

# **NON DESTRUCTIVE TESTING METHODS**

**Subject code: NT512OE**  
**Regulations: R16-JNTUH**  
**Class: III Year B. Tech MECH I Sem**



**Department of Mechanical Engineering**  
**BHARAT INSTITUTE OF ENGINEERING AND TECHNOLOGY**  
**Ibrahimpattam - 501 510, Hyderabad**



# **NON DESTRUCTIVE TESTING METHODS (NT512OE)**

## **COURSE PLANER**

### **I. COURSE OVERVIEW:**

The aim is to introduce students the overview of the non destructive testing methods of materials. The course covers NDE, Ultrasonic, MPI testing of metal parts. It gives an idea about selection of the testing criteria. It briefly describe the thermo-graph and radio graph methods of testing and provide selection properties for different tests.

### **02. PREREQUISITE(S):**

Basic fundamental knowledge at undergraduate level on following subjects is necessary:

**Metallurgy And Material Science**

**Mechanics Of Solids**

**Destructive Testing Methods**

**Production Technology**

### **03. COURSE OBJECTIVES:**

This course is recommended for undergraduate students of engineering program who are interested in gaining the awareness in various aspects of the Non Destructive Testing Methods. The objectives of this course are for

**Identify the basic methods of testing.**

**Understand the concept of non destructive testing**

**Describe the various types of NDT tests carried out on components.**

**Describe ultrasonic method of testing the materials.**

**Analyze the different types of test carried out on components and surfaces.**

**Understand the properties of materials suitable for NDT test.**

**Understand the radiography uses in engineering.**

### **04. COURSE OUTCOMES**

<b>Sl.NO</b>	<b>Description</b>	<b>Bloom's Taxonomy level</b>
<b>CO1</b>	Identify the requirements of testing criteria as per material composition	<b>L2: Understand</b>
<b>CO2</b>	Understand the theory of non destructive testing methods is used	<b>L2: Understand</b>
<b>CO3</b>	Determine the type of requirement of non destructive test	<b>L4: Analyze</b>
<b>CO4</b>	Distinguish between the various NDT test as Ultrasonic and Eddy current methods	<b>L4: Analyze</b>
<b>CO5</b>	Understand the properties of radiation used in engineering.	<b>L4: Analyze</b>
<b>CO6</b>	Describe the various types of non destructive test used to determine the surface cracks	<b>L2: Understand</b>

### 05.HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Level	Proficiency assessed by
PO1	<b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Assignment/ Exam
PO2	<b>Problem analysis:</b> Identify, formulate, review research literature, and analyze engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2	Assignment/ Exam
PO3	<b>Design/development of solutions:</b> Design solutions for complex engineering problems and design system components that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Assignment/ Exam
PO4	<b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Assignment/E xams
PO5	<b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	-	-
PO6	<b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	-	-
PO7	<b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	-	-
PO8	<b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	-	-
PO9	<b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.	3	Assignment/E xams
PO10	<b>Communication:</b> Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.	2	Assignment/E xams
PO11	<b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	-	-
PO12	<b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	2	Assignment/E xams

## 06. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Level	Proficiency assessed by
PSO1	The student will be able to apply the knowledge of Mathematics, Sciences and engineering fundamentals to formulate, analyze and provide solutions for the problems related to Mechanical engineering and communicate them effectively to the concerned.	2	Lectures, Assignments
PSO2	Design mechanical systems in various fields such as machine elements, thermal, manufacturing, industrial and inter-disciplinary fields by using various engineering/technological tools to meet the mercurial needs of the industry and society at large.	2	Lectures, Assignments
PSO3	The ability to grasp the latest development, methodologies of mechanical engineering and posses competent knowledge of design process, practical proficiencies, skills and knowledge of programme and developing ideas towards research.	2	Lectures, Assignments

## 07. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CO's	Program Outcomes (PO's)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1	3	1	--	--	--	--	--	--	3	2	--	2
CO.2	3	2	2	--	--	--	--	--	3	2	--	2
CO.3	3	2	3	1	--	--	--	--	3	2	--	2
CO.4	3	1	3	1	--	--	--	--	3	2	--	2
CO.5	2	3	3	1	--	--	--	--	3	2	--	2
CO.6	2	1	1	1	--	--	--	--	3	2	--	2
Average	3	2	2	1	--	--	--	--	3	2	--	2

### Program Specific Outcomes (PSO's)

CO's	PSO1	PSO2	PSO3
CO1.	--	2	3
CO2.	--	2	3
CO3.	2	2	3
CO4.	2	2	1
CO5.	3	2	1
CO6.	--	2	3
Average	2	2	2

## 08. JNTUH – R16 -SYLLABUS:

### UNIT - I

**Overview of NDT** - NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT, Visual inspection.

### UNIT - II

**Surface NDE Methods:** Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

### UNIT - III

**Thermography and Eddy Current Testing** - Principles, Contact and non contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

### UNIT - IV

**Ultrasonic Testing and Acoustic Emission** - Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique IV Principle, AE parameters, Applications

### UNIT - V

**Radiography** - Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films – graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

### TEXT BOOKS:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing;”, Narosa Publishing House, 2009.
2. Ravi Prakash, Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

### REFERENCES:

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005



3. Charles, J. Hellier, Handbook of Non-destructive evaluation”, McGraw Hill, New York 2001.

## **09. SUGGESTED BOOKS/RESOURCES:**

### **Text Books**

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu, Practical Non-Destructive Testing;”, Narosa Publishing House, 2009.
2. Ravi Prakash, Non-Destructive Testing Techniques”, 1st revised edition, New Age International Publishers, 2010

### **Reference Books**

1. ASM Metals Handbook, “Non-Destructive Evaluation and Quality Control”, American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. Paul E Mix, “Introduction to Non-destructive testing: a training guide”, Wiley, 2nd Edition New Jersey, 2005
3. Charles, J. Hellier, Handbook of Non-destructive evaluation”, McGraw Hill, New York 2001.

### **Additional Reading:**

#### **NPTEL Web Course:**

[https://nptel.ac.in/courses/112105182/.](https://nptel.ac.in/courses/112105182/)

#### **NPTEL Video Course:**

<https://nptel.ac.in/courses/112105182/1>

## **10. GATE SYLLABUS:**

**Applicable**

## **11. IES SYLLABUS:**

**Not Applicable**

## 12: COURSE PALN

Lecture No.	Week	Topics to be covered	Course Learning Outcomes( CO)	Teaching Methodology	References
<b>UNIT-I</b>					
1	1	Overview of NDT	CO-01	Chalk &Talk	T1, T2 and R1
2	1	Overview of NDT	CO-01	Chalk &Talk	T1, T2 and R1
3	1	NDT Versus Mechanical testing	CO-01	Chalk &Talk	T1, T2 and R1
4	1	Overview of the Non Destructive Testing	CO-01	Chalk &Talk	T1, T2 and R1
5	2	Methods for the detection of manufacturing defects as well as material characterization	CO-02	Chalk &Talk	T1, T2 and R1
6	2	Methods for the detection of manufacturing defects as well as material characterization	CO-02	Chalk &Talk	T1, T2 and R1
7	2	merits and limitations, various physical characteristics of materials and their applications in NDT	CO-03	Chalk &Talk	T1, T2 and R1
8	2	Visual inspection	CO-04	Chalk &Talk	T1, T2 and R1
9	3	Visual inspection	CO-02	Chalk &Talk	T1, T2 and R1
10	3	Bridge Class-1/Revision Class-1	-	Chalk &Talk	T1, T2 and R1
<b>UNIT-II</b>					
11	3	Surface NDE Methods-Liquid Penetrant Testing ,Magnetic Particle Testing	CO-04	Chalk &Talk	T1, T2 and R1
12	3	Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers	CO-05	Chalk &Talk	T1, T2 and R1
13	4	advantages and limitations of various methods	CO-06	Chalk &Talk	T1, T2 and R1
14	4	LPT Testing Procedure, Interpretation of results	CO-07	Chalk &Talk	T1, T2 and R1
15	4	Magnetic Particle Testing- Theory of magnetism	CO-08	Chalk &Talk	T1, T2 and R1
16	4	inspection materials, Magnetization methods	CO-04	Chalk &Talk	T1, T2 and R1
17	5	Interpretation and evaluation of test indications	CO-04	Chalk &Talk	T1, T2 and R1



