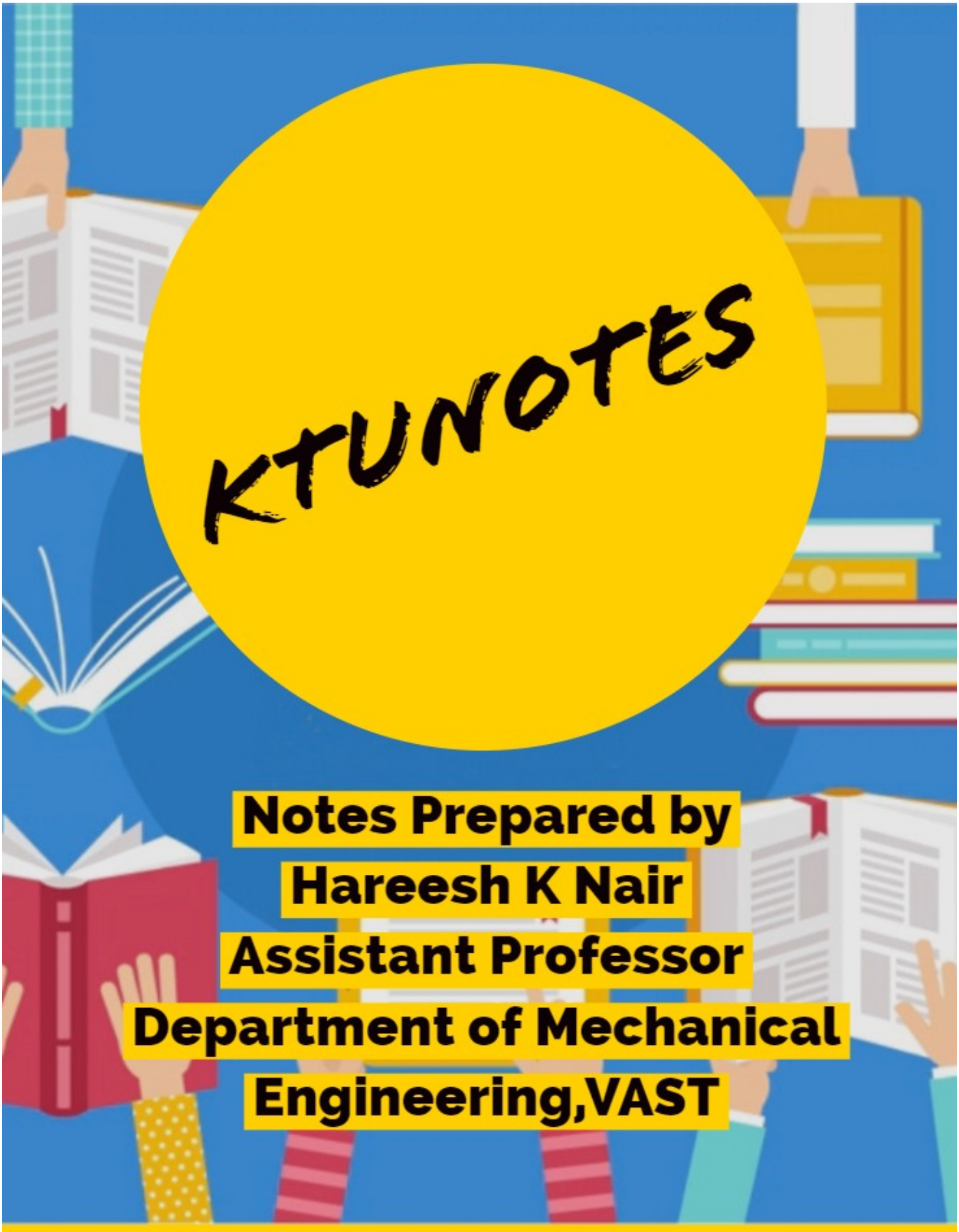

Notes Prepared by

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Non-Destructive Testing (NDT)
Module 1

