WINTER – 17 EXAMINATIONS

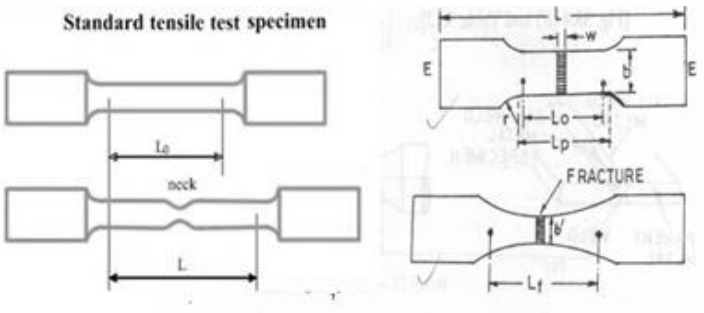
Subject Code: **17555** **Model Answer** Page No: ____/

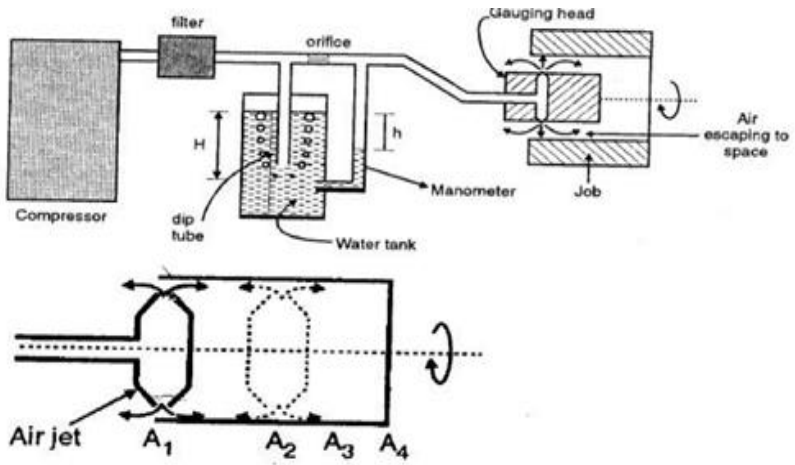
Important Instructions to examiners:

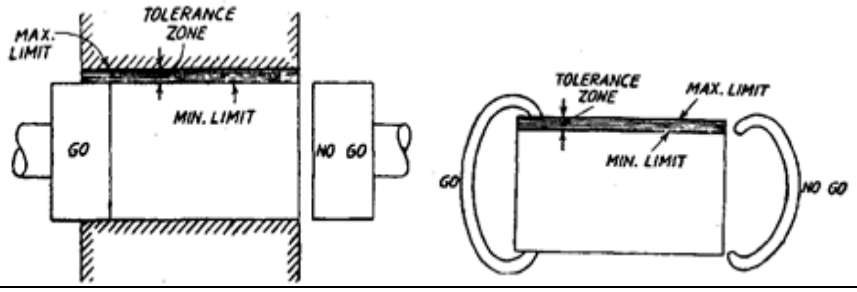
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and Communication Skills)
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

