



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

DEFINITIONS AND TERMINOLOGY

Course Name	:	NON DESTRUCTIVE TESTING
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Course Faculty	:	Mr. A. Venuprasad, Assistant Professor Mr. A. Anudeep Kumar, Assistant Professor

OBJECTIVES

I	To help students to consider in depth the terminology and nomenclature used in the syllabus.
II	To focus on the meaning of new words / terminology/nomenclature

DEFINITIONS AND TERMINOLOGY QUESTION BANK

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
UNIT - I					
1	What is a Testing or mechanical testing?	Mechanical testing is the testing of a material to find out its mechanical properties, for example its yield strength or hardness.	Understand	CLO1	CAME526.01
2	What is an inspection?	An inspection is most an organized examination or formal evaluation exercise. In engineering activities inspection involves the measurements, tests, and gauges applied to certain characteristic to certain characteristics in regard to an object or activity.	Understand	CLO1	CAME526.01
3	What is NDT?	Non destructive testing (NDT) is the process of inspecting, testing, or evaluating materials, components or assemblies for discontinuities, or differences in characteristics without destroying the serviceability of the part or system.	Remember	CLO1	CAME526.01
4	Define Destructive test.	Destructive type of testing includes methods where the component or specimen is broken down in order to determine physical and mechanical properties such as strength, toughness and ductility.	Understand	CLO2	CAME526.02
4	What is Interpretation?	Determining if an indication is of a type to be investigated. For example, in electromagnetic testing, indications from metal loss are considered flaws because they should usually be investigated, but indications due to variations in the material properties may be harmless and non relevant.	Understand	CLO4	CAME526.04
5	What is Flaw?	Flaw is an imperfection or discontinuities that maybe detectable by non – destructive testing and is not necessarily rejectable.	Remember	CLO4	CAME526.04
6	What is Evaluation?	Determining if a flaw is rejectable. For example, is porosity in a weld larger than acceptable by code	Understand	CLO3	CAME526.03
7	What is Defect?	Defect is one or more flaws whose aggregate size, shape, orientation, location, or properties do not meet specified acceptance criteria and are rejectable.	Remember	CLO3	CAME526.03
8	Visual inspection?	The examination of a material, component or product for conditions of non – conformance using light and the eyes, alone or in conjunction with various aids.	Understand	CLO2	CAME526.02

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
9	What is Liquid penetrant testing?	Liquid pane rant testing method is an effective method of detecting surface defects in metals and other non-porous material surfaces.	Understand	CLO2	CAME526.02
10	What is Penetrant?	Penetrant is a liquid capable of testing the entire surface and being into the opening. Usually brightly colored dyes or fluorescent material are used as penetrants.	Remember	CLO3	CAME526.03
12	What is Developer?	Developer is an absorbent material capable of drawing traces of penetrants from the defects back into the surface.	Understand	CLO4	CAME526.04
13	What are discontinuities?	Whenever there is a change in the homogeneity o properties within a material, it can invariably to the presence of discontinuities.	Remember	CLO4	CAME526.04
14	What are inherent discontinuities?	An inherent discontinuity is one that is generated in the original production of an alloy stock material.	Understand	CLO1	CAME526.01
15	What is Porosity?	An inherent discontinuity arises due to reduction in solubility of gases during solidification.	Remember	CLO1	CAME526.01
16	What is Dwell penetrant time?	Sufficient period of time is allowed for the penetrant to enter any discontinuity open to that surface.	Understand	CLO4	CAME526.4
17	What is post-process Cleaning?	The post process is finally the surface of component is cleaned and a corrosion penetrant is applied if necessary.	Remember	CLO1	CAME526.1
18	Define Detector.	A detector or sensor which is capable of detecting the changes in the probing medium.	Remember	CLO2	CAME526.2
19	Define recorder or indicator in NDT?	A recorder or indicator is used to indicate or record the response from the detector.	Remember	CLO3	CAME526.3
20	What is source or probing medium in NDT?	Source can be some probing medium that can be used to inspect the specimen under test. The source can be/probing medium can be liquid penetrant, magnetic particle, ultrasonic wave, radiations, etc.	Understand	CLO4	CAME526.4
21	Define Visual testing.	Visual testing involves the visual observation of the surface of a test object to evaluate the presence of surface discontinuities. VT inspections may be by Direct Viewing, using line-of sight vision, or may be enhanced with the use of optical instruments such as magnifying glasses, mirrors, boroscopes, charge-coupled devices (CCDs) and computer-assisted viewing systems (Remote Viewing).	Understand	CLO1	CAME526.01
22	Define Scanning Photoacoustic Microscope.	It is used in both the conventional and phase contrast modes to detect a well characterized subsurface flaw in Aluminium. The physical mechanism is that of thermal diffusion, with a subsurface probe depth and flaw resolution length of approximately one thermal diffusion length.	Remember	CLO1	CAME526.01