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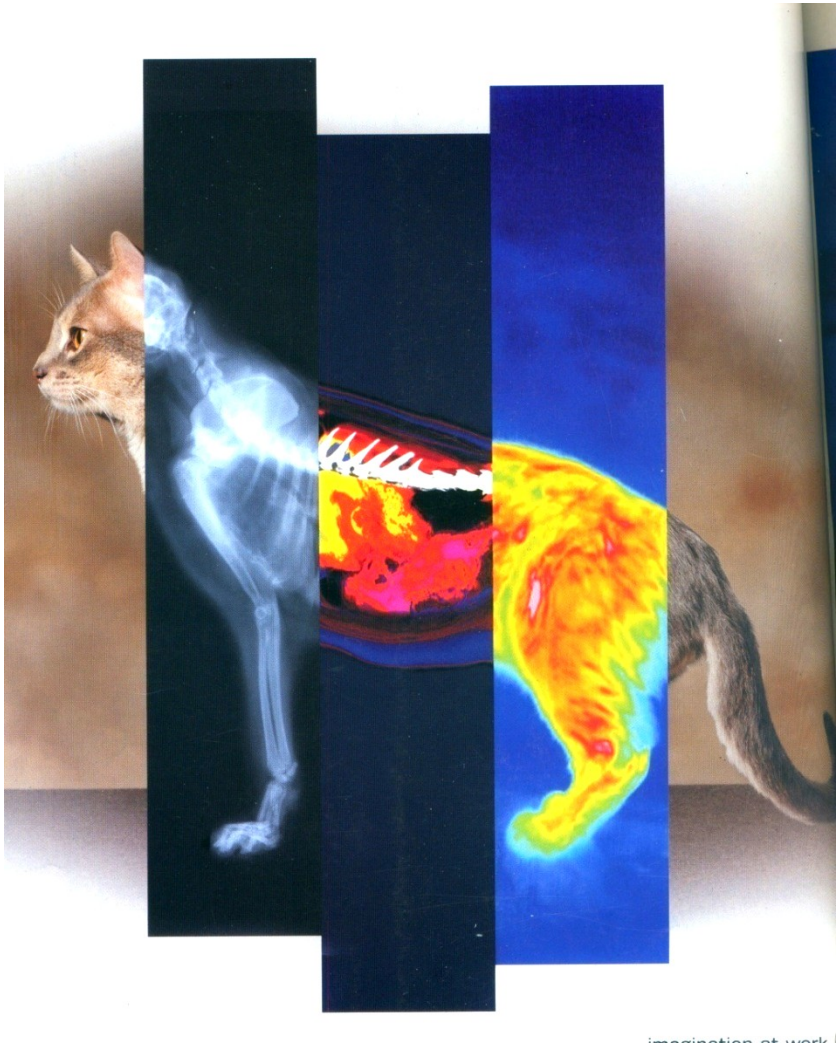
Introduction to NDT

- **Nondestructive testing** or **non-destructive testing** (**NDT**) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage.The terms **nondestructive examination** (**NDE**), **nondestructive inspection** (**NDI**), and **nondestructive evaluation** (**NDE**) are also commonly used to describe this technology.Because NDT does not permanently alter the article being inspected, it is a highly valuable technique that can save both money and time in product evaluation, troubleshooting, and research

Non-Destructive Testing (NDT)

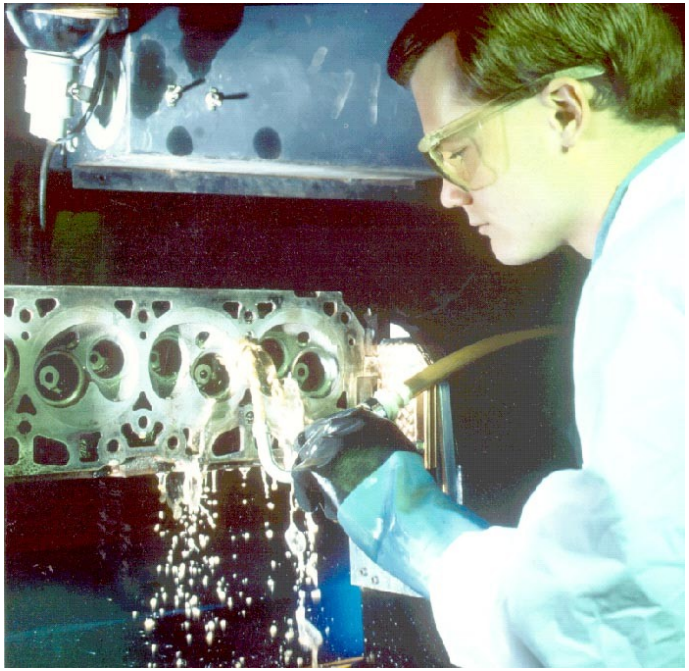
Non-Destructive testing is the use of noninvasive techniques to determine the integrity of a material, component or structure or quantitatively measure some characteristics of an object. It is the testing of materials, for surface or internal flaws or metallurgical condition, without interfering in any way with the integrity of the material or its suitability for service.