18	5	Principles and methods of demagnetization	CO-05	Chalk &Talk	T1, T2 and R1
19	5	Residual magnetism	CO-06	Chalk &Talk	T1, T2 and R1
20	5	LPT & MPT	CO-05	Chalk &Talk	T1, T2 and R1
21	6	Bridge Class-2/Revision Class-2	-	Chalk &Talk	T1, T2 and R1
<b>UNIT-III</b>					
22	6	Thermography and Eddy Current Testing	CO-06	Chalk &Talk	T1, T2 and R1
23	6	Principles, Contact and non contact inspection methods	CO-07	Chalk &Talk	T1, T2 and R1
24	6	Techniques for applying liquid crystals-Advantages and limitation	CO-08	Chalk &Talk	T1, T2 and R1
25	7	radiation and infrared detectors, Instrumentations and methods, applications	CO-09	Chalk &Talk	T1, T2 and R1
26	7	Eddy Current Testing-Generation of eddy currents, Properties of eddy currents	CO-06	Chalk &Talk	T1, T2 and R1
27	7	Eddy current sensing elements	CO-07	Chalk &Talk	T1, T2 and R1
28	7	Probes, Instrumentation, Types of arrangement	CO-08	Chalk &Talk	T1, T2 and R1
29	8	Applications, advantages, Limitations, Interpretation/Evaluation	CO-09	Chalk &Talk	T1, T2 and R1
30	8	Eddy Current Testing Method	CO-06	Chalk &Talk	T1, T2 and R1
31	8	Thermography	CO-07	Chalk &Talk	T1, T2 and R1
32	8	Contact and non contact inspection methods	CO-08	Chalk &Talk	T1, T2 and R1
33	9	Bridge Class-3/Revision Class -3	-	Chalk &Talk	T1, T2 and R1
<b>UNIT-IV</b>					
34	9	Ultrasonic Testing and Acoustic Emission	CO-06	Chalk &Talk	T1, T2 and R1
35	9	Ultrasonic Testing-Principle	CO-07	Chalk &Talk	T1, T2 and R1
36	9	Transducers, transmission and pulse-echo method	CO-08	Chalk &Talk	T1, T2 and R1



37	10	straight beam and angle beam	CO-09	Chalk &Talk	T1, T2 and R1
38	10	instrumentation	CO-10	Chalk &Talk	T1, T2 and R1
39	10	data representation, A/Scan, B-scan, C-scan	CO-11	Chalk &Talk	T1, T2 and R1
40	10	Phased Array Ultrasound	CO-12	Chalk &Talk	T1, T2 and R1
41	11	Time of Flight Diffraction	CO-12	Chalk &Talk	T1, T2 and R1
42	11	Acoustic Emission Technique IV Principle	CO-10	Chalk &Talk	T1, T2 and R1
43	11	AE parameters and Applications	CO-10	Chalk &Talk	T1, T2 and R1
44	11	Bridge Class-4/Revision Class -4	-	Chalk &Talk	T1, T2 and R1
<b>UNIT-V</b>					
45	12	Radiography Test	CO-12	Chalk &Talk	T1, T2 and R1
46	12	Radiography - Principle, interaction of X-Ray with matter	CO-13	Chalk &Talk	T1, T2 and R1
47	12	imaging, film and film less techniques	CO-14	Chalk &Talk	T1, T2 and R1
48	12	types and use of filters and screens	CO-15	Chalk &Talk	T1, T2 and R1
49	13	geometric factors, Inverse square, law	CO-16	Chalk &Talk	T1, T2 and R1
50	13	characteristics of films – graininess, density, speed, contrast	CO-17	Chalk &Talk	T1, T2 and R1
51	13	characteristic curves, Penetrameters, Exposure charts	CO-18	Chalk &Talk	T1, T2 and R1
52	13	Radiographic equivalence	CO-19	Chalk &Talk	T1, T2 and R1
53	14	Fluoroscopy- Xero-Radiography	CO-15	Chalk &Talk	T1, T2 and R1
54	14	Computed Radiography	CO-12	Chalk &Talk	T1, T2 and R1
55	14	Computed Tomography	CO-15	Chalk &Talk	T1, T2 and R1
56	14	Bridge Class-5/Revision Class -5	-	Chalk &Talk	T1, T2 and R1



### 13. QUESTION BANK (JNTUH)

#### 13.1 DESCRIPTIVE QUESTIONS:

Sl No	Question	Blooms Taxonomy Level	Course Learning OutComes
<b>UNIT-I</b>			
1	Define the non- destructive testing	Remember	CO-01
2	What are the objectives of non- destructive testing	Understand	CO-01
3	List any four uses of NDT methods	Remember	CO-01
4	What are purposes of material testing	Remember	CO-01
5	Name any four commonly employed destructive tests	Understand	CO-01
6	What are the advantages of non- destructive testing	Remember	CO-01
7	List any four limitations of non-destructive testing	Understand	CO-02
8	Explain NDT Versus Mechanical testing Methods	Remember	CO-01
9	What are the Testing Methods for the detection of manufacturing defects	Understand	CO-02
10	Explain the Testing Methods for the detection of material characterization	Understand	CO-02
11	Give Relative merits and limitations Of NDT	Remember	CO-01
12	Explain various physical characteristics of materials and their applications in NDT	Understand	CO-02
13	Explain Visual inspection Procedure.	Remember	CO-01
14	Role of visual inspection in industry	Remember	CO-03
15	How NDT Is Usefull For Quality Control.	Understand	CO-02
<b>UNIT-II</b>			
16	What do you mean by visual inspection	Remember	CO-02
17	Distinguish between aided and unaided visual testing.	Remember	CO-04
18	List any six optical aids that are being used in visual inspection.	Understand	CO-02
19	What is the principle of liquid penetrant testing	Remember	CO-03
20	What types of defects can be detected in a liquid penetrant test	Understand	CO-03
21	What are the different methods of penetrant application	Remember	CO-03
22	What is meant by dwell and development time with respect to liquid penetrant testing	Remember	CO-03
23	List any four typical defects that can be detected with liquid penetrant testing and their indications	Remember	CO-05
24	Difference between the fluorescent and visible penetrants	Understand	CO-04
25	List any four desirable characteristics of a good developer	Remember	CO-05
26	List out any six commonly used non – destructive testing methods/ techniques	Remember	CO-03
27	List the basic elements in NDT methods	Understand	CO-03
28	What is the Use of the telescopes and periscopes as a visual inspection aid	Understand	CO-01
29	Compare and contrast destructive and non- destructive testing methods	Understand	CO-01
30	Enlist, in detail various non- destructive testing methods/techniques	Understand	CO-01
31	Compare and contrast the principles, characteristics detected, advantages, limitations applications of visual inspection and liquid penetrant testing	Understand	CO-03
32	(a) Explain the principle and types of visual testing method. (b) Bring out the advantages, Limitations and applications of visual inspection.	Understand	CO-04
33	Explain the principle of liquid penetrant testing with neat sketch. Also bring out the advantages and limitations of the liquid penetrant testing.	Remember	CO-04