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23	Define Discontinuity.	It is defined as a flaw or flaws that by nature or accumulated effect render a part or product unable to meet minimum applicable acceptance standards or specifications.	Remember	CLO1	CAME526.01
24	Define Eddy current testing.	Eddy currents can be used for crack detection, material thickness measurements, coating thickness measurements, conductivity measurements for material identification, heat damage detection, case depth determination, heat treatment monitoring.	Understand	CLO2	CAME526.02
25	Define Shrinkage Cavities.	Shrinkage cavities are subsurface discontinuities that are found in casted parts. They are caused by the lack of enough molten metal to fill the space created by shrinkage.	Remember	CLO2	CAME526.02
26	Define Blowholes and Porosity.	Blowholes and porosity are small rounded cavities found at the surface or near surface of castings and they are caused by the entrapped gasses that could not escape during solidification. Blowholes are caused by gases released from the mold itself (external gases) while porosity is caused by gases entrapped in the molten material (internal gases). During subsequent manufacturing operations these gas pockets get flattened or elongated or fused shut.	Remember	CLO2	CAME526.02
27	Define Magnetic particle inspection.	This method uses magnetic fields and small magnetic particles, such as iron filings to detect flaws in components.	Understand	CLO3	CAME526.03
28	Define Nonmetallic Inclusions.	Nonmetallic inclusions are usually oxides, sulfides or silicates that remained with the molten metal during original casting. The properties of those inclusions are different from the metal and usually they have irregular shapes and discontinuous nature therefore they serve as stress raisers that limit the ability of the material to withstand stresses.	Remember	CLO3	CAME526.03
29	Define Segregation.	It is localized differences in material composition (and thus mechanical properties) caused by the concentration of some alloying elements in limited areas. These compositional differences may be equalized during subsequent hot working processes but some still remain.	Remember	CLO3	CAME526.03
30	Define Acoustic impact technique.	This technique consists of tapping the surface of an object and listening to and analysing the signals to detect discontinuities and flaws.	Understand	CLO4	CAME526.04
31	Define Lamination.	Laminations are thin flat subsurface separations that are parallel to the surface of plates. They may result from inherent discontinuities (pipe, inclusions, porosity, etc.) that are flattened during the rolling process.	Remember	CLO4	CAME526.04

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32	Define Stringers.	Stringers are elongated subsurface discontinuities that are found in bars (they run in the axial direction). They result from the flattening and lengthening of nonmetallic inclusions during the rolling process.	Remember	CLO4	CAME526.04
33	Define Acoustic Emission.	Acoustic emissions are detected with sensors consisting of piezoelectric ceramic elements. This method is particularly effective for continuous surveillance of load-bearing structures.	Understand	CLO1	CAME526.01
34	Define Cooling Cracks.	Cooling cracks may occur on the surface of bars after rolling operations due to stresses developed by uneven cooling. They run in the axial direction (similar to seams) but unlike seams, they do not have surface oxidation.	Remember	CLO1	CAME526.01
35	Define Forging and Rolling Laps	Laps are elongated surface discontinuities that occur during rolling or forging operations due to the presence of some excessive material (fin) that is folded over. They may result because of oversized blanks or improper handling of the material in the die.	Remember	CLO1	CAME526.01
UNIT – II					
1	What is Ultrasonic nondestructive testing	Ultrasonic nondestructive testing, also known as ultrasonic NDT or simply UT, is a method of characterizing the thickness or internal structure of a test piece through the use of high frequency sound waves.	Understand	CLO5	CAME526.05
2	What materials can ultrasonic testing be used on?	A Common example is ultrasonic thickness measurement, which tests the thickness of the test object, for example, to monitor pipe work corrosion. Ultrasonic testing is often performed on steel and other metals and alloys, though it can also be used on concrete, wood and composites, albeit with less resolution.	Understand	CLO5	CAME526.05
3	What is the basic principle of UT?	Basic Principles of Ultrasonic Testing Ultrasonic Testing (UT) uses high frequency sound energy to conduct examinations and make measurements. ultrasonic inspection can be used for flaw detection/evaluation, dimensional measurements, material and material characterization, and more.	Remember	CLO5	CAME526.05
4	Why Couplant is used in ultrasonic testing?	A couplant is a material (usually liquid) that facilitates the transmission of ultrasonic energy from the transducer into the test specimen. couplant is generally necessary because the acoustic impedance mismatch between air and solids (i.e. such as the test specimen) is large.	Understand	CLO6	CAME526.06

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5	What is ultrasonic flaw detection?	Flaw detection is the most commonly used technique among all the applications of industrial ultrasonic testing. Generally, sound waves of high frequency are reflected from flaws and generate clear echo patterns.	Understand	CLO7	CAME526.07
6	What is the pulse echo technique?	A diagnostic technique in which short-duration ultrasound pulses are transmitted into the region to be studied, and echo signals resulting from scattering and reflection are detected and displayed. The depth of a reflective structure is inferred from the delay between pulse transmission and echo reception.	Understand	CLO8	CAME526.08
7	What is ultrasonic wave?	Ultrasound is acoustic (sound) energy in the form of waves having a frequency above the human hearing range. The highest frequency that the human ear can detect is approximately 20 thousand cycles per second (20,000 Hz). This is where the sonic range ends, and where the ultrasonic range begins.	Understand	CLO6	CAME526.06
8	What is shear wave ultrasonic testing?	Shear wave testing, also known as angle beam inspection, is an ultrasonic testing technique used primarily for weld inspections. A probe consisting of an ultrasonic transducer coupled with a plastic or epoxy wedge introduces an ultrasonic beam at an angle into a test area.	Remember	CLO7	CAME526.07
9	What is a scan in ultrasonic testing?	Employing advanced ultrasonic imaging techniques for flaw detection and sizing. B-scan Ultrasonic Testing provides a two-dimensional graphic presentation, in which the travel time of an ultrasonic pulse is plotted along the vertical axis and the linear position of the transducer is plotted along the horizontal axis.	Understand	CLO8	CAME526.08
10	What is a pulse echo time?	a diagnostic technique in which short-duration ultrasound pulses are transmitted into the region to be studied, and echo signals resulting from scattering and reflection are detected and displayed. The depth of a reflective structure is inferred from the delay between pulse transmission and echo reception.	Remember	CLO8	CAME526.08
11	Define Run out.	It occurs due to enlargement of the mould cavity after pouring.	Understand	CLO5	CAME526.05
12	Define processing Discontinuities.	Processing discontinuities are usually related to the various manufacturing process such as machining, forming, extruding, rolling, welding, heat treating, and plating.	Remember	CLO6	CAME526.06
13	Define the Scams.	These are surface discontinuities and appears as longitudinal scratches or folds in the material.	Remember	CLO7	CAME526.07