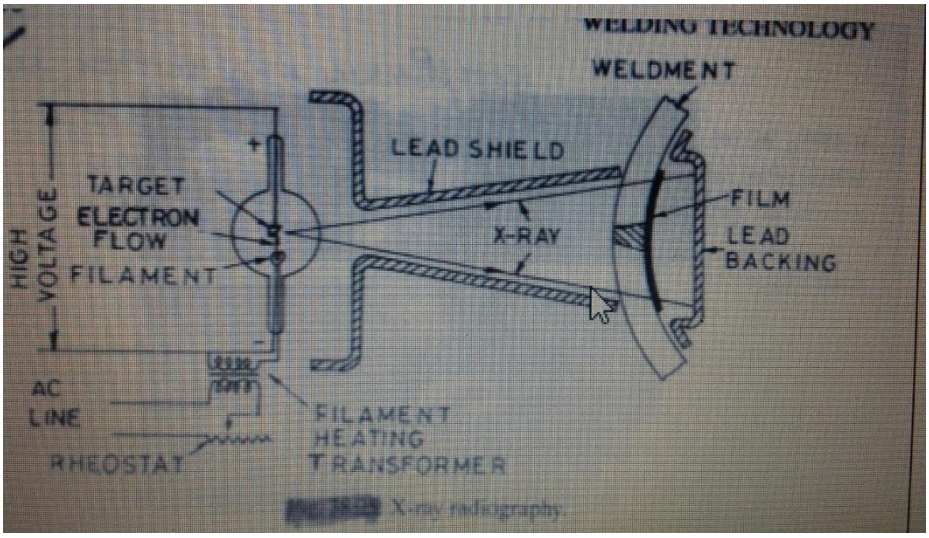
Q. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1	**Attempt any FIVE of the following:**		**5X4=20**
a	**Wavelength Standards** In these standards, the wavelength of the monochromatic light is used as a unit of length. A wavelength is a measure of distance between two identical peaks (high points) or troughs (low points) in a wave **Advantages of Wavelength Standards:** 1) Wavelength is accurately defined 2) It cannot be affected by change in temperature or place 3) It can be easily produced in any good laboratory 4) Highly accurate & precise 5) No parallax error	2 marks 2 marks. Any 2	**4M**
b	**Concept of Selective fit Assembly** Selective fit assembly is an economic method to obtain perfect precision assemblies In selective assembly, the parts of anyone type are categorized into several groups according to size. The mating parts are also categorized into same number of groups, so that the corresponding groups, when assembled will give the desired fit at assembly with little or no further machining. In this process, the parts are manufactured to rather wider tolerances and then separated into number of groups according to their actual sizes. Assembly is then made from the selected groups. Selective assembly results in reduced cost of production without affecting the quality of the product	04 mark	**04 marks**
c	**Basic Objective of Quality Control** 1. To improve company's income 2. To reduce company's cost 3. Achieve Interchangeability 4. Customer satisfaction 5. To produce optimum quality 6. To create quality mindness among the workers **7.** To improve quality & productivity	4 marks. Any 4	**04 marks**
d	**Calssification of Inspection** 1. Inspection of raw/ incoming materials 2. In process Inspection 3. Inspection of finished goods (final Inspection)	2 marks Any2	**04 marks**

	1.Inspection of raw/ incoming materials: It is also called receiving inspection. It consists of inspecting and checking of all the purchased raw materials and parts that are supplied before they are taken on to stock or used in actual manufacturing. **2. In process Inspection** The work of inspection is done while the production process is simultaneously going on. Inspection is done at various work centres of men and machines and at the critical production points **3. Inspection of finished goods (final Inspection)** This is the last stage when finished goods are inspected and carried out before marketing to see that poor quality product may be rejected	2 marks Any1	
e	**Ultrasonic Inspection** **Advantages:** 1. It is a fast and reliable method of non-destructive inspection. 2. This method of locating flaws with metal objects is more sensitive than radiography. 3. The minimum flaw size which can be detected is equal to about 0.1% of the distance from the probe to the defect. 4. Big weldments can be systematically scanned for initial detection of major defects. 5. Ultrasonic inspection involves low cost and high speed of operation. 6. The sensitivity of ultrasonic flaw detection is extremely high, being at a maximum when using waves of highest frequency **Disadvantages:** 1. Surface to be tested must be ground smooth and clean. 2. Skilled and trained operator is required. 3. It is not suited to the examination of weldments of complex shape or configurations 4. Surface must be accessible to transmit ultrasound 5. Coarse grained materials are difficult to inspect	2m Any 2 2m Any 2	**4m**
f	**Types of Leaks:** (1)Real Leak : It is an essentially localized leak that is a discrete passage through which fluid make flow. (2) Virtual leak: it is leak that involves gradual distortion from surface or components within a vacuum system. Leak (or tightness) test by gas. Concept: (1)Leak refers to an actual discontinuity or passage through which a fluid flows or permeates.	02 m Any2	**4m**