34	Explain the liquid penetrant testing flow chart? and write the limitations of liquid penetrant testing	Understand	CO-04
35	Discuss about the surface preparation, dwell or penetrant time and removal of excess penetrant	Understand	CO-05
36	Discuss about the post- emulsification method, solvent removal method and application of developer liquid penetrant testing	Understand	CO-04
37	Write about examination, interpretation and evaluation process in liquid penetrant testing	Understand	CO-04
38	Explain about advantages, limitations and applications of Magnetic particle testing	Remember	CO-05
39	Explain in details various steps involved in magnetic particle testing?	Remember	CO-05
40	Discuss about longitudinal magnetization, and circumferential magnetization in magnetic particle testing	Remember	CO-04
41	Explain about dry and wet particle inspection techniques in magnetic particle testing.	Understand	CO-03
42	Explain about magnetization equipment, portable power supplies, and lighting equipment	Understand	CO-04
43	Explain what are the equipment used in determination of magnetic field strength and direction	Understand	CO-05
44	Write on the following portable magnetization equipments : (a) Permanent magnet (b) Electromagnetic Yokes (c) Prods	Remember	CO-01
45	Explain the working of wet horizontal type magnetization equipment used in magnetic article testing	Understand	CO-02
46	Explain the about different type of magnetic particles used in magnetic particle testing	Remember	CO-03
47	Compare and contrast the applicability and capability of various NDT methods	Understand	CO-04
48	(a) Explain the principle and types of visible testing of visible testing methods	Understand	CO-05
49	Explain how the liquid penetrant test be used to detect surface discontinuities? Explain the various stages of liquid penetrant testing procedure	Understand	CO-04
50	Describe the purpose, types, Characteristics, and properties of penetant used in the liquid penetrant testing procedure.	Understand	CO-05
51	Discuss on various test stations used in inspection by liquid penetrant testing	Remember	CO-05
52	Explain the various penetrant inspection techniques? Explain them	Remember	CO-04
53	Explain the process flow chart, the water- washable penetrant techniques. Also bring out its applicability, advantages and limitations	Remember	CO-03
54	Describe the post- emulsifiable and solvent- removable penetrant inspection techniques	Remember	CO-04
55	Explain the principle of magnetic particle testing with its advantages and disadvantages	Remember	CO-05
56	Explain the dry particle inspection techniques with simple line diagram	Understand	CO-04
57	Explain the inspection of crankshaft by wet particle MT inspection techniques	Understand	CO-05
58	Explain the principle of liquid penetrant testing with neat sketch. Also bring out the advantages and limitations of the liquid penetrant testing.	Remember	CO-05
<b>UNIT-III</b>			
59	Explain Thermography Testing Working Principle.	Remember	CO-06
60	Explain Eddy Current Testing Working Principle.	Remember	CO-04



61	Explain Contact and Non Contact Inspection Methods.	Remember	CO-05
62	Define NDT Techniques for applying liquid crystals.	Understand	CO-06
63	Explain the advantages and limitations of thermography.	Understand	CO-06
64	What is Infra Red Radiation.	Understand	CO-04
65	What are the instruments used for infrared detection.	Understand	CO-05
66	Explain the process of eddy currents generation.	Remember	CO-07
67	What are the various properties of eddy current.	Remember	CO-08
68	Name few eddy current sensing elements.	Remember	CO-08
69	Explain Instrumentation and methods used for thermography	Understand	CO-09
70	Explain Instrumentation and methods used for eddy current testing	Understand	CO-09
71	Explain Advantages and limitations Of Eddy Current Testing	Remember	CO-08
72	What Are The Applications Of ECT	Understand	CO-09
73	Explain the evaluation procedure for Eddy Current Testing	Remember	CO-08
74	Define the Evaluation Procedure For Thermography Testing	Remember	CO-08
75	Tools Used For Thermography Testing	Remember	CO-07
76	Explain The Working Principle Of Thermography With Its Limitation and advantages.	Understand	CO-08
77	plain The Working Principle Of Eddy Current Testing With Its Limitation and advantages.	Remember	CO-07
78	Difference Between Thermography And Eddy Current Testing.	Understand	CO-06
<b>UNIT-IV</b>			
79	What are the Ultrasonic waves	Understand	CO-06
80	List the different modes of ultrasonic waves	Understand	CO-06
81	Differentiate between longitudinal and shear waves	Remember	CO-06
82	What is attenuation in Ultrasonic inspection	Remember	CO-07
83	What is the significance of couplant in ultrasonic testing	Remember	CO-07
84	State commonly used couplants	Remember	CO-07
85	State the advantages and disadvantages of ultrasonic inspection	Remember	CO-08
86	Distinguish between transmission and pulse-echo methods of ultrasonic testing	Remember	CO-09
87	List the basic component used in Ultrasonic equipment	Remember	CO-06
88	What are the ultrasonic transducers .	Understand	CO-08
89	List the factors influencing the selection of ultrasonic transducer	Remember	CO-09
90	Classify ultrasonic transducers	Remember	CO-09
91	What are immersion transducers	Remember	CO-07
92	What is non contact type ultrasonic testing	Understand	CO-07
93	What is the common modes data presentation in ultrasonic testing	Remember	CO-08
94	Distinguish between A- Scan, B-Scan, and C-Scan presentation in Ultrasonic testing (UT).	Understand	CO-09
95	List various factors influencing ultrasonic testing	Understand	CO-08
96	Explain how immersion transducer differs from other transducer in ultrasonic testing?	Understand	CO-08
97	What is mean by S/N ratio .	Understand	CO-08
98	What is State Snell's Law .	Understand	CO-09
99	(a) Describe the basic principle of ultrasonic testing with a suitable block diagram. (b) List down advantages, limitations and applications of employing ultrasonic testing method.	Remember	CO-06
100	(a) Explain the principle of through transmission ultrasonic testing with neat sketch?	Understand	CO-06