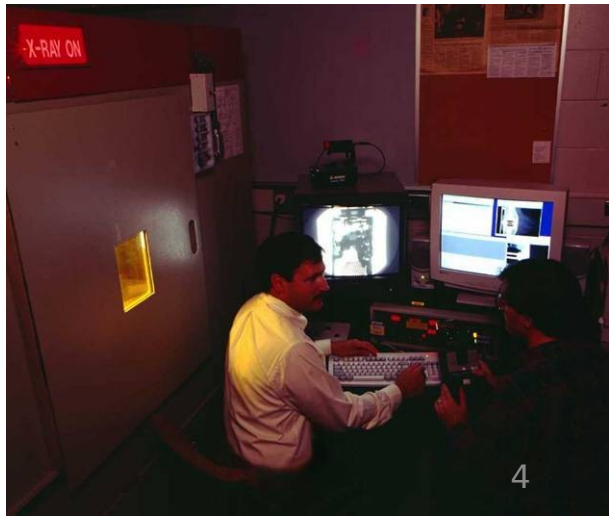


i.e. Inspect or measure without doing harm.

Six Most Common NDT Methods

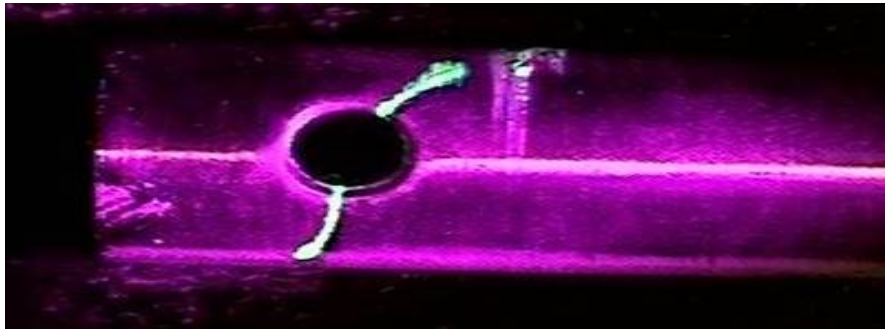
- Visual
- Liquid Penetrant
- Magnetic
- Ultrasonic
- Eddy Current
- X-ray