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14	What are the Service Induced Discontinuities	Discontinuities that are created during the use of a component are called “Service – Induced Discontinuities”	Understand	CLO7	CAME526.07
15	What is ultrasonic vibration?	Ultrasonic vibrations would refer to sound waves that have a frequency higher than human hearing. The vibration themselves would be the physical vibration of the molecules in the medium in which the sound is traveling. Frequency Range 20 kHz to 60 kHz. That would be above 20 kHz, or 20,000 cycles per second.	Remember	CLO5	CAME526.05
16	Define longitudinal waves.	Longitudinal waves particle motion in the medium is parallel to the direction of the wave direction.	Understand	CLO8	CAME526.08
17	Define Shear wave.	Shear wave particle motion in the medium is perpendicular to the direction of the wave direction.	Remember	CLO5	CAME526.05
18	Define Wavelength.	The distance between successive crests of a wave.	Understand	CLO6	CAME526.06
19	Define Lamb Waves.	Lamb waves are surface waves propagate parallel to the next surface and have a particle motion that is elliptical.	Understand	CLO6	CAME526.06
20	Define surface Waves or Rayleigh waves.	Surface Waves or Rayleigh waves represent an oscillating motion that travels along the surface of the test piece.	Understand	CLO7	CAME526.07
21	Define longitudinal waves.	In longitudinal waves, the oscillations occur in the longitudinal direction or the direction of wave propagation.	Understand	CLO4	CAME526.04
22	Define shear waves.	In the transverse or shear waves, particles oscillate at a right angle or transverse to the direction of propagation.	Understand	CLO4	CAME526.04
23	Define Surface waves.	Surface (or Rayleigh) waves travel at the surface of a relatively thick solid material penetrating to a depth of one wavelength. A surface wave is a combination of both a longitudinal and transverse motion which results in an elliptical motion.	Understand	CLO4	CAME526.04
24	Define Plate waves	Plate (or Lamb) waves are similar to surface waves except they can only be generated in materials a few wavelengths thick.	Remember	CLO5	CAME526.05
25	Define Symmetrical Lamb waves.	Symmetrical Lamb waves move in a symmetrical fashion about the median plane of the plate. This is sometimes called the extensional mode because the wave is stretching and compressing the plate in the wave motion direction.	Understand	CLO5	CAME526.05
26	Define Asymmetrical Lamb waves.	The asymmetrical Lamb wave mode is often called the flexural mode because a large portion of the motion is in a normal direction to the plate,	Remember	CLO5	CAME526.05

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		and a little motion occurs in the direction parallel to the plate. In this mode, the body of the plate bends as the two surfaces move in the same direction.			
27	Define Sensitivity.	Sensitivity is the ability to locate small discontinuities. Sensitivity generally increases with higher frequency.	Understand	CLO6	CAME526.06
28	Define Resolution.	Resolution is the ability of the system to locate discontinuities that are close together within the material or located near the part surface. Resolution also generally increases as the frequency increases.	Remember	CLO6	CAME526.06
29	Define Decibel (dB).	The Decibel (dB) is a logarithmic unit that describes a ratio of two measurements. The difference between two measurements X_1 and X_2 is described in decibels as: $\Delta X (dB) = 10 \log \frac{X_2}{X_1}$	Understand	CLO6	CAME526.06
30	Define acoustic impedance.	The acoustic impedance (Z) of a material is defined as the product of its density (ρ) and the velocity of sound in that material (v).	Understand	CLO6	CAME526.06
31	Define Snell's Law.	Snell's Law describes the relationship between the angles and the velocities of the waves. Snell's law equates the ratio of material velocities to the ratio of the sine's of incident and refracted angles	Understand	CLO4	CAME526.04
32	Define Mode conversion.	Mode conversion occurs when a wave encounters an interface between materials of different acoustic impedances and the incident angle is not normal to the interface.	Understand	CLO4	CAME526.04
33	Define Wave Interaction.	When sound emanates from an ultrasonic transducer, it does not originate from a single point, but instead originates from many points along the surface of the piezoelectric element. This results in a sound field with many waves interacting or interfering with each other.	Understand	CLO4	CAME526.04
34	Define Wave Diffraction.	Diffraction involves a change in direction of waves as they pass through an opening or around a barrier in their path.	Remember	CLO5	CAME526.05
35	Define Contact transducers.	Contact transducers are used for direct contact inspections, and are generally hand manipulated. They have elements protected in a rugged casing to withstand sliding contact with a variety of materials. These transducers have an ergonomic design so that they are easy to grip and move along a surface. They often have replaceable wear plates to lengthen their useful life. Coupling materials of water, grease, oils, or commercial	Remember	CLO5	CAME526.05

