VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SLOT: A2 + TA2

REG.NO.:

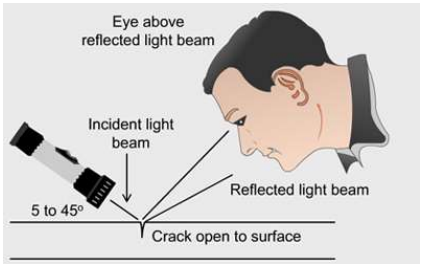
SCHOOL OF MECHANICAL ENGINEERING
CONTINUOUS ASSESSMENT TEST (CAT) -I
WINTER SEMESTER 2024-2025

Programme Name & Branch	**: B Tech Mechanical Engineering**	
Course Code	**: BMEE313E**	
Course Name	**: Non-destructive testing**	
Faculty Name(s)	**: Prof. Mahesh V. P.**	
Class Number(s)	**: VL2024250503824**	
Date of Examination	**: 27-01-2025, 2:00 - 3:30 PM**	
Exam Duration	**: 90 minutes**	**Maximum Marks: 50**

General Instruction(s):

- Answer **all**
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes Statements:
  CO. 1: Infer the knowledge of various NDT techniques.
  CO. 2: Apply the NDT techniques to identify surface defects of engineering components.
  CO. 3: Use the subsurface NDT techniques to identify the defects.

ANSWER KEY

Q. No	Question	M	CO	BL
1.	Compare two types of visual inspection methods used in the NDT analysis based on the techniques/apparatus involved and the analysis methods. Also, analyze the working principle of borescope and mention its applications in the industry. Answer: Types of Visual Inspection 1) Direct visual testing 2) Remote/ Indirect visual testing Direct Visual Testing: Inspection using the naked eye, magnifying lenses, mirrors, etc. Visual Inspection: • Naked eyes • Visual aids (Magnifying glasses, mirrors) • Physical access to the area to examine is limited or the visibilities is limited e.g. – inspecting inner diameter of the bolt hole To inspect the diameter Boroscope is very useful.  	10	1	4