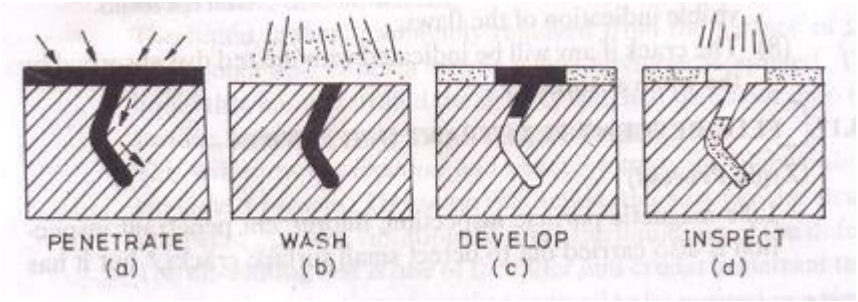
	(2)Leak testing is the determination of the rate at which a gas will penetrate from inside a tight component or assembly to the outside as a result of pressure differential between the two regions. Purpose: To test welded pressure vessels, tanks and pipelines to determine if leaks are present. Absolute tightness of all the welded joints can be tested this way Procedure: The welded vessel, after closing all its outlets; is subjected to internal pressure using gas (e.g. CO2),Hydraulic pressure, using gas, is the usual medium employed in this test. Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not. When using air/gas, failure of vessel can cause injuries to persons around. Application: Find out leakage from pipe, pressure vessels, boilers, heat exchangers	2m Any 1	
g	**Procedure for preparing the Specimen for Tensile Test** A Tensile Test specimen is cut from a welded butt joint at right angle to the weld direction. A tensile specimens is a standardized sample cross-section. This type of specimen is prepared by machining a groove in a plate of steel and then completely filling the groove with deposited weld metal. The surrounding steel is then machined away leaving a specimen of weld metal  Specimen for Tensile Test	2m Procedure 2m diag	**4m**

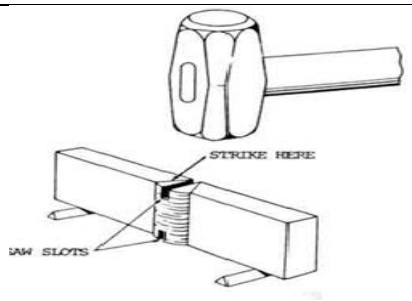
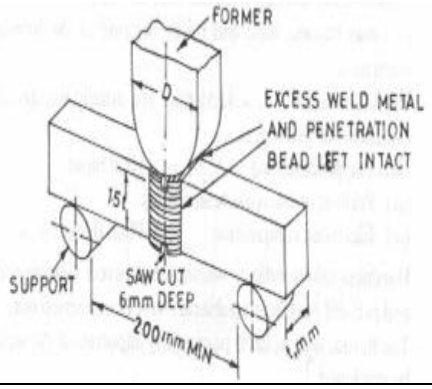
2.	**Attempt any FOUR of the following:**		**4X4=16**
a	**Pneumatic Comparator** Principle: Variations in the dimensions being measured with respect to reference are shown & amplified by a variations in air pressure Working: A jet of air is applied at constant pressure through the orifice & air escapes in the form of jets through a restricted space, which exerts aback pressure. The variation in the back pressure is then used to find the dimensions of the component.  Differentail Pneumatic Comparator	2m working 2m (diag)	**4m**
b	**Taylor's Principle of Gauge Design:** Taylor's principle is applied in designing GO and NO GO gauges for checking maximum and minimum limits as - i) GO limit: This designation is applied to that limit of the two limits of size which corresponds to maximum material limit consideration, i.e. the upper limit of a shaft and lower limit of a hole. The form of the GO gauge should be such that it checks one feature of the component in one pass. ii) NO GO limit: This designation is applied to that limit of the two limits of size which corresponds to minimum material limit condition, i.e. the lower limit of a shaft and higher limit of a hole. "NO GO" gauges should check only one part or feature of the component at a time.	2m Principle 2m (diag)	