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		materials are used to remove the air gap between the transducer and the component being inspected.			
UNIT – III					
1	What is radiographic testing in NDT?	Radiographic and Ultrasonic Testing of Welds. Radiographic and ultrasonic weld inspection are the two most common methods of non-destructive testing (NDT) used to detect discontinuities within the internal structure of weld	Understand	CLO9	CAME526.09
2	What is the principle of radiographic testing?	It is based on the principle that radiation is absorbed and scattered as it passes through an object. If there are variations in thickness or density (e.g. due to defects) in an object, more or less radiation passes through and affects the film exposure. Flaws show up on the film, usually as dark areas.	Remember	CLO9	CAME526.09
3	Why is radiography test required?	Radiographic and ultrasonic weld inspection are the two most common methods of non-destructive testing (NDT) used to detect discontinuities within the internal structure of welds Energy not absorbed by the object will cause exposure of the radiographic film. These areas will be dark when the film is developed.	Understand	CLO10	CAME526.10
4	What is radiographic technique?	Radiography is an Imaging technique using X-rays, gamma rays, or similar radiation to view the internal form of an object. The generation of flat two dimensional images by this technique is called projectional radiography.	Remember	CLO10	CAME526.10
5	Water-washable	Water-washable penetrants have an emulsifier included in the penetrant that allows the penetrant to be removed using a water spray. They are most often applied by dipping the part in a penetrant tank, but the penetrant may be applied to large parts by spraying or brushing.	Understand	CLO12	CAME526.12
6	Define radiography process	Industrial radiography is a method of non-destructive testing where many types of manufactured components can be examined to verify the internal structure and integrity of the specimen. Industrial Radiography can be performed utilizing either X-rays or gamma rays.	Understand	CLO11	CAME526.11
7	Define Real Time Radiography.	Real-time radiography (RTR), or real-time radioscopy, is a nondestructive test (NDT) method whereby an image is produced electronically, rather than on film, so that very little lag time occurs between the item being exposed to radiation and the resulting image.	Understand	CLO12	CAME526.12

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
8	Which type of joint radiography is done?	Industrial radiography is a method of non-destructive testing where many types of manufactured components can be examined to verify the internal structure and integrity of the specimen. Industrial Radiography can be performed utilizing either X-rays or gamma rays. Both are forms of electromagnetic radiation.	Remember	CLO09	CAME526.09
9	What is meant by spot radiography?	The spot radiography rules are also considered to be an aid to quality control. Spot radiographs made directly after a welder or an operator has completed a unit of a weld prove that the work is or is not being done in accordance with a satisfactory procedure	Remember	CLO11	CAME526.11
10	What is NSD in radiography?	Industrial radiography is a method of non-destructive testing where many types of manufactured components can be examined to verify the internal structure and integrity of the specimen. Industrial Radiography can be performed utilizing either X-rays or gamma rays. Both are forms of electromagnetic radiation.	Understand	CLO12	CAME526.12
12	What is RT procedure?	Radiographic Testing (RT) is a nondestructive examination (NDE) technique that involves the use of either x-rays or gamma rays to view the internal structure of a component. RT is also used to inspect weld repairs.	Remember	CLO9	CAME526.09
13	Why is radiography test required?	non- destructive testing (NDT) used to detect discontinuities within the internal structure of Radiographic and ultrasonic weld inspection are the two most common methods of welds. ... Energy not absorbed by the object will cause exposure of the radiographic film. These areas will be dark when the film is developed.	Understand	CLO9	CAME526.09
14	What is gamma radiography?	Industrial radiography is a method of non-destructive testing where many types of manufactured components can be examined to verify the internal structure and integrity of the specimen. Industrial Radiography can be performed utilizing either X-rays or gamma rays. Both are forms of electromagnetic radiation.	Remember	CLO10	CAME526.10
15	How beta rays are produced?	A beta particle, also called beta ray or beta radiation (symbol β), is a high-energy, high-speed electron or positron emitted by the radioactive decay of an atomic nucleus during the process of beta decay. There are two forms of beta decay, β^- decay and β^+ decay, which produce electrons and positrons respectively.	Understand	CLO11	CAME526.11