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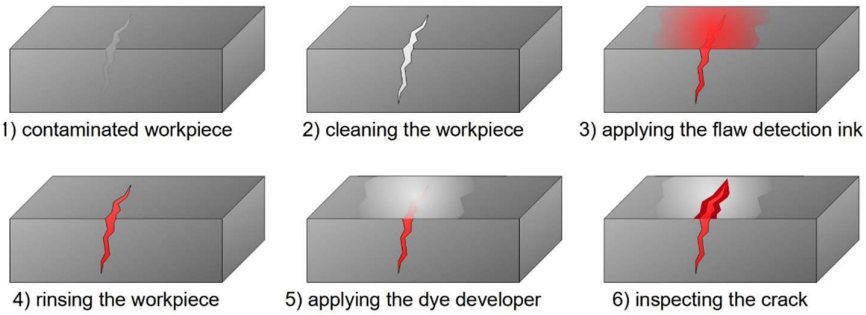
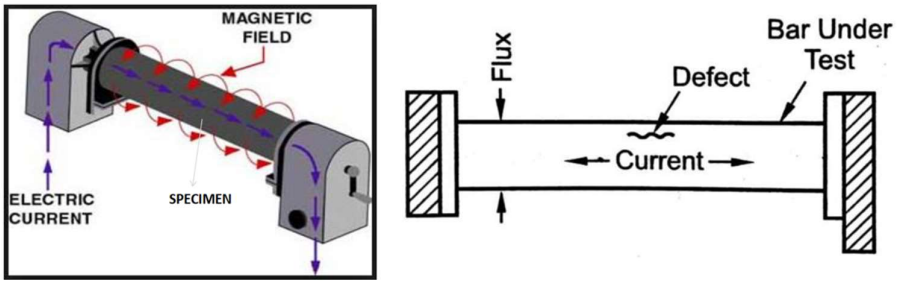
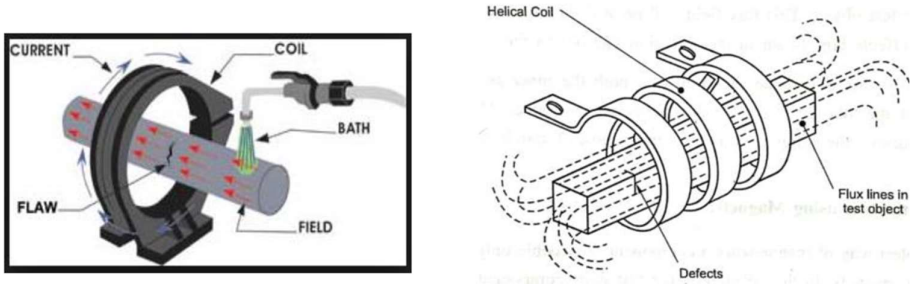
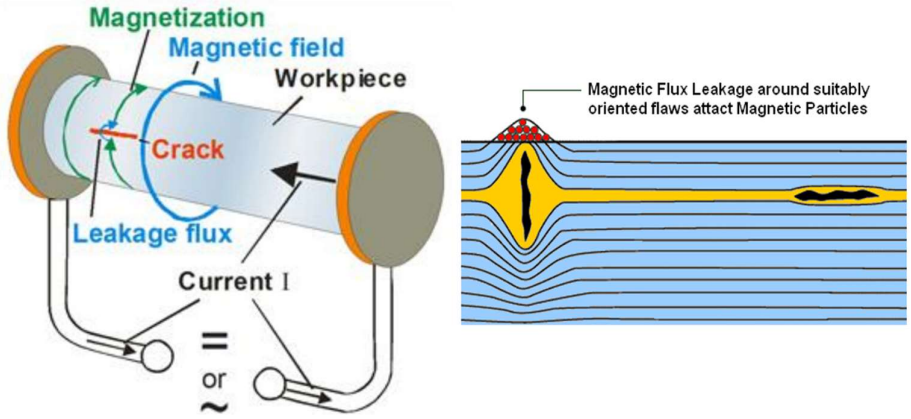
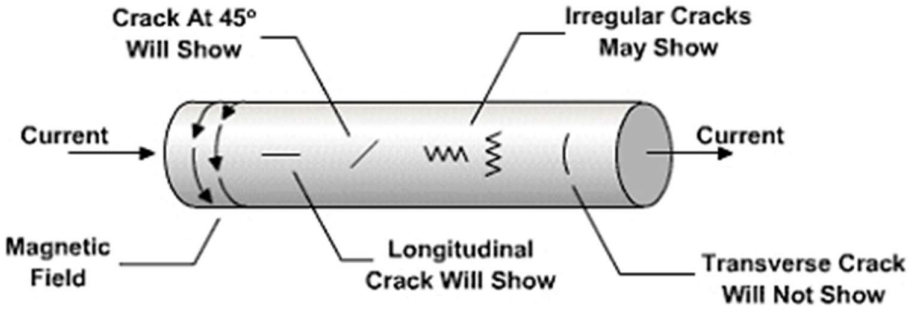
	Indirect Visual Testing: Fiberscope, borescope, robotic crawlers, etc. Boroscope: Optical instrument to inspect narrow spaces that are difficult to reach. • Tube can be rigid or flexible • With a camera or objective lens on one end • An eyepiece or display on the other. • Tube is connected by an optical or electrical system • Boroscopes are often used to inspect steel for corrosion. • They can be particularly useful for non-traditional construction dwellings. • Boroscope inspections can also confirm a property's structural stability.			
2.	Differentiate between the visible dye penetrant testing method and the fluorescent dye penetrant testing method used in non-destructive testing based on the apparatus/testing materials used, testing procedure, and industrial applications. Answer:  Dye penetrant testing – visible, fluorescent method: • Fluorescent penetrants contain a dye or several dyes that fluoresce when exposed to ultraviolet radiation • Fluorescent penetrant systems are more sensitive than visible penetrant systems • Eye is drawn to the glow of the fluorescing indication. • Visible penetrants contain a red dye that provides high contrast against the white developer background • However, visible penetrants do not require a darkened area and an ultraviolet light in order to make an inspection • Visible penetrants are also less vulnerable to contamination from things such as cleaning fluid • Contamination can significantly reduce the strength of a fluorescent indication. When selecting a penetrant method, you can consider factors such as: • Defect type and size: Method for detecting wide, shallow defects. • Surface condition: Rough surfaces are difficult to clean • Component material: Solvent removable methods may damage the surface if the penetrant and material are incompatible.	10	2	4