	(b) How the pulse-echo method of ultrasonic inspection is carried out and also state the advantages and disadvantages of pulse echo method.		
101	Explain various components involved in ultrasonic testing equipment with block diagram	Understand	CO-06
102	Explain different types of ultrasonic transducer with construction and working details. (a) Brief the working principle of any one Non- Contact types ultrasonic transducers. (b) Explain the working principle of phased array transducer in ultrasonic inspection?	Understand	CO-07
103	What is the need for angle beam inspection is carried out and also state the advantages and disadvantages of pulse echo method?	Understand	CO-07
104	Explain the principle of time of flight diffraction (TOFD) techniques of ultrasonic testing?	Understand	CO-07
105	Write an engineering brief about immersion ultrasonic testing	Understand	CO-07
106	Explain the different scan modes of ultrasonic testing. And hence discuss its applications to inspect porosity/ cavity in materials	Remember	CO-08
107	List and explain the various factors influencing ultrasonic testing.	Understand	CO-08
108	Explain the following test procedure is followed in inspection of following areas? (a) Inspection of castings (b) Corrosion monitoring (c) Weld inspection.	Understand	CO-08
109	Explain about the longitudinal waves, shear waves and surface waves in ultrasonic sonic	Remember	CO-09
110	Discuss about transmission method, and pulse- echo method in ultrasonic testing.	Understand	CO-09
111	Explain about pulser, Ultrasonic transducer, couplant, display receiver/ amplifier are used in ultrasonic testing	Understand	CO-09
112	Explain about straight beam ultrasonic inspection and angle beam inspection method.	Remember	CO-07
113	Explain about phased array ultrasonic inspection method, and Immersion ultrasonic method.	Remember	CO-07
114	Explain about data presentation in ultrasonic testing (Modes of display) in ultrasonic testing.	Remember	CO-08
115	Discuss about A- scan presentation, B- scan presentation, C- scan presentation,	Understand	CO-09
116	Explain about limitation and application of ultrasonic testing with examples.	Remember	CO-08
117	Explain about weld inspection by ultrasonic testing and thickness measurement by ultrasonic testing	Understand	CO-09
118	Explain about ultrasonic testing in inspection of casting and also explain about corrosion inspection by ultrasonic testing.	Understand	CO-09
119	What is the need for angle beam inspection is carried out and also state the advantages and disadvantages of pulse echo method?	Understand	CO-07
120	Explain the principle of time of flight diffraction (TOFD) techniques of ultrasonic testing?	Remember	CO-07
121	Write an engineering brief about immersion ultrasonic testing.	Understand	CO-07
122	Explain the different scan modes of ultrasonic testing. And hence discuss its applications to inspect porosity/ cavity in materials	Understand	CO-08
123	List and explain the various factors influencing ultrasonic testing.	Understand	CO-08



124	Explain about non contact ultrasonic testing in inspection of composite material.	Understand	CO-08
125	Discuss testing procedure of ultrasonic inspection/testing. And also writes its application	Remember	CO-09
126	Explain about time flight diffraction (TOFD) Technique principle and steps involved in TOFD and its advantages	Understand	CO-09
127	Explains about piezo electric transducer un ultrasonic testing and write about transducer?	Remember	CO-07
128	Explain the steps involved in through Transmission method in ultrasonic testing.	Remember	CO-07
129*	Define Computed Tomography in non-destructive evaluation of 2D and 3D images. (ANDT-II)	Understand	CO-18
130	List out the advantages of Computed Tomography in non-destructive testing	Understand	CO-19
131	Define leak testing in non-destructive evaluation	Understand	CO-20
132	List out the limitations of Computed Tomography in non-destructive testing.	Understand	CO-18
133	Define Acoustic Emission Test in non-destructive evaluation	Remember	CO-19
134	List out the limitations of leak testing	Remember	CO-20
135	Enumerate the factors influencing acoustic wave propagation and data acquisition in AE technology	Remember	CO-18
136	List out the applications of Computed Tomography in non-destructive testing	Understand	CO-19
137	Define wave propagation and wave velocity in Acoustic Emission Testing.	Understand	CO-20
138	List out the advantages of leak testing.	Understand	CO-18
139	Enumerate the components used in Acoustic Emission Testing setup.	Understand	CO-19
140	Define burst acoustic emission signal	Understand	CO-20
141	List out the applications of leak testing.	Understand	CO-18
142	Define continuous acoustic emission signal	Remember	CO-19
143	List out the stages in Acoustic Emission Testing	Remember	CO-20
144	List out the different data storages in Acoustic Emission Testing	Remember	CO-18
145	Discuss compare CT and FR in non destructive testing	Remember	CO-19
146	Discuss the applications of CT inspection?	Remember	CO-20
147	Define is the computer tomography in non destructive testing	Understand	CO-18
148	List the components of computed tomography	Understand	CO-19
149	Explain the working principle of Computed Tomography with a neat sketch and list out its advantages .	Remember	CO-19
150	Differentiate between Computed Tomography Testing and Acoustic Emission Testing	Remember	CO-20
151	Discuss the importance of Computed Tomography testing in non-destructive evaluation and list out its limitations	Remember	CO-20
152	Explain the working principle of Acoustic Emission Testing with a neat sketch and list out its advantages	Understand	CO-18
153	Discuss the importance of Acoustic Emission testing in non-destructive evaluation and list out its limitations.	Understand	CO-19
154	Differentiate between Computed Tomography Testing and Leak Testing.	Understand	CO-20
155	Explain the working principle of leak Testing with a neat sketch and list out its advantages	Understand	CO-18
156	Discuss the importance of Leak testing in non-destructive evaluation and list out its limitations	Understand	CO-19
157	Differentiate between Acoustic Emission Testing and Leak Testing.	Remember	CO-20
158	Describe briefly burst acoustic emission signal with a neat sketch	Understand	CO-18
159	Differentiate between burst and continuous mode acoustic emission signal.	Understand	CO-19
160	Describe briefly continuous acoustic emission signal with a neat sketch.	Understand	CO-20



161	Briefly explain data analysis and data storage in Acoustic Emission Testing.	Understand	CO-18
162	Explain inspection of weld microstructure by Acoustic Emission Testing with a neat sketch	Understand	CO-19
163	Explain inspection of aerospace structure by Acoustic Emission Testing	Remember	CO-20
164	Describe instrumentation of Acoustic Emission Testing with a neat sketch.	Remember	CO-18
165	Briefly explain sensor and couplant used in Acoustic Emission Testing setup	Remember	CO-19
166	Explain factors influencing acoustic wave propagation and data acquisition in AE technology	Understand	CO-20
167	Discuss briefly the stages involved in Acoustic Emission Testing	Understand	CO-18
168	Explain four channel data acquisition in Acoustic Emission Testing with a neat sketch.	Understand	CO-19
169	Discuss basic principle of acoustic emission test in Non – Destructive testing	Understand	CO-18
170	Discuss the stages and source of acoustic emission testing in non destructive testing	Remember	CO-19
171	Explain advantages and of limitation acoustic emission testing in advanced non destructive testing.	Remember	CO-20
172	Discuss the factors influencing acoustic wave propagation and data acquisition.	Understand	CO-18
173	Explain about instrumentation of acoustic emission testing of non destructive testing	Remember	CO-19
174	Explain the modes acoustic emission testing the transient (burst) and continuous signals	Remember	CO-19
175	Discuss about the four channel data acquisition in acoustic emission testing and also explain about applications of acoustic emission.	Remember	CO-19
176	Explain about computed tomography principle of non destructive testing.	Understand	CO-20
177	Discuss the advantage, limitation and applications of computed tomography in non destructive testing.	Remember	CO-20
178	Explain the major components are used in computed tomography and give some examples of computed tomography (CT) of Non Destructive testing?	Remember	CO-20
<b>UNIT-V</b>			
179	Enlist the major components of an x- ray generator	Remember	CO-10
180	What is the purpose of focusing cup and filters in an x-ray generator?	Remember	CO-11
181	What are the applications of radiographic inspection?	Understand	CO-12
182	What is crank- out the mechanism in gamma ray testing of components?	Understand	CO-13
183	Define the term density and film speed, with respect to radiography testing.	Understand	CO-14
184	What are intensifying screens? Write its types.	Understand	CO-10
185	What is half- value layer in the radiography testing?	Understand	CO-11
186	What are penetrometers? Write its types	Remember	CO-12
187	What is film graininess in radiography testing?	Understand	CO-13
188	What is film contrast in radiography testing?	Understand	CO-14
189	What is geometric unsharpness with respect to radiography?	Remember	CO-11
190	What is need for exposure chart in radiography over film radiography?	Remember	CO-12
191	What is the effect of radiation on the film in radiographic NDT study?	Understand	CO-13
192	What are the advantages of computed radiography over film radiography?	Understand	CO-14
193	Difference between computed radiography and film radiography.	Remember	CO-10
194	What are the applications of computed radiography?	Remember	CO-11
195	What is Compton scattering	Remember	CO-12
196	What is Thomson scattering?	Understand	CO-13
197	State the inverse square law.	Remember	CO-14