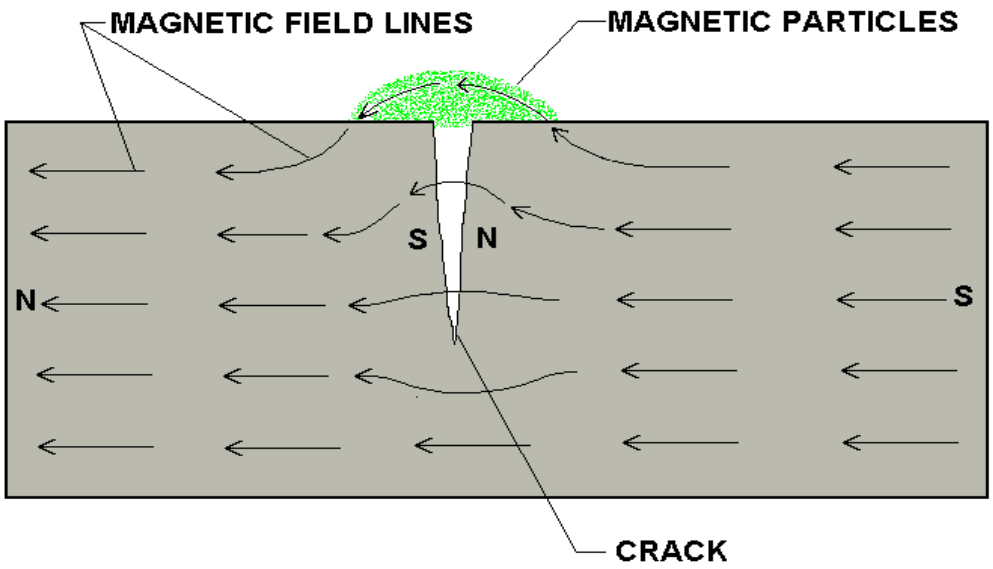


1. Visual Inspection

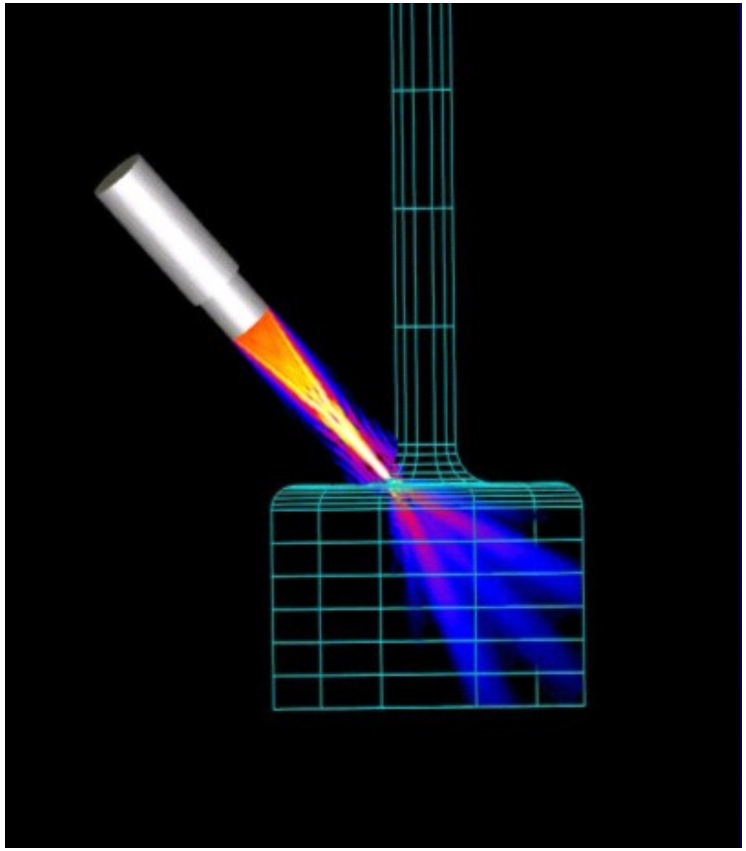
2.Liquid Penetrant Inspection



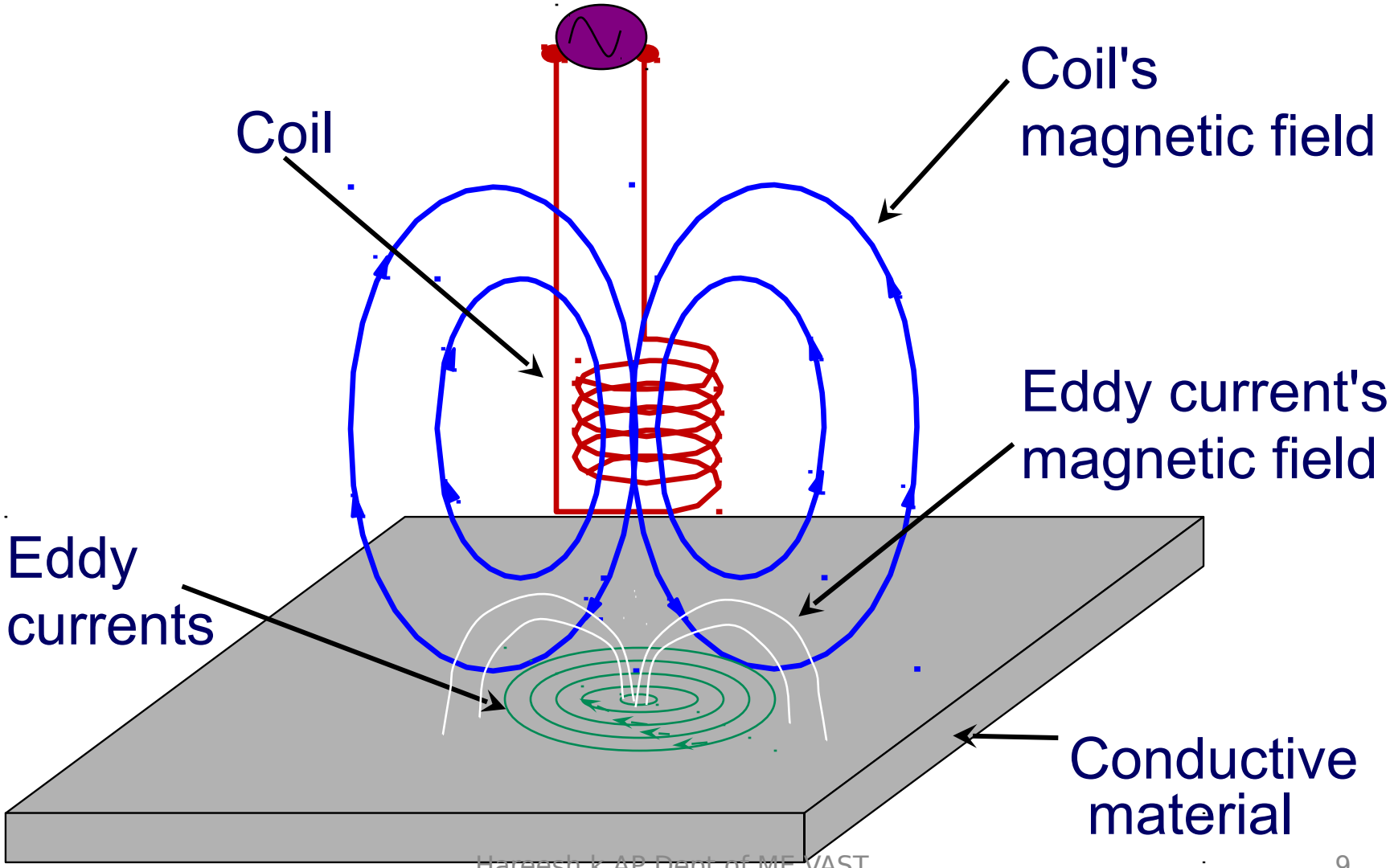
3.Magnetic Particle Inspection



4.Ultrasonic Imaging



5.Eddy Current Testing



6.Radiograpic Inspection (x-Ray)

Comparison Between Destructive and Non Destructive Testing

	Destructive Testing	Non Destructive testing
Purpose	It is carried to find properties and behaviour of specimen under different load	It is used to find properties of material and to find out defects.
Specimen	Specimen is damaged during test	Specimen is not damaged during test
Defects	Defects cannot be found using Destructive testing	Defects are found using NDT
Cost	More Costly	Less Costly
Example	Bending Test, Tensile Testing, Compression Testing, Impact testing e.t.c.	Ultrasonic testing, Liquid die penetrant method, eddy current testing.

Importance of NDT

1. NDT increases the safety and reliability of the product during operation.
2. It decreases the cost of the product by reducing scrap and conserving materials, labor and energy.
3. It enhances the reputation of the manufacturer as a producer of quality goods. All of the above factors boost the sales of the product which bring more economical benefits for the manufacturer.
4. NDT is also used widely for routine or periodic determination of quality of the plants and structures during service.
5. This not only increases the safety of operation but also eliminates any forced shut down of the plants.

Scope of NDT

- Non-destructive testing is a descriptive term used for the examination of materials and components in such a way that allows materials to be examined without changing or destroying their usefulness. NDT or NDE can be used to find, size and locate surface and subsurface flaws and defects.
- NDT plays a crucial role in everyday life and is necessary to assure safety and reliability. Typical examples are found in aircraft, spacecraft (shuttle), motor vehicles, pipelines, bridges, trains, power stations, refineries, buildings and oil platforms which are all inspected using NDT.

- NDT is a Quality Assurance management tool which can give impressive results when used correctly. It requires an understanding of the various methods available, their capabilities and limitations, knowledge of the relevant standards and specifications for performing the tests

Scope of NDT Cont..

NDT is used typically for the following reasons:

Accident prevention and to reduce costs

To improve product reliability

To determine acceptance to a given requirement

To give information on repair criteria.

