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16. en.wikipedia.org

SUMMARY

- Non Destructive testing refers to a method of detecting internal flaws engineering materials without breaking them.
- Non Destructive testing is the corner stone of all activities in all engineering industries as it provides perfection, no risk factor and flawless performance.
- Destructive testing refers to determining the properties like elasticity, stiffness, resilience, ductility, hardness and toughness.
- Some common destructive testing methods are tensile test, compressive test, shear and bending test, torsion test, impact test, creep test, fatigue test, hardness test.
- Some common Non destructive testing methods are visual and optical test, penetrant testing, magnetic particle testing, eddy current testing, radiographic and ultrasonic testing.
- Defects are classified as inherent defects, introduced at the stage and process defect, caused during processing, fabrication or finishing.
- Defects raised during the use of the end product due to either to environmental loads perhaps both, these defects are called as service defects.

OBJECTIVE TYPE QUESTIONS

1. Young's Modulus is an indicative of property
 - (a) Resilience
 - (b) Stiffness
 - (c) Elasticity
 - (d) Plasticity

2. Ability of metal to withstand elongation or deformation is known as
 - (a) Malleability
 - (b) Stiffness
 - (c) Ductility
 - (d) Brittleness
3. Universal testing machine is used for determining
 - (a) Tensile strength
 - (b) Hardness
 - (c) Fatigue Strength
 - (d) (a) and (b) both
4. X-rays was discovered by
 - (a) Hart Ford
 - (b) W.C. Rontgen
 - (c) Dr. H.H. Lester
 - (d) Dr. Eimer Sperry
5. Magnetic induction system for inspecting rail road's was developed by
 - (a) Hart Ford
 - (b) W.C. Rontgen
 - (c) Dr. H.H. Lester
 - (d) Dr. Eimer Sperry
6. Lack of ductility is called as
 - (a) Hardness
 - (b) Elasticity
 - (c) Creep
 - (d) Brittleness
7. High frequency sound waves are used in
 - (a) Ultrasonic Testing
 - (b) Radiographic Testing
 - (c) Magnetic Particle Testing
 - (d) Visual Inspection
8. First electromagnetic eddy current instrument was developed in
 - (a) 1926
 - (b) 1920
 - (c) 1925
 - (d) 1927
9. Ultrasonic waves are generated by
 - (a) Photoelectric effect
 - (b) Piezoelectric effect
 - (c) Radioactive decay
 - (d) Skin effect
10. Which one is an inherent discontinuity
 - (a) Scar
 - (b) Seams
 - (c) Crater Cark
 - (d) Slag inclusion

Answers

- | | | | | |
|--------|--------|--------|--------|---------|
| 1. (b) | 2. (c) | 3. (a) | 4. (b) | 5. (d) |
| 6. (d) | 7. (a) | 8. (a) | 9. (b) | 10. (a) |

REVIEW QUESTIONS

1. What do you meant by Non Destructive testing?
2. Discuss the scope and advantage of Non Destructive testing.
3. What do you mean by Destructive testing methods? Explain any one test method in brief.
4. Enlist in details about the various Non Destructive testing method used.
5. What do you mean by Defects?
6. Discuss any Six defects inspected by Non Destructive testing methods.
7. Discuss the importance of Non Destructive testing.
8. Enlist various fields of applications of Non Destructive testing methods.
9. Differentiate between Destructive and Non Destructive testing methods.

8. NDT.net, Nondestructive Online Journal.
9. NDT.org NDT Jobs, News, and Social Network.
10. NDTWiki.com, Non Destructive Testing wiki for professionals.
11. SimplyNDT.com, NDT Employment, News, Blog Website.
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SUMMARY

- Visual inspection is commonly defined as the examination of material, component or product for conditions of non-conformance using light and eyes, alone or in conjunction with various aids.
- Visual inspection involves shaking, listening, feeling and sometimes even smelling the components being inspected.
- Contrast is the difference in luminance that makes an object distinguishable from its environment.
- Maximum contrast of an image is called as contrast Ratio or Dynamic Range.
- Machine vision is the technology and method which uses an imaging system and a computer to analyze an image.
- Steps involved in Machine vision inspection are Image acquisition, Image Processing, Feature extraction, and Decision & control.
- Oil and whiting inspection technique was used for the inspection of railroad axle, wheels, couplers and locomotive parts.
- Hammer test is used for checking the healthiness of castings.