198	What is the effect of radiation on the film in radiographic NDT study?	Remember	CO-10
199	Explain with sketch, the working principle of X- ray radiography and state its advantages, Limitations and applications.	Understand	CO-10
200	Explain the types of radiation produced by radioactive decay (gamma ray) and their application with neat sketch.	Remember	CO-11
201	Classify X-ray films used in industrial radiography and brief about construction of film with simple line diagram.	Understand	CO-12
202	Explain the characteristic curve of X-ray film used in radiography testing?	Remember	CO-13
203	Explain the stages of development od X-ray film in radiography testing.	Understand	CO-14
204	Brief write about the following processes during interaction of X-ray with matter: (a) photoelectric effect (b) Compton scattering, (c) Pair production ,and (d) Thomson scattering.	Understand	CO-10
205	Explain how X- rays are produced in radiography testing? Briefly write about two methods of X- ray production,	Understand	CO-11
206	what are the different radiography techniques? Explain any one technique with neat sketch	Understand	CO-12
207	What is the fluoroscopy in non – destructive testing? Explain the principle with neat sketch?	Understand	CO-13
208	Explain the working principle of X ray radiography and state its advantages, disadvantages with applications.	Understand	CO-14
209	Explain advantages, limitations and applications of x-ray radiography testing.	Understand	CO-11
210	Explain the gamma ray radiographic testing and also explain about gamma ray testing arrangements?	Understand	CO-12
211	Explain about crank out mechanism for Gamma ray radiographic exposure.	Remember	CO-13
212	Discuss the half –life of radioactive isotopes in Gamma ray testing (isotope decay rate) and write the advantages of gamma ray radiography testing	Understand	CO-14
213	Explains the metal foil screen and fluorescent intensifying screen (or Salt screen).	Understand	CO-10
214	Explain the stages of film processing and development in radiography testing.	Remember	CO-11
215	Discuss the interaction of X-rays with matter and explain about photoelectric effect, and the Compton effect.	Remember	CO-12
216	Explain the pair production and Thomson (or raylagh) scattering in radiographic testing.	Remember	CO-13
217	Discuss the production of X- rays and explain about characteristic X-ray, and Bremsstrahlung X ray.	Remember	CO-14
218	Explain Inverse square law, X- ray beam attenuation and half – value layer in radiographic testing.	Remember	CO-10
219	How computed radiography differs from conventional radiography? Briefly write about the principle of operation of computed radiography.	Understand	CO-10
220	Explain the principle, advantages, limitations and applications of computed tomography	Remember	CO-11
221	Briefly Explain the advantages, limitations and applications of X-ray radiography testing	Remember	CO-12
222	Explain gamma ray radiography testing and also explain about gamma ray source and gamma ray testing arrangement?	Understand	CO-13
223	Explain about crank-out Mechanism for Gamma Ray radiographic exposure with	Remember	CO-14



	neat sketches.		
224	Write about Half- life of radioactive isotopes in gamma testing (Isotope Decay Rate), and also explain about advantage of gamma ray radiography testing.	Remember	CO-10
225	Explain construction and structure of Industrial X –Ray Film with neat sketches?	Remember	CO-11
226	Write in detail about screen in radiography testing and explain about Metal foil screens and Fluorescent intensifying (or Sat Screens)	Remember	CO-12
227	Explain about various of development of a radiographic X-ray films in radiography testing .	Remember	CO-13
228	Briefly explain about Interaction of X-rays with matter and also explain about the photoelectric effect and the Compton effect.	Remember	CO-14

### 13.2 OBJECTIVE QUESTIONS:

#### UNIT-1

1. Mechanical testing specifications have been developed by the:
  - a. AWS
  - b. ASTM**
  - c. GSA
  - d. ANSI
2. In tensile strength tests, yield strength is a measure of:
  - a. springback
  - b. fracture point
  - c. ultimate strength
  - d. permanent elongation**
3. Impact refers to:
  - a. shock loading**
  - b. compressive loading
  - c. fatigue loading
  - d. torsion loading
4. A principle advantage of the 'dropped weight impact test' is:
  - a. less costly
  - b. applicable to all material
  - c. part failure isn't required for a successful test**
  - d. can be done at room temperatures
5. 'Fatigue life' is a measure of the number of cycles:
  - a. below the endurance limit
  - b. above the endurance limit**
  - c. at the point of fracture
  - d. at the point of permanent deformation
6. Visual non-destructive testing is limited to:
  - a. small, easily handled parts
  - b. non-ferrous materials
  - c. dimensional defects
  - d. surface defects**
7. In magnetic particle inspection, a flaw is indicated by:
  - a. it's lack of magnetism
  - b. particles arranged in line
  - c. particles arranged perpendicular to the discontinuity**
  - d. circular patterns

8. Eddy-current testing relies on:
- a. **accurate reference standards**
  - b. coil strength
  - c. electrolytic solution strength
  - d. solid ground connections
9. X-ray testing is used most often on:
- a. complex shapes
  - b. non-ferrous metals
  - c. round objects
  - d. **welded joints**
10. What is the first step involved in the process of preparation of test sample of material?
- a) Rough polishing
  - b) **Fine grinding**
  - c) Fine polishing
  - d) Etching
11. Which of the following compound is used for fine polishing?
- a) **Aluminum oxide**
  - b) Nitric oxide
  - c) Silicon carbide
  - d) Iron oxide
12. Etching of specimen is done to achieve
- a) **Visible grain boundary**
  - b) Invisible grain boundary
  - c) Toughness
  - d) Hardness
13. Find grain diameter in 'mm' for ASTM 12?
- a) .0066
  - b) .0078
  - c) .0021
  - d) **.0056**
14. Equipment used for inspection of inside portion of hollow chamber or narrow tube is known as
- a) Endoscope
  - b) Telescope
  - c) **Borescope**
  - d) Flexiscope
15. What is the value of average number of grains in per square inch for ASTM 11?
- a) 2048
  - b) **1024**
  - c) 6
  - d) 5
16. Which of the following property will be more in fine grained structure?
- a) **Ductility**
  - b) Corrosion resistance
  - c) Creep resistance
  - d) Hardness
17. Which of the following property will be more in coarse grain structure?
- a) **Ductility**
  - b) Corrosion resistance
  - c) Hardness
  - d) Toughness
18. Which of the following penetrating liquid is used in a liquid penetration test?
- a) Water
  - b) **Chlorine based solvent**

- c) Petroleum based carrier fluid  
d) Fluorine based solvent
19. Which of the following non destructive testing is used to detect change in composition of any material?  
a) Liquid penetration test  
b) Ultrasonic test  
c) Eddy current test  
**d) Radiography**
20. In which type of test the capillary action principle is used?  
a. Probe test  
b. Bend liquid test  
**c. Dye penetrant test**  
d. None of the above
21. Non-destructive testing is used to determine  
a. location of defects  
b. chemical composition  
c. corrosion of metal  
**d. All of these**
22. Which among the following is not a type of Non-destructive testing?  
**a. compression test**  
b. visual testing  
c. ultrasonic testing  
d. eddy current testing
23. Identify the type of destructive testing.  
a. Radiographic test  
b. Dye penetrant test  
**c. Creep test**  
d. All of the above
24. Which among the following is the last step in magnetic particle test method?  
a. observation and inspection  
b. circular magnetization  
**c. demagnetization**  
d. magnetization
25. Which of the following statements is/are true for ultrasonic test?  
**a. Equipment used for ultrasonic testing is portable**  
b. Complicated shapes can be easily scanned  
c. Waves generated are health hazardous  
d. All the above statements are true
26. During radiography test, which region absorbs less radiation and transmits more  
a. Low and high density regions absorb and transmit same amount of radiation  
b. High density region  
**c. Low density region**  
d. None of the above
27. Which test is used to determine dimensions of any object?  
a. Ultrasonic test  
b. Torsion test  
**c. Eddy current test**  
d. All of these tests can be used to determine dimensions of any object.

