DEPARTMENT OF PHYSICS

NATIONAL INSTITUTE OF TECHNOLOGY, TIRUCHIRAPPALLI.

Course Plan for I M.Tech. Non-Destructive Testing (NDT)

COURSE PLAN – PART I			
Course Title	**ULTRASONIC TESTING**		
Course Code	**PH603**	**No. of Credits**	**3**
Course Code of Pre-requisite subject(s)	**NIL**		
Session	**AUGUST 2019**	**Section (if, applicable)**	**N.A.**
Name of Faculty	**M.MANIMOHAN**	**Department**	**Physics**
Email	**manmobhel@gmail.com**	**Telephone No.**	**9442503011**
Name of Course Coordinator(s)		**Prof. Dr. B. Karthikeyan**	
E-mail	**bkarthik@nitt.edu**	**Telephone No.**	**(0431) 250-3612**
Course Type	**☑ Core course** ☐	**Elective course**	

Syllabus (approved in BoS)

Fundamentals of Ultrasonic Waves

Nature of sound waves, wave propagation in metals
modes of sound wave generation – longitudinal waves, transverse waves, surface waves, lamb waves -Velocity, frequency and wavelength of ultrasonic waves -Ultrasonic pressure, intensity and impedance-Attenuation of ultrasonic waves – reflection, refraction and mode convection – Snell's law and critical angles-Fresnel and Fraunhofer effects – ultrasonic beam split – wave propagation in other engineering materials- Decibel

Generation of ultrasonic waves

Methods of ultrasonic wave generation – piezo electric effect, piezo electric materials and their properties – crystal cuts and mode of vibration -Ultrasonic search Units (transducers), types (straight, angle, dual) – Construction materials and shapes-Beam intensity, characteristics, sensitivity, resolution and damping – Transducer operation, manipulations.

Ultrasonic Inspection Methods and Equipment

Principle of pulse echo method, through transmission method, resonance method – Advantages, limitations-contact testing, immersion testing-couplant-Data presentation A, B and C scan displays, comparison of contact and immersion method-Pulse Echo instrumentation, controls and circuits, pulse generation, signal detection, display and recording methods, gates, alarms and attenuators, detectability of defect, cables, connectors, test specimens etc

Calibration of Testing Equipment

Basic instrument calibration -calibration blocks (IIW Block, ASTM Blocks, Distance Amplitude Block, Area Amplitude Block, etc.),. Reference reflectors for calibration (side drilled holes, notches, etc.) Inspection calibration, comparison with reference blocks, reference for planned tests (straight beams angle beam. etc.), transmission factors-factors affecting the performance of ultrasonic test.

Testing/Evaluation/interpretation

Weld body examination with normal and angle beam by DAC and DGS methods -Ultrasonic testing and evaluation of base material product forms -(a) Ingot, (b) Plate and Sheet (c) Bar and Rod (d) Castings (e) Forgings (f) Pipe and Tubular products-Ultrasonic test indications-Variables affecting ultrasonic test results-case studies in metals and composites, weld geometries, root inspection types, origin and typical orientation of discontinuities-response of discontinuities to ultrasound safety precautions, Test Procedure- Scan plan/technique sheets,

Applicable codes and standards, specifications (ASME, ASTM, AWS, BS. etc.)

COURSE OBJECTIVES

To introduce students to a variety of practical applications associated with ultrasonic testing and the course is especially designed to provide a sound theoretical knowledge and practical skill for Ultrasonic testing. Wide range of case studies would be covered.

COURSE OUTCOMES (CO)

Course Outcomes	Aligned Programme Outcomes (PO)
Basic knowledge about ultrasonic waves, its properties / propagation through material media	Students will have clear understanding about the properties and propagation of ultrasonic wave through various material media.
Basic knowledge about the production and detection of ultrasonic wave using various physical phenomena	Students will get to know about production role of various physical phenomena by which the ultrasound are produced / detected.

COURSE PLAN – PART II

COURSE OVERVIEW

Fundamental of PA ultrasonic, ToFD, Guided wave ultrasonics, Laser shearography , structural Health Monitoring and its usage in the NDT. Methods of calibration of instrument and evaluation of signals.