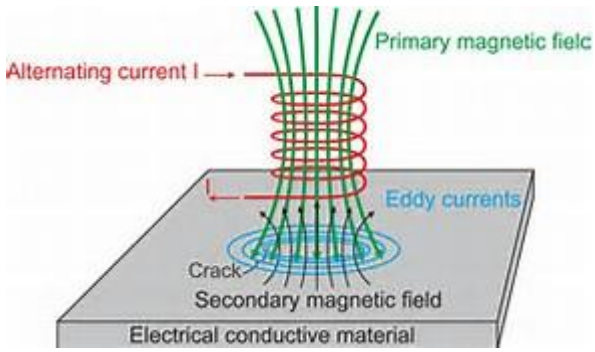
			
c	**Quality of Design:** Is the quality which the producer or supplier is intending to offer to the customer. When the producer is making the quality of design of the product, he should take into consideration the customer's requirements in order to satisfy them with fitness for use of the product. It concerned with the tightness of specification Generally greater the requirement for strength, life, function & interchangeability of manufactured item, better the quality of design **Factors Governing Quality of Design:** Types of customers in the market Intended life Environmental condition Reliability Strength Life Interchangeability Economical & profit considerations	2m Definition 2m Any2	**04M**
d	**Various Duties of Quality Inspector:** **(**1)Interpretation of specification (2)Measurement of product (3)Comparison with standards (4)Judging conformity (5)Recording data (6)Disposition of product	4m Any4	**04M**
e	**XRay Radiography Testing** Working principle: X rays are produced in X ray tube where cathode produce electron which move towards the anode. A part of K.E.is converted to energy of radiation on X rays. The portion of weld metal where defects are to be suspected is exposed to X rays emitted from the tube. X-rays are produced in X-ray tube were a cathode produced electrons which move towards anode. A part of K.E is converted to energy of rotation of x-rays A cassette containing X ray film is place behind and in contact with	2m Principle	**04M**

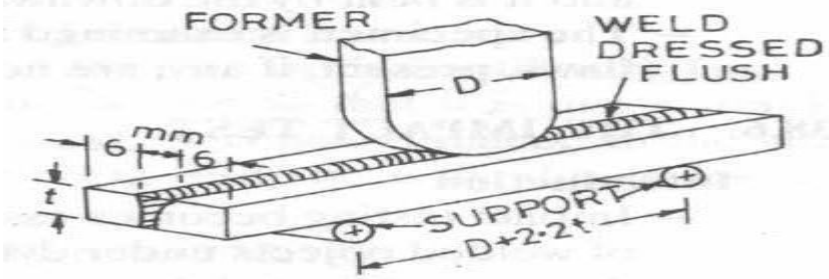
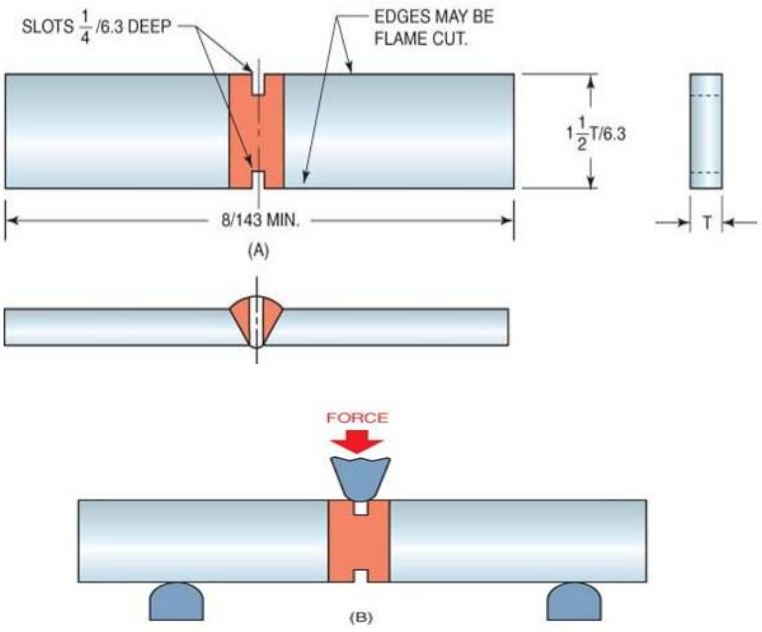
	weldment perpendicular to the rays. During expose X rays penetrated the welded object and thus affect welded X- ray film. The X- Ray photograph shows the existence of flaw, internal crack, Leak or any deformity with their exact location  **Xray Radography**	2m diagram	
f	**Etching Reagents for Etch Test:** Ammonia Hydrogen Peroxide Hydrochloric Acid Ferric Chloride Ethanol Nitric Acid Hydrofuloric Acid **Use of** Ammonia Hydrogen Peroxide- Etching copper, copper alloys Hydrofuloric Acid- for stainless steel & super alooys Ethanol – Stainless steel Ferric chloride –Stainless steel	4m Any4	
3	**Attempt any FOUR of the following:**		**4X4=16**
a	**End Standard** When length is expressed as the distance between two flat parallel faces,it is known as end standard. **<u>Characteristics of End Standards:</u>** 1.These standards are highly accurate for measurement of close tolerance up to + 0.001mm. 2. They are not subjected to parallax error (reading error). 3. Can be easily aligned with the axis of measurement. 4. Group of slip gauges can be wrung together to build up a given size 5. They require more time for measurement and measure only one dimension at a time.	1m Def. 3m Any3	**04 marks**