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16	What symbol is used for a beta particle?	A beta particle, also called beta ray or beta radiation (symbol β), is a high-energy, high-speed electron or positron emitted by the radioactive decay of an atomic nucleus during the process of beta decay.	Understand	CLO12	CAME526.12
17	What is Film speed?	Film speed refers to the relative sensitivity of X- ray films to a given amount of radiation .	Understand	CLO11	CAME526.11
18	Define Screens in RT?	Screens also known as intensifying screens, are fitted in X- ray cassettes and interact with X – rays to convert most of their radiant energy.	Understand	CLO12	CAME526.12
19	What is Emulsion layer?	The sensitive emulsion layer consist of silver bromide, suspended in gelatin.	Remember	CLO09	CAME526.09
20	Define Half – life of the radio isotope.	Half – life of the radio isotope is defined as the time required for the activity of any particular radio nuclide to decrease to one half of its initial value.	Remember	CLO11	CAME526.11
21	What Pair production?	The pair production occurs when an electron and positron are created with the disappearance of X- ray photon.	Understand	CssLO12	CAME526.12
22	Define Computed Tomography (CT).	CT is a radiographic based technique that provides both cross-sectional and 3D volume images of the object under inspection. These images allow the internal structure of the test object to be inspected without the inherent superimposition associated with 2D radiography. This feature allows detailed analysis of the internal structure of a wide range of components.	Understand	CLO7	CAME526.07
23	Define Activity.	The quantity which expresses the radiation producing potential of a given amount of radioactive material is called “Activity”.	Understand	CLO7	CAME526.07
24	Define Curie (Ci).	The Curie (Ci) was originally defined as that amount of any radioactive material that disintegrates at the same rate as one gram of pure radium	Remember	CLO7	CAME526.07
25	Define Becquerel (Bq)	The quantity of radioactive material in which one atom is transformed per second.	Remember	CLO8	CAME526.08
26	Define specific activity.	The concentration of radioactivity , or the relationship between the mass of radioactive material and the activity, is called “specific activity”.	Remember	CLO8	CAME526.08
27	Define Isotope Decay Rate (Half-Life).	Half-life is defined as the time required for the activity of any particular radionuclide to decrease to one-half of its initial value.	Understand	CLO8	CAME526.08
28	Define Electromagnetic radiation (EMR).	It is a form of radiant energy involving photons. They travel normally in straight lines and are emitted and absorbed by charged particles	Remember	CLO9	CAME526.09

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29	Define Imaging.	The specimen to be inspected is placed between the source of radiation and the detecting device and the radiation is allowed to penetrate for a required length of time. Lead is often placed behind the detector to reduce the 'back scattered' radiation.	Understand	CLO9	CAME526.09
30	Define Compton effect.	The second type of ionization is known as the Compton effect. In this form of interaction, the initial photon energy is higher than that of the Photoelectric effect. The primary difference is that not all of the photon energy will be utilized in liberating and accelerating an electron. There is also energy left over to cause further ionization.	Remember	CLO9	CAME526.09
31	Define pair-production.	The third process of ionization is known as pair-production. In this process, the initial photon energy is very high, normally occurring at energies of 1.02 Mev and above. This particular process does not involve orbital electrons, rather the interaction occurs near the nucleus of the atom instead.	Understand	CLO7	CAME526.07
32	Define Radioisotopes.	Radioisotopes are elements that are atomically unstable and radioactive. Radioisotopes stabilize by releasing energy and matter. Natural radioisotopes, which have relatively low radioactive energy, have been largely replaced by artificially produced radioisotopes. Artificially produced radioisotopes are widely utilized as sources of radiation for radiography, gauging, and as tracers for a multitude of measurements that are not easily made by other methods.	Understand	CLO7	CAME526.07
33	How are radioisotopes produced?	radioisotopes includes three principle categories, which are (1) neutron activation (2) fission product separation, and (3) charged particle bombardment. Nuclear bombardment constitutes the major method for obtaining industrially important radioisotope materials. Radioisotopes may exist in any form of matter, with solid materials comprising the largest group.	Remember	CLO8	CAME526.08
34	What are transformers?	Transformers are electromagnetic devices that allow a voltage of alternating current to be changed; the voltage may be increased or decreased. Two common types of transformers which are of importance to X-ray generation are step-up and step-down Transformers are comprised of two sets of windings (coiled conductors) that are electrically isolated from each other.	Understand	CLO8	CAME526.08

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		One set of windings is connected to a power supply and is known as the primaries. The other set of windings is connected to a load (in this case the X-ray tube) and is referred to as the secondary windings.			
35	Define Cyclotron.	This device is capable of accelerating charged particles (protons) in a circular path to energies that exceed 10 MeV. The Cyclotron is comprised of a large cylindrical box sandwiched between the poles of an electromagnet. The box is evacuated until a high vacuum exists. Charged particles are fed into the cylindrical box. Two 'D' shaped electrodes placed back to back with a gap between them are connected to a high voltage source inside of the box. By rapidly reversing the electric charge on the electrodes, and due to the presence of the magnetic field of the electromagnets, the charged particles move in a circular fashion. Each time the charged particles cross the gap of the electrodes, the particles gain energy and begin moving towards the outside of the cylindrical box. Once the charged particles reach the outer edge of the box, they are deflected towards the target, resulting in high energy X-radiation.	Understand	CLO9	CAME526.09
36	Define Electroscope.	The electroscope is a fairly simple device comprised of a metal rod with two thin leaves attached to one end. If the electroscope is given a negative charge, the metal leaves will separate from each other. It is this characteristic that makes the electroscope useful as a detection device. A negatively charged electroscope will discharge when ions in the air remove electrons from it, and consequently, a positively charged electroscope will discharge when it takes electrons from the air around it. The rate of discharge of the electroscope is a measure of ions in the air and can be used as a basis of measurement and detection.	Understand	CLO9	CAME526.09
UNIT - IV					
1	Define Phased array.	Phased array inspections are done using a probe with multiple elements that can be individually activated. By varying the time when each element is activated, the resulting sound beam can be "steered", and the resulting data can be combined to form a visual image representing a slice through the part being inspected.	Understand	CLO13	CAME526.13