Difficulties in NDT

- However lack of skilled operators, an aging workforce and cost conscious users are key challenge faced by Non Destructive testing market. Though development in infrastructure and power generation have incrementally increased demand for new operators but shortage of supply and shrinking budget continues to …

Future Progress in NDT

3D characterisation

Ultrasound is the ideal vehicle for exploring the local response of a composite structure to stress, and map this across the whole 3D structure

Mechanical Modelling Using NDT Data

Recent developments in X-ray CT and ultrasonic 3D characterisation of composites offer the potential for a greater understanding of the effects on structural integrity of material variations such as in-plane fibre waviness, out-of-plane ply wrinkling, and 3D variations in fibre-volume fraction or porosity

Economic Aspects of NDT

- It is highly Economical compared to other methods.
- Products can be reused
- Rejection rate is less

Visual Inspection

Visual Inspection

Most basic and common inspection method.

Portable video inspection unit with zoom allows inspection of large tanks and vessels, railroad tank cars, sewer lines.

Robotic crawlers permit observation in hazardous or tight areas, such as air ducts, reactors, pipelines.

Visual Inspection

- Visual Inspection is one of the most widely used Non-Destructive Testing methods for the detection of discontinuities before they cause major problems, e.g. poor welding, surface defects, corrosion pits, general condition, degradation, blockages and foreign materials.

- Visual Inspection means the inspection of equipment and structures using a combination of human senses such as vision, hearing, touch and smell.
- Visual Inspection is sometimes carried out in conjunction with devices such as a low power magnifying glass, boroscopes, fiberscopes, digital video borescopes, camera systems and robotic crawler systems.

- Generally, almost any specimen can be visually examined to determine the accuracy of its fabrication.
- For example, visual inspection can be used to determine whether the part was fabricated to the correct size, whether the part is complete, or whether all of the parts have been appropriately incorporated into the device.

Vision

The eye

- Human eye is the most valuable NDT Tool
- Sensitivity of the human eye varies according to the light source
- Human eye has an excellent visual perception
- Yellow green light of wavelength 5560°A is the most suitable light for human eye at normal condition

Tools Used in Visual Inspection

- Mirrors
- Magnifying Glasses
- Microscopes
- Borescope
- Endoscope
- Flexible fibres
- Closed circuit Television system
- Computer enhanced systems

Applications of Visual Inspection

- It is used to inspect whether there is a misalignment of parts in the equipment
- It checks for corrosion, erosion, cracks and deformities of machine components
- It inspect the plant components for any leakage or abnormal operation
- It is used to identify the defects in weldments

Limitations of Visual Inspections

- Can identify only large discontinuities
- Limited to surface discontinuities
- Skilled labour required
- Result depend on the eye resolution of the inspector
- It may cause eye fatigue to the inspector

Lighting and Lighting source

- The amount of light is depend up on the type of test.
- For an appropriate visual inspection, suitable lighting of about 800-1000 Lux
- The major lighting sources are
  - Incandescent Lamp
  - Fluorescent lamp
  - High intensity discharge lamp

Material factors that affect Visual Testing

- Surface Condition
  - Cleanliness
  - Colour
  - Texture
- Physical Conditions
  - Specimen Condition
  - Shape and Size
  - Temperature
- Environmental Factors
  - Atmosphere
  - Cleanliness
  - Humidity and Temperature
  - Safety
- Physiological Factors
  - Physical Comfort
  - Health , mental attitude, fatigue and test item position

Types of Visual Inspection

- 1. Unaided Visual Inspection
- 2.Aided Visual Inspection

1. Unaided Visual Inspection

- It is also Known as Direct Visual Inspection
- It can be accomplished with the help of naked eye
- It can done with out the help of optical aids
- Defects can be detected are
  - Absence of cracks, Corrosion layer, surface porosity, Misalignment of mated parts

2. Aided Visual Inspection

- It is also known as Indirect Visual Inspection
- It is performed using optical instruments
- This will identify the defects which cannot detect with human eye
- It permits visibility to areas are not accessible to human eye

Visual Perception

- It is the interpretation of impressions transmitted from retina of eye to the brain in terms of information
- Visual perception depends on the vision acuity
- Human eye has an excellent visual perception

Tools Used in Visual Inspection

- Mirrors
- Magnifying Glasses
- Microscopes
- Borescope
- Endoscope
- Flexible fibres
- Closed circuit Television system
- Computer enhanced systems

Magnifying Mirrors

- It is also known as concave spherical mirrors
- It is used to magnify the areas which are not accessible to human eye.