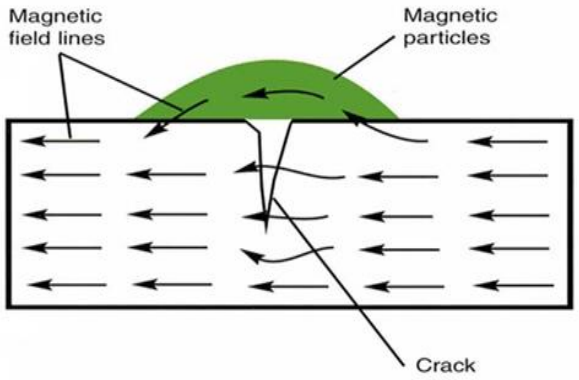
b	**Requirements of the material for gauges:** 1.Resistance to wear & tear 2.Resistance to scratches 3.Corrosion resistent 4.Economical 5.Resistance to thermal expansion 6.Dimensionally stable 7.Superioir wringing quality	4m Any4	
c	**Principles of TQM** Management Commitment • Plan (drive, direct) • Do (deploy, support, participate) • Check (review) • Act (recognize, communicate, revise) Employee Empowerment • Training • Suggestion scheme • Measurement and recognition • Excellence teams Continuous Improvement • Cross-functional process management • Attain, maintain, improve standards Customer Focus • Supplier partnership • Service relationship with internal customers • Never compromise quality • Customer driven standards	4m Any4	**04 marks**
d	**Parameters in Inspection Planning** 1.What is inspect Dimension governing fits should be checked in piece part prior to assembly Raw materials, components, sub assembly 2.When to inspect Incoming material Inprocess Finished goods inspection 3.Where to inspect Proper factory layout Precisions measurement is located in air condition rooms. 4. How much to inspection Either 100% inspection or as per sampling plan. 5. How to inspect Suitable inspection device capable of measuring the characteristics desired	4m Any4	**4M**

e	**Flurescent Penetrent Inspection** Fluorescent penetrant inspection is carried out to detect small surface cracks, but it has the advantage that it (i.e. Penetrant inspection technique) can be used for testing both ferrous and nonferrous welded jobs. - This method is sensitive to small surface discontinuities such as cracks, shrinkage and porosity open to the surface which tend to retain penetrant in spite of the rinse. Smooth or machined job surfaces provide more satisfactory conditions for the test. Operational Steps (i) Clean the surfaces of the object to be inspected for cracks etc. (ii) Apply the fluorescent penetrant on the surface by either dipping, spraying or brushing. Allow a penetration time up to one hour. The fluorescent penetrant is drawn into crack by capillary action [Fig. (a)]. (iii) Wash (the surface) with water spray to remove penetrant from surface but not from crack [Fig. (b)]. (iv) Apply the developer. The developer acts like a blotter to draw Penetrant out of crack and enlarges the size of the area of penetrant indication [Fig. (c)]. (v) The surface is viewed under black light [having a wavelength of 3650 Angstrom (A) units (1A = 10 -8 cms)], which is between the visible and ultraviolet in the spectrum. Black light causes penetrant to glow in dark [Fig. (d)].  	2m 2m diagram	**4M**
f	**Nick Break Test** A nick-break test involves breaking the weld joint to examine the fractured surfaces for internal defects such as: 1. Gas pockets 2. Slag inclusions 3. Porosity. 4. The test also determines weld ductility and the degree of fusion **Nick Break Test Process:** Take a sample piece, partially cut through it, then break the remainder off. This allows you to ‘see inside defectsThe weld defects can be seen by visual inspection	2m Process	