OBJECTIVE TYPE QUESTIONS

1. Photo receptors rods and cones are part of
 - (a) Retina
 - (b) Iris
 - (c) Pupils
 - (d) Lens
2. Difference in luminance that makes an object distinguishable is called as
 - (a) Brightness
 - (b) contrast
 - (c) Vision
 - (d) Visual acuity
3. is used for visual inspection
 - (a) Transducer
 - (b) Telescope
 - (c) Binocular
 - (d) None of the above

4. The method involved use of an oil usually made of a dark lubrication oil diluted with to find surface defects
(a) Zyglo test (b) Hammer test
(c) Oil and whitening test (d) A and C only
5. Inspection technique which must take place prior to, during, after welding.
(a) Liquid penetrant testing (b) Ultrasonic testing
(c) Radio graphic Testing (d) Visual inspection

Answers

1. (a) 2. (b) 3. (b) 4. (c) 5. (d).

REVIEW QUESTIONS

1. What do you mean visual inspection and what are its types?
2. Differentiate between Manual inspection and Automated inspection.
3. Enlist the various equipment involved in visual inspection.
4. Define machine vision and what are the steps involved in inspection via machine.
5. Describe in Brief about oil and whitening inspection and Hammer test.
6. Enlist the advantages and limitations of visual inspection.



- Zyglo Fluorescent test is a simple, reliable and economical testing method which can be used for inspecting defects like seams, forging laps, porosity, cold shuts, fatigue crack, grinding crack etc. in a variety of porous and non-porous materials.

OBJECTIVE TYPE QUESTIONS

1. Penetrants can be applied by:
(a) Dipping (b) Spraying
(c) Brushing (d) All of the above
2. Dry developers can be applied to:
(a) Wet part (b) Dry part
(c) Partially wet part (d) None of the above
3. Contamination on the surface of test object can lead to
(a) Shift in wavelength (b) High background fluorescence
(c) Lower background fluorescence (d) None of the above
4. Minimum penetrants dwell time is:
(a) 5-10 minutes (b) 10-25 minutes
(c) 25-100 minutes (d) 5-60 minutes
5. Wet soluble powder is to be checked.
(a) Daily (b) Weekly
(c) Monthly (d) Yearly
6. Developer are used to:
(a) Draw out penetrant from discontinuity
(b) Provide contrast
(c) Increase penetrant
(d) Both A and B
7. Emulsifier can be applied by:
(a) Dipping (b) Spraying
(c) Brushing (d) Both A and B
8. Which emulsifier is water based:
(a) Lipophilic emulsifier (b) Type I emulsifier
(c) Hydrophilic emulsifier (d) Form A emulsifier
9. Raising the temperature:
(a) Will increase the evaporation speed of penetrant
(b) Will decrease the evaporation speed of penetrant
(c) Will increase the developer time
(d) Will decrease the emulsifier time
10. Total time in which penetrant is in direct contact with test specimen.
(a) Soak time (b) Baking time
(c) Dwell time (d) Immersion time

Answers

- | | | | | |
|--------|--------|--------|--------|----------|
| 1. (d) | 2. (b) | 3. (b) | 4. (d) | 5. (b) |
| 6. (d) | 7. (d) | 8. (c) | 9. (a) | 10. (c). |

REVIEW QUESTIONS

1. Explain the working principle of liquid penetrant testing with neat sketch.
2. Enlist various test stations used in inspection by penetrant testing method.
3. What are various penetrants inspection techniques?
4. Write short notes on:
 - (a) Method A
 - (b) Method B
 - (c) Method C
5. Enlist various properties of penetrants.
6. What do you mean developers and what are its types?
7. What are the standards applicable to liquid penetrant testing?
8. Write short notes on
 - (a) Leak test
 - (b) Zyglo fluorescent penetrant test.