Magnifying Glass

- It is also called as Hand Lens
- This lens is used to produce a magnified Image
- Magnification depends upon the position where it is being placed between the human eye and the object
- For higher power magnification, double or multiple lenses are used

Microscope

- Microscope is used to magnify the image of a small object
- Magnification Power = 10/F

Borescope

- Which is used to inspect the inside of a narrow tube
- It is a flexible tube with an eyepiece at one end and objective lens at another end
- Light is passed through the lens and to obtain a clear image
- Available range is 2.5 mm to 19 mm
- Video

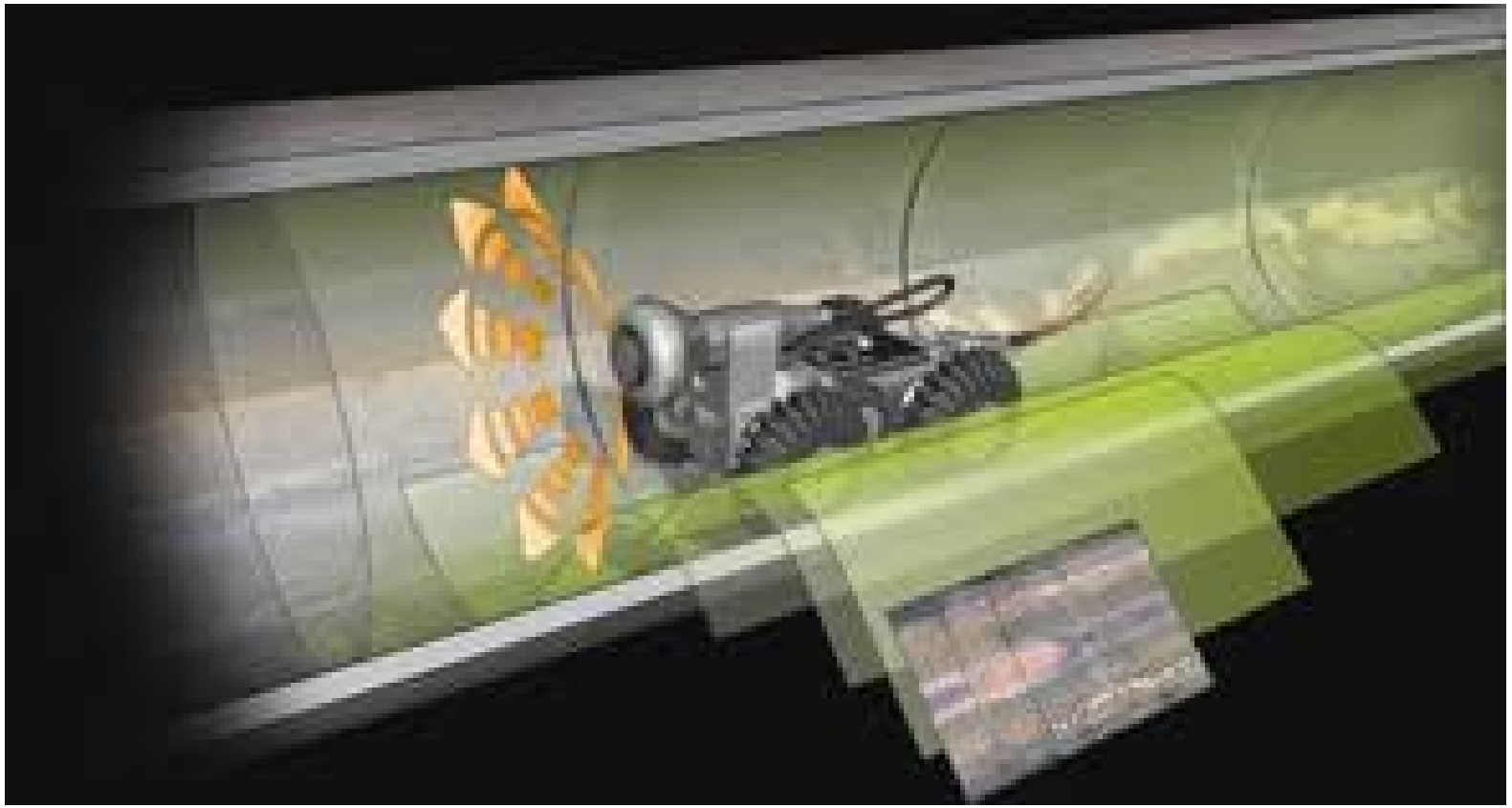
Endoscope

- It is bit superior than borescope
- Magnification factor of 10X is obtained
- Available up to smaller dia of 1.7 mm and length upto 100-150mm

