (L2)
3. Apply LPI and MPI for flaw detection. (L3)

UNIT-II **(10-Lectures)**

Radiography: Sources of ray X-ray production-properties of γ and X- rays – film characteristics – exposure charts – contrasts – operational characteristics of X- ray equipment – applications.
Industrial Computed Tomography (CT): Computed Tomography, X-Ray detectors - CT image reconstruction algorithm - Capabilities, comparison to other NDT methods - industrial CT applications, CT System design and equipment.
Ultrasonic techniques: Production of ultrasonic waves – types of waves - general characteristics of waves – pulse echo method – A, B, C scans.
Learning outcomes:

1. Compare computed tomography with other NDT methods. (L5)
2. Interpret A, B and C scans of ultrasound. (L2)
3. Use radiography, computed tomography and ultrasound to inspect the components. (L3)

UNIT-III **(10-Lectures)**

Acoustic emission techniques: Principles of acoustic emission techniques – advantages and limitations - instrumentation – applications Acoustical Holography: Liquid Surface Acoustical Holography - Optical System, Object size and shape, sensitivity and resolution, commercial liquid surface equipment – Scanning Acoustical Holography - Reconstruction, Object size, Sensitivity and resolution, Commercial Scanning equipment - Comparison of liquid surface and scanning systems – Read out methods, calibration, Interpretation of results - Applications - Inspection of welds in thick materials.
Learning outcomes:

1. Interpret the principles of acoustical emission techniques. (L2)
2. Judge the advantages and disadvantages of acoustic emission techniques. (L5)
3. Apply acoustic emission techniques for flaw detection. (L3)

UNIT-IV **(10-Lectures)**

Principles of Thermography: Contact and non-contact inspection methods - Heat sensitive paints - Heat sensitive papers - thermally quenched phosphors- liquid crystals - techniques for applying liquid crystals - calibration and sensitivity - other temperature sensitive coatings - non contact thermographic inspection - Advantages and limitations - infrared radiation and infrared detectors, Instrumentations and methods, applications.

Learning outcomes:

1. Apply thermography for flaw detection (L3)
2. Compare contact and non-contact inspection methods. (L5)
3. Describe applications of thermography. (L2)

UNIT-V **(10-Lectures)**

Optical Holography and Speckle Metrology: Laser fundamentals – coherence – types of lasers – holography, recording and reconstruction – holographic interferometry – real-time, double-exposure & time- averaged techniques – holographic NDT – methods of stressing and fringe analysis – typical applications – requirements – advantages and disadvantages – laser speckle metrology basics – electronic speckle pattern interferometry (ESPI) – shearography –applications.

Learning outcomes:

1. Explain holographic interferometry. (L2)
2. Assess the advantages and disadvantages of optical holography. (L5)
3. Apply optical holography for NDT inspection. (L3)

TEXT BOOKS:

1. Baldev Raj, T. Jayakumar and Thavasimuthu M., *Practical Non-destructive Testing*, Woodhead Publishing Limited, 2009
2. Barry Hull and Vernon John, *Non-destructive Testing*, MacMilan, 1988.

REFERENCE BOOKS:

1. Miller Ronnie and Paul Mclntire, *Non-Destructive Testing Handbook; Acoustic Emission Testing*, VoL-5, 2nd Edition, Columbus, OH: American Society for Non-Destructive Testing, 2013.
2. American Metals Society, *Non-Destructive Examination and Quality Control: Metals HandBook*, Vol-17, 9th Edition, Metals Park, 2018.
3. Dewit, D.P., *Theory and Practice of Radiation Thermometry*, Wiley-lnterscience, John Wiley & Sons, Inc, 1989.

WEB REFERENCE:

https://www.nde-ed.org/EducationResources/educationresource.htm