□ □ □

- Some common equipment used in MPI are permanent magnets, electromagnets, prods, coils and conductive cables, wet horizontal unit, lights, magnetic field indicator etc.
- Testing technique in MPI is classified as dry particle inspection, wet suspension inspection, Magnetic Rubber inspection.

OBJECTIVE TYPE QUESTIONS

1. Most effective NDT method for locating defects in ferromagnetic material:
(a) Ultrasonic testing
(b) ~~Magnetic particle testing~~
(c) Liquid penetrant testing
(d) Radio graphic testing
2. Which of the following are ferromagnetic materials?
(a) Aluminium, iron, copper
(b) Iron, copper, nickel
(c) Copper, aluminium, silver
(d) Iron, cobalt, nickel
3. Narrower hysteresis loop in a material is due to
(a) Higher residual magnetism
(b) Higher retentivity
(c) Lower residual magnetism
(d) Higher permeability
4. Magnetic field applied to reduce the magnetic flux of a magnetic material to zero is called
(a) Permeability
(b) Residual magnetism
(c) Retentivity
(d) coercive force
5. In a magnet, exit poles are concentrated at
(a) Dipole
(b) North pole
(c) South pole
(d) Flux density
6. Magnetic field contained completely within the test specimen is called as:
(a) Confined field
(b) Longitudinal field
(c) Circular field
(d) Saturated field
7. Circular field is produced by
(a) Coil
(b) Heat shot
(c) Yoke
(d) All of the above.
8. Prod method is sensitive to cracks
(a) Parallel to point of contact
(b) Tangential to radius of contact point
(c) Perpendicular to contact point
(d) Perpendicular to axis of coil
9. Skin effect is noticeable in
(a) Magnetic conductor carrying a DC current
(b) Non-magnetic conductor carrying a DC current
(c) Magnetic conductor carrying an AC current
(d) Non-Magnetic conductor carrying an AC current
10. Wet method is superior to dry particle for detecting
(a) Sub surface defects
(b) Fine surface cracks
(c) Open surface cracks
(d) None of the above

Answers

- | | | | |
|--------|---------|--------|--------|
| 1. (b) | 2. (d) | 3. (d) | 4. (d) |
| 5. (b) | 6. (c) | 7. (b) | 8. (a) |
| 9. (d) | 10. (b) | | |

REVIEW QUESTIONS

1. Explain the working principles of magnetic particle testing with a net sketch. Also mention its scope.
2. What are various methods of magnetization of a ferromagnetic material?
3. Differentiate between ferromagnetic and non-ferromagnetic materials with example.
4. Discuss in brief about skin effect.
5. Enlist some equipments used in magnetic particle inspection testing.
6. Discuss various testing techniques employed in magnetic particle inspection.
7. Write short notes on
 - (a) Magnetic rubber inspection
 - (b) Wet suspension inspection
 - (c) Dry particle inspection
 - (d) Direct method of magnetization
 - (e) Indirect method of magnetization
8. What are the advantages and limitations of magnetic particle inspection?

□□□

- Natural radioactive sources are Radium and Mesothorium and man-made radioactive sources are ytterbium 169, Indium 192, Selenium 75, Cobalt 60, Caesium 137.
- X-ray film is a medium that records the images of objects exposed to X-rays.
- Quality of a radiographic image is measured by radiographic sensitivity in terms of detection of small details or defects.
- Radiographic sensitivity depends on two variables: Contrast And Definition.
- Radiographic density is the measure of degree of darkness of the film.
- Image quality indicators provides an ample information about contrast sensitivity and definition of a radiographic image.
- Digital radiography is categorised under three methods: Digitisation of Radiograph, computed radiography, and Direct radiography.
- Some commonly used radiographic techniques are image magnification technique, Neutrography, compton back scatter technique and computed tomography.
- Radiation risk assessment provides necessary information regarding radiation protection and safety procedures.

OBJECTIVE TYPE QUESTIONS

- Neutrons are classified according to their

(a) Mass	(b) Spin
(c) Charge	(d) Energy
- A small dose of X-radiation received by a pregnant woman will.