28. Eddy current test is used to detect
- a. cracks
  - b. hardness
  - c. conductivity
  - d. All of the above.**
29. Which test can be performed without skilled labour?
- a. Dye penetrant testing**
  - b. Visual testing
  - c. Ultrasonic testing
  - d. Magnetic particle test.

## UNIT-II

1. Liquid penetrant testing is based on the principle of:
- (a) Polarized sound waves in a liquid
  - (b) Magnetic domains
  - (c) Absorption of X rays
  - (d) Capillary action**
2. When a small diameter tube is placed in a glass of water, water rises in the tube to a level above the adjacent surface. This is called:
- (a) Viscosity
  - (b) Capillary action**
  - (c) Surface tension
  - (d) Barometric testing
3. How is the size of a liquid penetrant indication usually related to the discontinuity it represents:
- (a) Larger than**
  - (b) Smaller than
  - (c) Equal to
  - (d) Not related to
4. A penetrant that is self-emulsifying is called:
- (a) Solvent removable
  - (b) Water washable**
  - (c) Post-emulsified
  - (d) Dual sensitivity method
5. A penetrant process which employs an emulsifier as a separate step in the penetrant removal process is called:
- (a) Solvent removable
  - (b) Water washable
  - (c) Post-emulsified**
  - (d) Dual sensitivity method
6. A penetrant process in which excess penetrant is removed with an organic solvent is called:
- (a) Solvent removable**
  - (b) Water washable
  - (c) Post-emulsified

- (d) Dual method
7. Which of the following statements accurately describes the capabilities of liquid penetrant testing?
- (a) Liquid penetrant testing is useful for locating subsurface discontinuities in a test piece
  - (b) Liquid penetrant testing is useful for locating discontinuities in porous materials
  - (c) Liquid penetrant testing is useful for locating discontinuities which are open to the surface in non-porous materials**
  - (d) none of the above.
8. Which of the following discontinuity types could typically be found with a liquid penetrant test?
- (a) Internal slag in a weld
  - (b) Internal slag in a casting
  - (c) Sensitization in austenitic stainless steel
  - (d) Fatigue cracks**
9. Which of the following chemical elements are normally held to a minimum in liquid penetrant materials, when testing stainless steel and titanium?
- (a) Hydrogen
  - (b) Chlorine**
  - (c) Carbon
  - (d) Oil
10. Which of the following chemical elements are normally held to a minimum in liquid penetrant materials when testing nickel based alloys?
- (a) Sulphur**
  - (b) Oxygen
  - (c) Carbon
  - (d) Nitrogen.
11. Which of the following is the most desirable method of pre-cleaning a test piece prior to penetrant testing?
- (a) Sand blasting
  - (b) Vapour degreasing**
  - (c) Emery COth
  - (d) Wire brushing
12. Which of the following pre-cleaning processes is not recommended?
- (a) Detergent cleaning
  - (b) Vapour degreasing
  - (c) Shot blasting**
  - (d) Ultrasonic cleaning
13. A wire brush should be used for pre-cleaning:
- (a) When grease and oil must be removed
  - (b) Only as a last resort
  - (c) When rust is to be removed**
  - (d) When grinding burrs must be removed
14. A hydrometer is used to measure:
- (a) Penetrant viscosity

**(b) Specific gravity of water based wet developers**

(c) Penetrant specific gravity

(d) Cleaner specific gravity

15. Visible, solvent removable penetrants are most advantageous for:

(a) Inspecting parts with rough surfaces

(b) Inspecting batches of small parts

**(c) Inspecting parts at remote locations**

(d) Inspecting parts with porous surfaces

16. For adequate test results, the black light used in fluorescent penetrant examination should provide what minimum black light intensity at the test surface?

(a) 100 foot candles per square centimetre

**(b) 1000 microwatts per square centimetre**

(c) 800 foot candles

(d) 35 microwatts per square centimetre

17. What minimum warm-up time is required for acceptable performance of a mercury Vapour arc black light?

(a) None

(b) 2 minutes

**(c) 5 minutes**

(d) 10 minutes

18. Which of the following penetrants contains an emulsifying agent?

(a) Solvent removable

**(b) Water washable**

(c) Post emulsifiable

(d) Fluorescent

19. Which of the following penetrants must be treated with an emulsifier prior to water removal?

(a) Solvent removable

(b) Water washable

**(c) Post emulsifiable**

(d) Fluorescent

20. What is the function of an emulsifier?

(a) To remove the excess penetrant

(b) To develop indications with a post emulsifiable penetrant system

(c) To assist penetration with a post emulsifiable penetrant system

**(d) To make a post emulsifiable penetrant water washable.**

### UNIT-III

1. Magnetic particles testing is most likely to find subsurface discontinuities in:

**(a) Soft steels with high permeability**

(b) Soft steels with low permeability

(c) Hardened steels with low permeability

(d) Hardened steels with high permeability

2. Which of the following is not an advantage of magnetic particles testing?

(a) Fast and simple to perform

- (b) Can detect discontinuities filled with foreign material  
**(c) Most reliable for finding surface cracks in all types of material**  
(d) Works well through a thin coat of paint
3. Which of the following does not represent a limitation of magnetic particle testing?  
(a) The type of materials which may be effectively tested  
(b) The directionality of the magnetic field  
(c) The need for demagnetization  
**(d) The ability to detect discontinuities filled with foreign material**
4. The most effective NDT method for locating surface cracks in ferromagnetic materials is:  
(a) Ultrasonic testing  
(b) Radiographic testing  
**(c) Magnetic particle testing**  
(d) Liquid penetrant testing
5. Which of the following may cause magnetic particle test indications?  
(a) A joint between two ferromagnetic materials of different permeability  
(b) A shrink fit joint in ferromagnetic materials  
(c) A brazed joint in ferromagnetic materials  
**(d) All of the above**
6. A discontinuity which is produced during solidification of the molten metal is called:  
**(a) Inherent**  
(b) Processing  
(c) Service  
(d) None of the above
7. Pipe would be classified as what type of discontinuity?  
**(a) Inherent**  
(b) Processing  
(c) Service  
(d) None of the above
8. A seam would be classified as what type of discontinuity?  
(a) Inherent  
**(b) Processing**  
(c) Service  
(d) None of the above
9. A lamination in steel plate would be classified as what type of discontinuity?  
(a) Inherent  
**(b) Processing**  
(c) Service  
(d) None of the above
10. An internal rupture caused by working steel at improper temperatures is called a:  
(a) Lap  
(b) Cold shut  
**(c) Forging burst**  
(d) Slag inclusion
11. Cracks which are caused by alternating stresses above a critical level are called:  
(a) Stress corrosion cracks