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2	Define Immersion Testing.	Immersion Testing is a technique where the part is immersed in a tank of water with the water being used as the coupling medium to allow the sound beam to travel between the transducer and the part.	Remember	CLO14	CAME526.14
3	What is Time of Flight Diffraction (TOFD)?	Time of Flight Diffraction (TOFD) uses two transducers located on opposite sides of a weld with the transducers set at a specified distance from each other. One transducer transmits sound waves and the other transducer acting as a receiver.	Understand	CLO13	CAME526.13
4	Define Straight Beam.	Straight beam inspection uses longitudinal waves to interrogate the test piece as shown at the right. If the sound hits an internal reflector, the sound from that reflector will reflect to the transducer faster than the sound coming back from the back-wall of the part due to the shorter distance from the transducer.	Understand	CLO14	CAME526.14
5	Define Film radiography.	Film radiography uses a film made up of a thin transparent plastic coated with a fine layer of silver bromide on one or both sides of the plastic. When exposed to radiation these crystals undergo a reaction that allows them, when developed, to convert to black metallic silver.	Remember	CLO15	CAME526.15
6	Define Computed radiography.	Computed radiography (CR) is a transitional technology between film and direct digital radiography. This technique uses a reusable, flexible, photo-stimulated phosphor (PSP) plate which is loaded into a cassette and is exposed in a manner similar to traditional film radiography.	Understand	CLO15	CAME526.15
7	Define Computed tomography (CT).	Computed tomography (CT) uses a computer to reconstruct an image of a cross sectional plane of an object as opposed to a conventional radiograph. The CT image is developed from multiple views taken at different viewing angles that are reconstructed using a computer.	Understand	CLO16	CAME526.16
8	Define Digital Radiography.	Digital radiography (DR) digitizes the radiation that passes through an object directly into an image that can be displayed on a computer monitor	Understand	CLO13	CAME526.13
9	Define Infrared Thermography (IRT).	Infrared Thermography involves measurement of emissions and temperature variations on a component.	Remember	CLO14	CAME526.14
10	Define Guided Wave Testing (GW).	Guided wave testing on piping uses controlled excitation of one or more ultrasonic waveforms that travel along the length of the pipe, reflecting from changes in the pipe stiffness or cross sectional area.	Understand	CLO14	CAME526.14
11	Define Solvent Removable.	Solvent Removable penetrants are those penetrants that require a solvent other than water to remove the excess penetrant. These penetrants are	Understand	CLO16	CAME526.16

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
		usually visible in nature, commonly dyed a bright red colour that will contrast well against a white developer.			
12	What is pressure change Testing?	Pressure Change Testing can be performed on closed systems only. Detection of a leak is done by either pressurizing the system or pulling a vacuum then monitoring the pressure. Loss of pressure or vacuum over a set period of time indicates that there is a leak in the system.	Remember	CLO15	CAME526.15
13	What is Halogen Diode Testing?	Halogen Diode Testing is done by pressurizing a system with a mixture of air and a halogen-based tracer gas. After a set period of time, a halogen diode detection unit, or "sniffer", is used to locate leaks.	Understand	CLO16	CAME526.16
14	What is Angle beam inspection?	Angle beam inspection uses the same type of transducer but it is mounted on an angled wedge (also called a "probe") that is designed to transmit the sound beam into the part at a known angle. The most commonly used inspection angles are 45°, 60° and 70°, with the angle being calculated up from a line drawn through the thickness of the part (not the part surface).	Remember	CLO15	CAME526.15
15	What is Post- emulsifiable?	Post-emulsifiable penetrants are penetrants that do not have an emulsifier included in its chemical make-up like water-washable penetrants.	Understand	CLO16	CAME526.16
16	What is vignetting in image processing?	Vignetting is a source of noise on thermogram that causes a darkening of the image corners with respect to the image center due to limited exposure	s	CLO15	CAME526.15
17	What are infrared detectors?	Thermal detector used infrared energy as heat. Their photo sensitivity is independent of the wave length being detected.			
18	Define NDE.	Non-Destructive Evaluation (NDE) used to determine material properties, such as fracture toughness, formability, and other physical characteristics. Example: NDE method would not only locate a defect, but it would also be used to measure something about that defect such as its size, shape, and orientation.	Understand	CLO10	CAME526.10
19	Define Visual and Optical Testing (VT).	The most basic NDT method is visual examination. Visual examiners follow procedures that range from simply looking at a part to see if surface imperfections are visible, to using computer-controlled camera systems to automatically recognize and measure features of a component.	Understand	CLO10	CAME526.10
20	Define Radiography (RT).	RT involves using penetrating gamma or X-radiation on materials and products to look for defects or examine internal or hidden features. An X-ray generator or radioactive isotope is	Understand	CLO10	CAME526.10