(a) result is fetal death	(b) Causes brain damage
(c) Chance of birth defects	(d) All of the above
- Mass is not a property of

(a) neutrons	(b) Beta particles
(c) X-rays	(d) Alpha particles
- Wavelength of ultraviolet ray is longer than

(a) Cosmic rays	(b) Gamma rays
(c) X-rays	(d) All of the above
- Electron volt (eV) is a unit of

(a) Energy	(b) Power
(c) Electric charge	(d) None of the above
- In decay of positron, which particle is emitted.

(a) Alpha particle	(b) Neutron
(c) Neutrino	(d) Electron
- Ionizing radiation refers.

(a) Electromagnetic radiation	(b) Corpuscular radiation
(c) Just a Beam	(d) Radiation capable of producing ions

8. In decay of the atomic number (z) changes by
 (a) -1 (b) 0
 (c) 1 (d) 2
9. By increasing the frequency of gamma photon, its
 (a) Wavelength will increase (b) Velocity will increase
 (c) Wavelength will decrease (d) Velocity will decrease
10. Half life of cobalt 60 is
 (a) 5.1 years (b) 5.2 years
 (c) 5.3 years (d) 5.8 years

Answers

- | | | | |
|--------|---------|--------|--------|
| 1. (d) | 2. (c) | 3. (c) | 4. (d) |
| 5. (a) | 6. (c) | 7. (d) | 8. (c) |
| 9. (c) | 10. (c) | | |

REVIEW QUESTIONS

1. What do you mean by Nature of a radiation?
2. Mention in details about some basic properties of a radiation.
3. What do you mean by Attenuation and its sources?
4. Write short notes on
 (a) Photo electric effect (b) Compton's effect
 (c) Pair production (d) Thomson scattering
5. Describe in brief about working X-ray radiography.
6. Describe in brief about working of Gamma ray radiography.
7. Derive Braggs equation for reflection.
8. Write short notes on
 (a) Cooling of anode (b) Focal spot and spot size
 (c) Tube voltage and tube current
9. Describe with neat sketch about different layers in X-ray films.
10. Mention recommendation followed in film Handling.
11. Describe the contributors of film interpretation.
12. What does IQI stands for? What are its type?
13. Define digital radiography with its different methods?
14. Write short notes on
 (a) Image magnification technique
 (b) Neutrography
 (c) Compton back scatter technique
 (d) Computed tomography
15. Enlist some biological effects of radiation.
16. Enlist some general practices followed against radiation protection.
17. How risk assessment of radiation is made?
18. What are the advantages of gamma ray radiography over X-ray radiography?
19. Enlist some applications of radiography?

□ □ □

OBJECTIVE TYPE QUESTIONS

1. Which wave travels through this section of material?
 - (a) Lamb wave
 - (b) Shear wave
 - (c) Surface waves
 - (d) Longitudinal waves
2. Backing material is used in transducers to:
 - (a) Control the sound
 - (b) Provide impedance mismatch
 - (c) Control the ringing of active element
 - (d) All of the above
3. Acoustic impedance is characterised by symbol:
 - (a) α
 - (b) z
 - (c) β
 - (d) p
4. Number of cycle per second is called as:
 - (a) Wave length
 - (b) Frequency
 - (c) Velocity
 - (d) None of the above
5. Most commonly used Active element in acoustic transducer is
 - (a) Piezoelectric ceramic
 - (b) Barium Titanate
 - (c) Lithium sulphate
 - (d) Quartz
6. Combined effect of absorption and scattering is called as
 - (a) Impedance
 - (b) Propagation
 - (c) Attenuation
 - (d) Shear factor
7. Ability of locating a flaw or defect is defined by
 - (a) Frequency and size
 - (b) Space and time
 - (c) Sensitivity and penetrating intensity
 - (d) Sensitivity and Resolution
8. The velocity of longitudinal waves will be highest in
 - (a) Water
 - (b) Aluminium
 - (c) Air
 - (d) Stainless steel
9. Lower the crystal thickness
 - (a) Lower will be frequency
 - (b) Higher will be frequency
 - (c) No affect
 - (d) None of above
10. Ultrasonic wheel units are used for
 - (a) Straight beam examination
 - (b) Shear wave examination
 - (c) Surface wave
 - (d) All of the above