Fibroscopes

- Also called fibre optic borescope
- Dia range of about 3 to 12.5mm and length varies between 60 – 365 cm

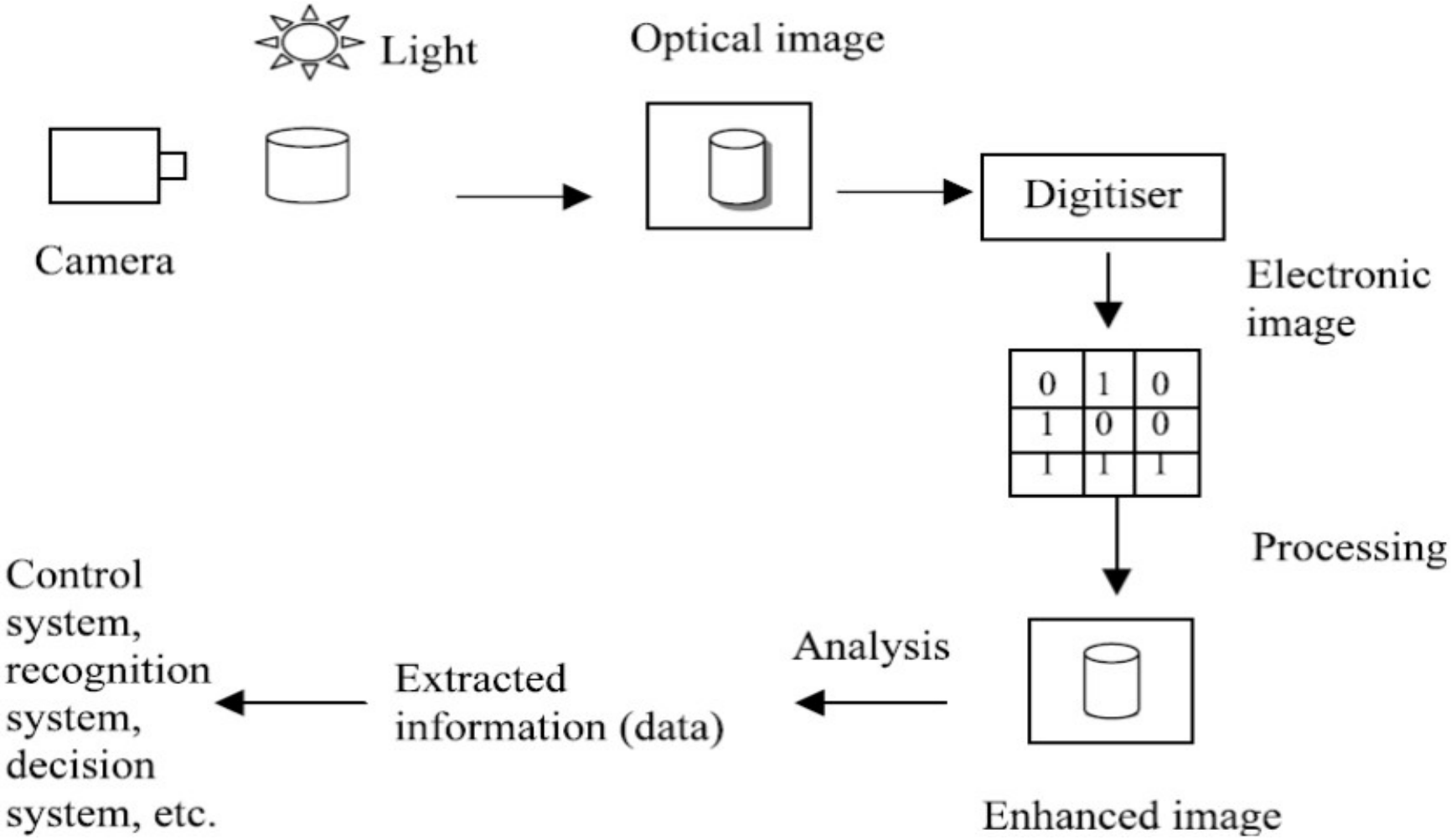
CCTV



Special Lighting

- Back Lighting
- Front Lighting
- Structured Lighting
- Strobe Lighting
- Ultraviolet Lighting

Computer Enhanced Visual System



thank you!