- (b) Cycling cracks  
(c) Critical cracks  
**(d) Fatigue cracks**
12. Cracks which are caused by a combination of tensile stress and corrosion are called:  
**(a) Stress corrosion cracks**  
(b) Cycling cracks  
(c) Critical cracks  
(d) Fatigue cracks
13. Which of the following are ferromagnetic materials?  
(a) Aluminium, iron, copper  
(b) Iron, copper, nickel  
(c) Copper, aluminium, silver  
**(d) Iron, cobalt, nickel**
14. The reverse magnetising force necessary to remove a residual magnetic field from a test piece after it has been magnetically saturated is called:  
(a) Hysteresis  
**(b) Coercive force**  
(c) Demagnetising flux  
(d) Reverse saturation
15. Magnetic lines of force enter and leave a magnet at:  
(a) Saturation  
(b) L/D ratios of greater than 4 to 1  
(c) Flux concentration points  
**(d) Poles**
16. The ease with which a magnetic field can be established in a test piece is called:  
(a) Reluctance  
(b) Retentivity  
**(c) Permeability**  
(d) Electromagnetism
17. Opposition to establishment of a magnetic field is called:  
**(a) Reluctance**  
(b) Retentivity  
(c) Permeability  
(d) Electromagnetism
18. The ability of a material to remain magnetic after the magnetising force is removed is called:  
(a) Reluctance  
**(b) Retentivity**  
(c) Permeability  
(d) Electromagnetism
19. A magnetic field which is contained completely within the test piece is called a:  
(a) Confined field  
(b) Longitudinal field  
**(c) Circular field**  
(d) Saturated field
20. Which of the following produces a circular field?

- (a) Coil
- (b) Head shot**
- (c) Yoke
- (d) All of the above.

#### UNIT-IV

1. The divergence of an ultrasonic beam is dependant on:
  - (a) Transducer wavelength and diameter**
  - (b) Test specimen density
  - (c) The sound wave's angle of incidence
  - (d) The degree of damping of the ultrasonic transducer
2. When a longitudinal wave is incident upon an inclined interface between zero degrees and the first critical angle:
  - (a) The sound beam is totally reflected
  - (b) Only shear waves are produced in the second material
  - (c) Shear waves and longitudinal waves are produced in the second material**
  - (d) Only longitudinal waves are produced in the second material
3. The piezoelectric material in a search unit which vibrates to produce ultrasonic waves is called:
  - (a) A backing material
  - (b) A lucite wedge
  - (c) A transducer element or crystal**
  - (d) A couplant
4. When a longitudinal wave is incident upon an inclined interface and is refracted at ninety degrees, the angle of the incident longitudinal wave is called:
  - (a) The Snell constant
  - (b) The Snell angle
  - (c) The mode conversion constant
  - (d) The first critical angle**
5. When a longitudinal wave sound beam passes through an acoustic interface at some angle other than zero degrees:
  - (a) Surface waves are generated
  - (b) Plate waves are generated
  - (c) Reflection, refraction and mode conversion will occur**
  - (d) The first critical angle is reached
6. Which of the following can be a source of spurious ultrasonic signals?
  - (a) Surface roughness of the test piece
  - (b) Mode conversion within the test piece
  - (c) Shape or contour of the test piece
  - (d) All of the above**
7. A noisy base line, or hash may result in:
  - (a) Laminations in the test piece
  - (b) Discontinuities at an angle to the test piece surface
  - (c) Large grain size**
  - (d) Fatigue cracks

8. Sound waves which travel on the surface of a solid in a manner similar to waves on a water surface are called:
- (a) **Rayleigh waves**
  - (b) Shear waves
  - (c) Primary waves
  - (d) Compression waves
9. Lamb waves are formed in a part which has:
- (a) A thickness greater than about ten wavelengths
  - (b) **A thickness approximately equal to the wavelength**
  - (c) Low acoustic impedance compared to the transducer crystal material
  - (d) A thickness of about four wavelengths.
10. Which type(s) of sound wave modes will propagate through liquids?
- (a) **Longitudinal**
  - (b) Shear
  - (c) Surface
  - (d) All of the above
11. When the motion of the particles of a medium is transverse to the direction of propagation, the wave being transmitted is called a:
- (a) Longitudinal wave
  - (b) **Shear wave**
  - (c) Surface wave
  - (d) Lamb wave
12. Which of the following test frequencies would generally provide the best penetration in a 12 inch thick specimen of coarse-grained steel?
- (a) **1.0 MHz**
  - (b) 2.25 MHz
  - (c) 5.0 MHz
  - (d) 10 MHz
13. An oscilloscope display in which the screen base line is adjusted to represent the one way distance in a test piece is called a:
- (a) A scan display
  - (b) **B scan display**
  - (c) C scan display
  - (d) D scan display
14. A common use of ultrasonic testing is:
- (a) Cleaning
  - (b) **Detecting of sub-surface indications**
  - (c) Determination of the test piece ductility
  - (d) Communications.
15. Sound waves of a frequency beyond the hearing range of the human ear are referred to as ultrasonic waves or vibrations, and the term embraces all vibrational waves of frequency greater than approximately:
- (a) **20 kHz**
  - (b) 2 MHz
  - (c) 2 kHz
  - (d) 200 kHz

16. Y cut crystals produce:
- (a) Longitudinal waves
  - (b) Shear waves**
  - (c) Lamb waves
  - (d) Surface waves
17. The cable that connects the ultrasonic instrument to the search unit is specially designed so that one conductor is centred inside another. The technical name for such a cable is:
- (a) BX cable
  - (b) Conduit
  - (c) Coaxial cable**
  - (d) Ultrasonic conductor cable grade 20
18. As ultrasonic frequency increases:
- (a) Wavelength increases
  - (b) Wavelength decreases**
  - (c) Sound velocity increases
  - (d) Sound velocity decreases
19. In an A scan presentation, the amplitude of vertical indications on the screen represents the:
- (a) Amount of ultrasonic sound energy returning to the search unit**
  - (b) Distance travelled by the search unit
  - (c) Thickness of material being tested
  - (d) Elapsed time since the ultrasonic pulse was generated.
20. Loss of the test piece back wall echo during scanning may be caused by:
- (a) An abnormally homogeneous material structure
  - (b) A smooth entry surface on the test piece
  - (c) A discontinuity which is not parallel to the entry surface**
  - (d) An opposite surface which is parallel to the entry surface.