Answers

- | | | | |
|--------|----------|--------|--------|
| 1. (a) | 2. (c) | 3. (b) | 4. (b) |
| 5. (a) | 6. (c) | 7. (d) | 8. (c) |
| 9. (b) | 10. (d). | | |

9. "MIL-STD-271, Requirements for Non-destructive Testing Methods". United States Department of Defence. 27 June 1986.
10. "TO 3B-1-1, Non-destructive Test Methods, Basic Theory, Technical Manual". United States Army. 15 June 2007.
11. NonDestructiveTesting. <http://www.sgs.com/~media/Global/Documents/Brochures/SGS-IND-NDT-A4-EN-10.pdf>
12. NDTAeroTech.com, The Online Community for Aerospace NDT Professionals.
13. en.wikipedia.org.
14. olympus-ims.com.
15. How to detect through and partial wall defects using eddy current testing method by Anthony Graviano.

SUMMARY

- Discovery of electromagnetic induction by Michael Faraday forms the basic principle of eddy current inspection.
- Eddy current testing can detect defects in an electrically conductive materials only.
- When a coil carrying alternating current is brought in proximity to a conductive test specimen and it produces a variable magnetic field around the coil and eddy current is then induced in test specimen.
- For correct interpretation of indications, factors like defects, frequency, geometry, conductivity, proximity etc. are considered.
- Flow path of eddy current's are parallel to turns of coils and perpendicular to coil flux field axis.
- Flow pattern of an eddy current is circular, until its path is disturbed by any non-conducting material or defect.
- Density of eddy current varies with the depth of penetration.
- Dedicated instruments, standard impedance plane display instrument and multifrequency instrument are some examples of eddy current testing instrument.
- Eddy current probes are classified according to the mode of operation and basic configuration of the test coil assembly.
- Eddy current testing method is applicable for thickness measurement, conducting measurement, deflection of cracks or discontinuity, conductive coating thickness measurements etc.

OBJECTIVE TYPE QUESTIONS

1. Inductance is caused by

(a) Direct current

(c) Interaction of changing magnetic field material with conductor

(d) Material

(b) Resistance in the coil

2. Pencil Probes are Prone to
 - (a) Skin effect
 - (b) Low frequency noise
 - (c) Wobble
 - (d) None of the above
3. Which type of probe is used to inspect solid products
 - (a) Bobbin probes
 - (b) Bolt hole probes
 - (c) Encircling probes
 - (d) Shielded probes
4. Higher the inductance of a coil
 - (a) Higher will be the penetration of eddy current
 - (b) Higher will be sensitivity of coil
 - (c) Lower will be sensitivity of coil
 - (d) All of the above
5. Sliding probes are usually operated in
 - (a) Differential mode
 - (b) Absolute mode
 - (c) Reflection mode
 - (d) Through-transmission mode
6. The Depth of penetration is affected by
 - (a) Magnetic Permeability
 - (b) Probe drive frequency
 - (c) Electrical resistivity
 - (d) All of the above
7. Which type of probe is used to inspect the inside diameter of a bore?
 - (a) Pencil Probes
 - (b) Pancake Probes
 - (c) Bobbin Probes
 - (d) Bolt hole probes
8. Shielding of an eddy current probe is done by ?
 - (a) Aluminium
 - (b) Lead
 - (c) Ferrite
 - (d) Both A and C
9. For inspecting sub surface defects, the frequency should be
 - (a) High
 - (b) Low
 - (c) at 90° to produce difference between lift off and flaw signals
 - (d) None of the above
10. Which type of probe is used to inspect the restricted spaces?
 - (a) Pencil Probes
 - (b) Pancake Probes
 - (c) Bobbin Probes
 - (d) Bolt hole Probes

Answers

- | | | | |
|--------|---------|--------|--------|
| 1. (c) | 2. (c) | 3. (c) | 4. (b) |
| 5. (c) | 6. (d) | 7. (d) | 8. (d) |
| 9. (c) | 10. (a) | | |

REVIEW QUESTIONS

1. Explain the working principle of eddy current testing method?
2. Discuss the factors effecting eddy current.
3. Discuss the characteristics of eddy current flow.