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
		used as the source of radiation. Radiation is directed through a part and onto film or another detector. The resulting shadowgraph shows the internal features and soundness of the part. Material thickness and density changes are indicated as lighter or darker areas on the film or detector. The darker areas in the radiograph below represent internal voids in the component.			
21	Define Magnetic Particle Testing (MT).	This NDT method is accomplished by inducing a magnetic field in a ferromagnetic material and then dusting the surface with iron particles (either dry or suspended in liquid). Surface and near surface flaws disrupt the flow of the magnetic field within the part and force some of the field to leak out at the surface. Iron particles are attracted and concentrated at sites of the magnetic flux leakages. This produces a visible indication of defect on the surface of the material. The images above demonstrate a component before and after inspection using dry magnetic	Remember	CLO11	CAME526.11
22	Define Ultrasonic Testing (UT).	In ultrasonic testing, highfrequency sound waves are transmitted into a material to detect imperfections or to locate changes in material properties. The most commonly used ultrasonic testing technique is pulse echo, whereby sound is introduced into a test object and reflections (echoes) from internal imperfections or the part's geometrical surfaces are returned to a receiver. Below is an example of shear wave weld inspection. Notice the indication extending to the upper limits of the screen. This indication is produced by sound reflected from a defect within the weld.	Understand	CLO11	CAME526.11
23	Define Penetrant Testing (PT).	With this testing method, the test object is coated with a solution that contains a visible or fluorescent dye. Excess solution is then removed from the surface of the object but is left in surface breaking defects. A developer is then applied to draw the penetrant out of the defects. With fluorescent dyes, ultraviolet light is used to make the bleedout fluoresce brightly, thus allowing imperfections to be readily seen. With visible dyes, a vivid color	Understand	CLO11	CAME526.11

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
		contrast between the penetrant and developer makes the bleedout easy to see. The red indications in the image represent a defect in this component.			
24	Define Electromagnetic Testing (ET).	There are a number of electromagnetic testing methods but the focus here will be on eddy current testing. In eddy current testing, electrical currents (eddy currents) are generated in a conductive material by a changing magnetic field. The strength of these eddy currents can be measured. Material defects cause interruptions in the flow of the eddy currents which alert the inspector to the presence of a defect or other change in the material. Eddy currents are also affected by the electrical conductivity and magnetic permeability of a material, which makes it possible to sort some materials based on these properties. The technician in the image is inspecting an aircraft wing for defects.	Understand	CLO11	CAME526.11
25	Define Leak Testing (LT).	Several techniques are used to detect and locate leaks in pressure containment parts, pressure vessels, and structures. Leaks can be detected by using electronic listening devices, pressure gauge measurements, liquid and gas penetrant techniques, or simple soap bubble tests.	Understand	CLO10	CAME526.10
26	Define Acoustic Emission Testing (AE).	When a solid material is stressed, imperfections within the material emit short bursts of acoustic energy called "emissions." As in ultrasonic testing, acoustic emissions can be detected by special receivers. Emission sources can be evaluated through the study of their intensity and arrival time to collect information (such as their location) about the sources of the energy.	Understand	CLO10	CAME526.10
27	Define Eddy Current Array (ECA).	A technique that drives multiple eddy current coils placed together in the same probe assembly for flaw detection and sizing of surface cracks.	Remember	CLO10	CAME526.10
28	Define Infrared Thermography (IR).	A nonintrusive, noncontact system for mapping thermal patterns on the surface of an object using infrared detectors.	Remember	CLO10	CAME526.10
29	Define In-Line Inspection (ILI).	The inspection of pipe and pipelines using "smart pigs" (both tethered and non-tethered) that use primarily Ultrasonic Technique/Magnetic Flux Leakage for detection and sizing of damage.	Remember	CLO11	CAME526.11
30	Define Internal Rotating Inspection System (IRIS).	An ultrasonic technique for detecting and sizing corrosion in pipe and tubing using an internally inserted probe that generates sound waves.	Remember	CLO11	CAME526.11
31	Define Long Range Ultrasonic Testing (LRUT).	A technique that uses low frequency guided wave ultrasonics (GWUT) for detection of internal and/or external corrosion in pipe and tubing.	Understand	CLO12	CAME526.12

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
32	Define Magnetic Flux Leakage (MFL).	A technique that is used to detect corrosion in steel piping and storage tanks whereby a magnetic detector that is placed between the poles of the magnet detect a leakage field where corrosion is present.	Understand	CLO12	CAME526.12
UNIT - V					
1	What is Acoustic Emission Monitoring?	The process of detecting sound produced by discontinuities (cracking) within a structure when the structure has stress applied to it or when it is leaking or corroding.	Understand	CLO17	CAME526.17
2	What are Acoustic Emission (AE) Sensors?	Purpose of AE sensors is to detect stress waves motion that cause a local dynamic material displacement and convert this displacement to an electrical signal.	Remember	CLO17	CAME526.17
3	Define Attenuation?	The decrease in AE amplitude as a stress wave propagate along a structure due to Energy loss mechanisms, from dispersion, diffraction or scattering.	Understand	CLO18	CAME526.19
4	Define dispersion?	A phenomenon caused by the frequency dependence of speed for waves. Sound waves are composed of different frequencies hence the speed of the wave differs for different frequency spectrums.	Understand	CLO18	CAME526.18
5	Define Diffraction?	The spreading or bending of waves passing through an aperture or around the edge of a barrier.	Remember	CLO17	CAME526.17
6	Define Scattering?	The dispersion, deflection of waves encountering a discontinuity in the material such as holes, sharp edges, cracks inclusions et	Understand	CLO19	CAME526.19
7	What is Leak testing (LT)?	The leak testing method of NDT includes several techniques to detect, locate and measure leaks which have occurred in the pressure boundary or envelope of a component, vessel, pipeline or piping component.	Understand	CLO19	CAME526.19
8	Define vibration analysis.	Vibration analysis refers to the process of monitoring the vibration signatures specific to a piece of rotating machinery and analyzing that information to determine the condition of that equipment. Three types of sensors are commonly used: displacement sensors, velocity sensors and accelerometers.	Remember	CLO20	CAME526.20
9	What is guided wave testing?	Guided wave testing on piping uses controlled excitation of one or more ultrasonic waveforms that travel along the length of the pipe, reflecting from changes in the pipe stiffness or cross sectional area.	Understand	CLO20	CAME526.20
10	What is bubble leak testing?	Bubble Leak Testing, as the name implies, relies on the visual detection of a gas (usually air) leaking from a pressurized system. Small parts can be pressurized and immersed in a tank of liquid and larger vessels can be	Understand	CLO19	CAME526.19