## UNIT-V

1. Which of the following types of intensifying screens are not used in industrial radiography?
- (a) Lead
  - (b) Fluorescent
  - (c) Silver halide**
  - (d) All of the above
2. Betatrons are used to produce X rays in what range?
- (a) Several MeV**
  - (b) 50-500 keV
  - (c) 500-1000 keV
  - (d) 0-50 keV
3. Which of the following is an isotope not artificially produced for industrial use:
- (a) Ir-192
  - (b) Ra-226**
  - (c) Co-60

- (d) All of the above
4. One half value layer of lead for Iridium-192 is approximately:
- (a) 12 mm
  - (b) 4 mm
  - (c) 2 mm**
  - (d) 25 mm
5. One half value layer of lead for Cobalt-60 is approximately:
- (a) 12 mm**
  - (b) 6 mm
  - (c) 2 mm
  - (d) 25 mm
6. The film processing step in which the undeveloped silver bromide is removed from the film emulsion is called:
- (a) Development**
  - (b) Stop bath
  - (c) Fixing
  - (d) Rinsing
7. A radiation producing device which emits radiation of one or a few discrete wavelengths is:
- (a) An X ray machine
  - (b) A linear accelerator
  - (c) A gamma ray source**
  - (d) A betatron
8. The intensifying action of lead screens is caused by:
- (a) Secondary X ray emission
  - (b) Secondary gamma ray emissions
  - (c) Fluorescence of lead screens
  - (d) Electron emission**
9. Most of the energy applied to an X ray tube is converted into:
- (a) X rays
  - (b) Light
  - (c) Heat**
  - (d) Ultraviolet radiation
10. Radiography of tubular sections using a double wall, double viewing technique is mainly applicable to sections:
- (a) Over 38 mm in diameter
  - (b) 88 mm in diameter or less**
  - (c) 125 mm in diameter and less
  - (d) Under 25 mm in diameter
11. Which of the following is the most common method of packaging film?
- (a) Individual sheets for use in cassettes
  - (b) Rolls
  - (c) Pre-packaged ('day-pack')
  - (d) All of the above**
12. Which of the following types of radiation is particulate?
- (a) X

- (b) Gamma  
(c) **Alpha**  
(d) None of the above
13. Most scattered radiation which adversely affects the radiographic image quality originates:  
(a) **From floors and walls adjacent to the test piece**  
(b) From other nearby objects  
(c) From the test piece itself  
(d) From the lead intensifying screens
14. An effect of scattered radiation is to:  
(a) Decrease required exposure time  
(b) **Diminish contrast, detail and clarity of radiographic image**  
(c) Decrease film density  
(d) All of the above
15. What is the most important factor in determining the archival quality of radiographic film?  
(a) Film density  
(b) Image quality  
(c) **Degree of removal of fixer residues during washing**  
(d) Degree of removal of developer residues during washing
16. Radiographic enlargement to distinguish small defects is possible:  
(a) **Only with a very small source or focal spot size radiation source**  
(b) Routinely  
(c) With most sources  
(d) Never
17. A detrimental effect of fluorescent screens might be:  
(a) High definition  
(b) **Screen mottle**  
(c) Non-linear attenuation  
(d) Displaced core effect
18. The penetrating power of an X ray machine is indicated by:  
(a) Milliamperage  
(b) **Tube voltage**  
(c) Filament current  
(d) Anode current
19. Reticulation may be the result of:  
(a) Inadequate agitation of the film during development  
(b) Inadequate water rinse during processing  
(c) Using exhausted stop bath solution  
(d) **Developing solutions not maintained at the same temperatures**
20. The main advantage of having small focal spot on an X ray tube is:  
(a) Heat is conducted away more efficiently than with a large focal spot  
(b) A smaller focal spot is unlikely to be damaged from the required tube currents  
(c) Longer tube life  
(d) **A smaller focal spot allows sharper radiographic images than does a larger focal spot.**

#### 14. WEBSITES' ADDRESSES:

<https://www.journals.elsevier.com/case-studies-in-nondestructive-testing-and-evaluation>

<https://www.ndt-global.com/our-work/case-studies>

[www.springer.com](http://www.springer.com)

<https://www.materialstoday.com/characterization/journals/case-studies-nondestructive-testing-evaluation/>

<http://www.isnt.org.in/cgi-sys/suspendedpage.cgi>

[http://www.mac-ndt.com/?gclid=EAIaIQobChMI1r-UtpPy4gIVCCUrCh0dNwG9EAAYASAAEgIQcPD\\_BwE](http://www.mac-ndt.com/?gclid=EAIaIQobChMI1r-UtpPy4gIVCCUrCh0dNwG9EAAYASAAEgIQcPD_BwE)

<https://www.journals.elsevier.com/ndt-and-e-international>

<https://www.tms.org/portal/PUBLICATIONS/Journals/JOM/portal/Publications/Journal/s/JOM/JOM.aspx?hkey=29f32fd0-4f20-4182-92e5-e130b57e3990>

<http://www.kalva.net/>

<https://www.inderscience.com/jhome.php?jcode=ijmpt>

<https://www.inderscience.com/jhome.php?jcode=ijmmp>.

#### 15. EXPERT DETAILS:

- a) Mr. Srinivas  
NDT Engineer  
Kalva Enterprises Ltd.
- b) Dr.G.Shiva Rao  
Scientist G  
DRDL.
- c) Dr.R.N.Roy  
Scientist F  
DRDL.

#### 16. JOURNALS (NATIONAL & INTERNATIONAL)

- a) Case Studies in Non destructive Testing and Evaluation.
- b) Journal of Nondestructive Evaluation, ISSN: 0195-9298 (Print) 1573-4862 (Online)
- c) International Journal of Microstructure and Materials Properties
- d) International Journal of Materials and Product Technology, ISSN online,1741-5209

#### 17. LIST OF TOPICS FOR STUDENTS' SEMINARS

- a) Material Testing Methods
- b) Destructive Testing Methods
- c) Non Destructive Testing Methods
- d) NDT Methods Adopted For Medical Field
- e) NDT Methods Adopted For Construction Field.
- f) NDT Methods For Advanced Materials.(Composites,Alloys Etc)

### 18.CASE STUDIES / SMALL PROJECTS:

- a) Comparison Of NDT With Medical Equipment.
- b) NDT Methods In Composites
- c) NDT Methods In Construction
- d) NDT Methods In Steel Structures.

### 19.CASE STUDIES & COURSE PLAN(Prepared By:

Mr.C.Anil Kumar Reddy

Asst.Professor

Department Of Mechanical Engineering.

### 20.COURSE LEARNING OUTCOMES:

Course Learning Outcomes(CO)	DESCRIPTION
CO-01	Understand the visual examination techniques in direct and indirect methods for NDT.
CO-2	Remember the various equipment available for the visual inspection and the codes and standards for non-destructive testing
CO-3	Apply the liquid penetrant test that can be used for effective identification of surface cracks in metals.
CO-4	Apply the codes and standards applicable for the liquid penetrant testing in the classification of NDT
CO-5	Understand the principle of magnetic particle testing and the advantages and limitations of the magnetic particle testing equipment and process
CO-6	Understand the principle of ultrasonic testing and identify the suitable methods for conducting non-destructive testing using the ultrasonic testing equipment.
CO-7	Evaluate the interpretation procedures for NDT by ultrasonic testing along with its applications.
CO-8	Understand transmission and pulse-echo methods of ultrasonic testing.
CO-9	Evaluate and apply ultrasonic testing and acoustic emission testing and for various particle applications.
CO-10	Understand the working principle, advantages, limitations and applications of X-ray film in radiography testing
CO-11	Remember X-ray films used in industrial radiography and describe the stage of development of X-ray films in radiography testing

CO-12	Apply the knowledge of radiographic testing method for the NDT of metals for knowing the defects internally present in the metals.
CO-13	Remember the variables and the radiographic image quality improving techniques along with the safety norms to be considered for radiation effects
CO-14	Understand various process during interaction of X-ray with matter.
CO-15	Understand the working principle, advantages, limitations and applications of various advanced radiography techniques viz fluoroscopy testing, xerography, computed tomography
CO-16	Understand the principle of phase array and its technique utilized for the NDT of materials along with the equipment for phase array.
CO-17	Remember the verification for flow existence and position for reporting and applications of the phase array
CO-18	Understand the techniques and interpretation of radiography in the field of phase array techniques and various applications of the process
CO-19	Remember the special radiographic techniques and the various advantages and limitations of the processes.
CO-20	Understand the acoustic emission inspection method principle and understand its various applications.