	• Item size and position: Fluorescent and water washable methods require darkened conditions or a water source, so they are not suitable for on-site welds. • Equipment and expertise: Fluorescent, water washable, and post-emulsifiable methods use flow lines, so they are better suited for factory use.			
3.	Justify why the coil-shot technique is more suitable for low melting point materials compared to the head-shot technique. Support your arguments with proper schematics. Answer: The heating by the Joules Heating Effect has to be discussed. It is a problem for low melting point materials. **Methods of Magnetization** 1. Head shot technique  2. Coil shot technique 	10	2	4
4.	Illustrate different types of magnetic particle testing methods available for non-destructive testing of metallic materials. Among these types, which type will be suitable for the defect/flaw analysis of a hollow cylindrical steel pipe and why? Answer: Dry and wet magnetic particle testing methods are available. The method suitable for the given condition is wet method as the surface is curved. General steps involved are as follows: • Prepare the part surface: Surface should be relatively clean • Apply the suspension: Gently sprayed or flowed over the surface of the part • Apply the magnetizing force: Magnetizing force should be applied	10	3	3

	immediately after applying the suspension of magnetic particles • When using a wet horizontal inspection unit, the current is applied to improve particle mobility • Inspect for indications - Look for areas where the magnetic particles are clustered • Surface discontinuities will produce a sharp indication • Indications from subsurface flaws will be less defined and lose definition as depth increases  • Wet method magnetic particles differ from dry powder products • Both visible and fluorescent particles are available • Non-fluorescent particles are ferromagnetic iron oxides (black/brown) • Fluorescent particles: Coated with pigments that fluoresce when exposed to UV light • Particles that fluoresce green-yellow are most common • Other fluorescent colors are also available • Particles are typically 10 µm (0.0004 inch) and smaller • Synthetic iron oxides have particle diameters ~0.1 µm (0.000004 inch) • Suspension: Either a light petroleum distillate or water with additives 			
5.	Differentiate the two major types of ultrasonic testing methods based on the positioning of probes. Draw neat sketches and analyze the inspection methods for these two types.	10	3	4

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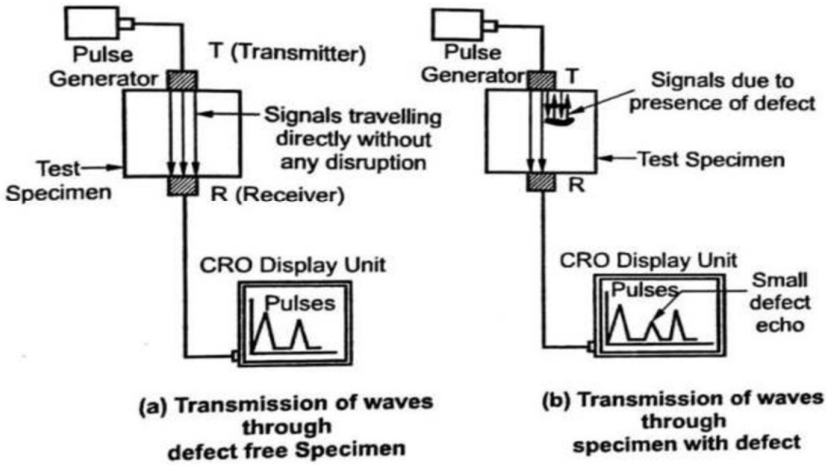
Answer:

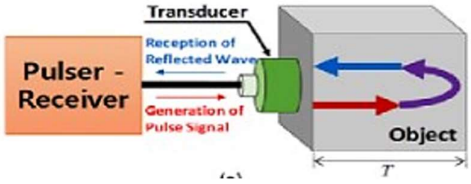
1. Transmission method

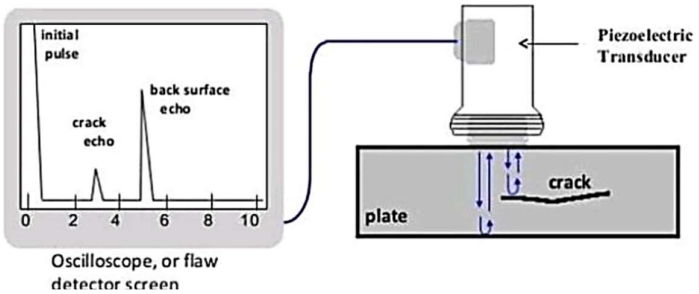


(a) Transmission of waves through defect free Specimen

(b) Transmission of waves through specimen with defect

2. Pulse – echo method





Oscilloscope, or flaw detector screen

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