S No	QUESTION	ANSWER	Blooms Level	CLO	CLO Code
		pressurized and inspected by spraying a soap solution that creates fine bubbles to the area being tested.			
11	Define Laser shearography.	Laser Shearography applies laser light to the surface of the part being tested with the part at rest (non-stressed) and the resulting image is picked up by a charge-coupled device (CCD) and stored on a computer.	Remember	CLO19	CAME526.19
12	Define laser profilometry .	Laser Profilometry uses a high-speed rotating laser light source, miniature optics and a computer with high-speed digital signal processing software.s	Understand	CLO18	CAME526.19
13	Define holographic testing.	Holographic Testing uses a laser to detect changes to the surface of a part as it deforms under induced stress which can be applied as mechanical stress, heat, pressure, or vibrational energy.	Understand	CLO17	CAME526.17
14	What is Neutron radiography?	Neutron radiography uses an intense beam of low energy neutrons as a penetrating medium rather than the gamma- or x-radiation used in conventional radiography.	Remember	CLO19	CAME526.19
15	Define Thermal/Infrared Testing (IR).	Thermal/Infrared Testing, or infrared thermography, is used to measure or map surface temperatures based on the infrared radiation given off by an object as heat flows through, to or from that object.	Understand	CLO20	CAME526.20
16	Define Meandering Winding Magnetometer Array (MWMA).	A relatively new technique for detecting and characterizing corrosion and cracking using multiple inductive sensors.	Understand	CLO13	CAME526.13
17	Define Phased Array Ultrasonic Technique (PAUT).	a set of UT probes made up of multiple small elements each of which is pulsed individually with computer-calculated timing which can be used to inspect more complex geometries that are difficult and much slower to inspect with single probes.	Understand	CLO13	CAME526.13
18	Define Pulsed Eddy Current (PEC).	A technique for measuring wall thicknesses on insulated equipment without having to remove the insulation and jacketing.	Remember	CLO13	CAME526.13
19	Define Real Time Radiography (RTR).	A radiographic technique that produces an almost immediate electronic digital image of the item being inspected/ radiated rather than on film.	Understand	CLO13	CAME526.13
20	Define Remote Field Eddy Current (RFEC).	An electromagnetic technique for finding defects in piping and tubing using an internally inserted probe that generates a magnetic field.	Understand	CLO13	CAME526.13
21	Define Remote Visual Inspection (RVI).	refers to methods of enhanced visual examination means of visual aids including video borescopes, push cameras, pan/tilt/zoom cameras and robotic crawlers.	Understand	CLO14	CAME526.14

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22	Define American Society for Nondestructive Testing (ASNT).	ASNT is a globally recognized organization that offers credentials for NDT personnel in a broad range of industries. Current certification programs include ASNT NDT Level II, ASNT NDT Level III, ASNT Central Certification Program (ACCP), and Industrial Radiography and Radiation Safety Personnel (IRRSP).	Remember	CLO14	CAME526.14
23	Define British Institute of NonDestructive Testing (BINDT).	BINDT is an accredited certification body and offers a Personnel Certification in Non-Destructive Testing (PCN).	Remember	CLO14	CAME526.14
24	Define ASTM International.	ASTM International, formerly the American Society of Testing and Materials, is a globally recognized leader in developing standards.	Remember	CLO14	CAME526.14
25	Define API QUPA.	Qualification of Ultrasonic Testing Examiners (Phased Array)	Remember	CLO15	CAME526.15
26	Define API QUSE.	Qualification of Ultrasonic Testing examiners (Sizing)	Remember	CLO15	CAME526.15
27	Define API QUTE.	Qualification of Ultrasonic Testing Examiners (Detection)	Remember	CLO15	CAME526.15
28	Define phased array ultrasonic testing (PAUT).	It is effective at detecting, characterizing, and sizing cracks and corrosion than conventional NDT methods. This in turn enables more accurate fitness for service calculations and equipment end of useful life decision making.	Understand	CLO14	CAME526.14
29	Define time of flight diffraction (TOFD).	It is effective at detecting, characterizing, and sizing cracks and corrosion than conventional NDT methods. This in turn enables more accurate fitness for service calculations and equipment end of useful life decision making.	Understand	CLO14	CAME526.14
30	Define Advanced NDT techniques.	These are developed to discover, characterize, measure, and document corrosion, wear, cracks, and flaws in equipment such as pressure vessels and piping systems, which might otherwise leak and cause catastrophic failures.	Understand	CLO14	CAME526.14

Signature of the Faculty

Signature of the HOD