COURSE TEACHING AND LEARNING ACTIVITIES

Sl.No	Week/Month/ Hours	Topic	Mode of Delivery
1	2nd to 4th week of August (3 Hours per week)	**Fundamentals of Ultrasonic Waves** Introduction to ultrasonic waves, Wave propagation in metals, Modes of sound wave generation , Properties of ultrasound waves ,Snell's law and critical angles, Wave propagation in other engineering materials	PPT+ Black Board Presentation
2	1st to 4th Week of September (3 Hours per week)	**Generation of ultrasonic waves** Methods of ultrasonic wave generation, Ultrasonic transducers, Beam intensity, characteristics, sensitivity, resolution and damping, Transducer operation, manipulations. **Ultrasonic Inspection Methods and Equipment** Principle of pulse echo method, through transmission method, resonance method, contact testing, immersion testing, couplant, Data presentation A, B and C scan displays, comparison of contact and immersion method. Pulse Echo instrumentation, controls and circuits etc.	PPT+ Black Board Presentation
3	1st to 5th week of October (3 Hours per week)	**Calibration of Testing Equipment** Basic instrument calibration – calibration blocks (IIW Block, ASTM Blocks, Distance Amplitude Block, Area Amplitude Block, etc.) Inspection calibration, comparison with reference blocks, reference for planned tests (straight beams angle beam. etc.) Transmission factors – factors affecting the performance of ultrasonic test. **Testing/Evaluation/interpretation** Weld body examination with normal and angle beam by DAC and DGS methods. Ultrasonic testing and evaluation of base material product forms (a) Ingot, (b) Plate and Sheet (c) Bar and Rod (d) Castings (e) Forgings (f) Pipe and Tubular products, Ultrasonic test indications, Variables affecting ultrasonic test results-	PPT+ Black Board Presentation

4	1st to 2nd week of November (3 Hours per week)	studies in metals and composites- weld geometries, root inspection - types, origin and typical orientation of discontinuities - response of discontinuities to ultrasound Safety precautions, test Procedure- scan plan/technique sheets, Applicable codes and standards, specifications (ASME, ASTM, AWS, BS. etc.)	PPT+ Black Board Presentation

COURSE ASSESSMENT METHODS

S.No.	Mode of Assessment	Week/Date	Duration	% Weightage
1	CT -1	3rd week of September 2019	1 hour	20%
2	CT -2	4th week of October 2019	1 hour	20%
3	Assignment	1st Week of November 2019	1 hour	10%
4	Final Exam	End of Semester	3 Hours	50%
		Total		100 %

ESSENTIAL READINGS : Textbooks, reference books Website addresses, journals, etc

Text Books& Reference Books::

1. Ultrasonic Testing of Materials- Josef Krautkramer & Herbert Krautkramer
2. American Society of Metals Handbook-Volume 17-NDT Evaluation and Quality Control
3. ASNT Handbook-Ultrasonic Testing-Volume 7
4. Ultrasonic Inspection- GE Inspection Technologies
5. Treatise on Non-Destructive Testing annd Evaluation-J.Prasad, T.Rangachari, B.N.S.Murthy

Website addresses : ndt.net, net.ed,

Journal: Journal of Non- Destructive Testing & evaluation. Material Evaluation Journal

COURSE EXIT SURVEY

- Feedback from the student after 18th week: on knowledge gained, subjects relevant to the course, methodology adopted, aspect of improvement. Whether the topics fulfill the course outcome and program outcome.

COURSE POLICY (including plagiarism, academic honesty, attendance, etc.)

- Absenteeism in Assessment: Extra chances will be given to the students (on medical or official purpose) not appeared in any assessments 1 - 3 with full syllabus.

ADDITIONAL COURSE INFORMATION

The Course Coordinator is available for consultation at times that are displayed on the coordinator's office notice board. Queries may also be emailed to the Course Coordinator directly at bkarthik@nitt.edu

MODE OF CORRESPONDENCE (email/ phone etc.)

- Class representatives can contact the Faculty using Email manmobhel@gmail.com or Phone 9442503011.

- **Students other than class representatives shall contact only for any necessary requirements.**

ATTENDANCE

- **It is mandatory to have a min. of 75% attendance to appear in the semester examination.**
- **Already, 25% of attendance has been relaxed for any sickness, family ceremony / festivals and academic / sport activities or any industrial visits etc.**
- **Student(s) having less than 75% attendance may not be allowed in the Final Assessment.**
- **NITT approved on-duty (OD) and genuine medical certificates will be considered.**

COMPENSATION ASSESSMENT

- **There will be one compensation assessment for all those who miss writing Test I or Test II or both for genuine permissible reasons (sickness and institute approved ODs).**
- **No compensation assessment will be available for improving the score in any assessments.**

MINIMUM PASS MARK

- **The minimum pass mark is 40% for PG students**

ACADEMIC HONESTY & PLAGIARISM

- **Those who indulge in malpractice such as copying, plagiarism will get punishment which may lead to REDO the course (depending on the actual intensity of the activity).**

ADDITIONAL INFORMATION

- **Those who fail in the course can appear for the supplementary exam.**
- **Any misbehavior, indiscipline in the classroom / examination hall will be dealt with seriously. In the worst case, the institute's disciplinary committee is empowered to debar the student from the course.**

FOR SENATE'S CONSIDERATION

Sd

(M.Manimohan)	**(Sd)**	**(Sd)**
Course Faculty	**CC-Chairperson**	**HOD**