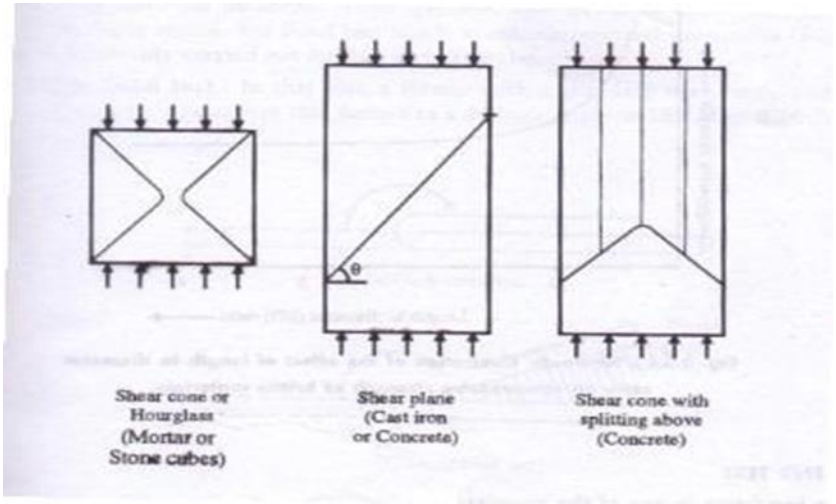
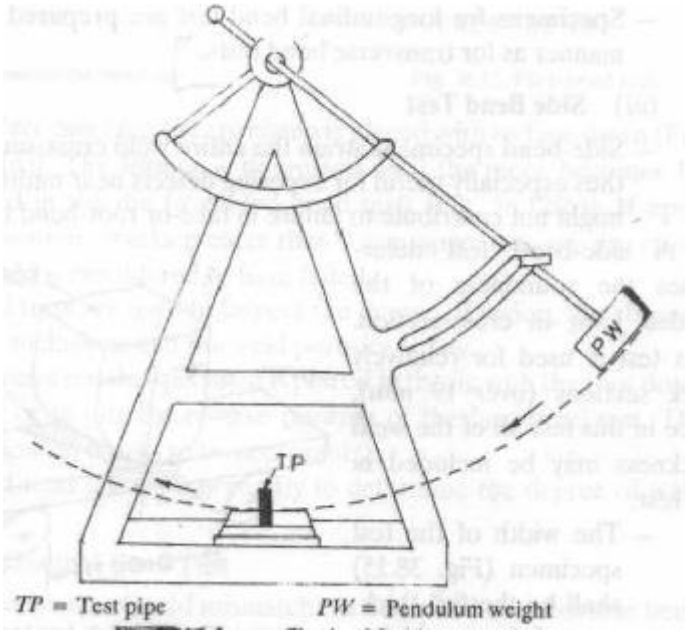
	 OR 	2m diag	**04m**
4	**Attempt any FOUR of the following**		**4x4=16**
a	**Requiements of Good Comparator** 1) The comparators must be of robust design and construction so as to withstand the effect of ordinary usage without impairing its measuring accuracy. 2) The indicating devices are such that readings are obtained in the least possible time. 3) Provision is made for maximum compensation for temperature effects. 4) The scale is linear and having straight line characteristic. 5) Measuring pressure is low and constant 6) High degree of accuracy & precision 7) High amplification & good resolution 8) Comparator should be versatile 9) No backlash in the movement of the plunger & recording mechanism	4m Any4	
b	**Testing of non magnetic material** Eddy Current Testing is used for non magnetic materials In this technique, a coil (also called probe or sensor) is excited with alternating current. Following the Ampere's law, this current generates primary magnetic field in the vicinity of the coil. When an electrically conducting material is brought close to this coil, eddy currents are induced in the material. <u>Principle of Operation:</u> An A.C. coil is brought up close to the weldment to be tested. The A.C. Coil induces eddy currents in the welded object. These eddy currents produce their own magnetic field which opposes the field of the A.C. coil. The result is an increase in the impedance (resistance) of the A.C.	2m	

	Coil. Coil impedance can be measured. If there is a flaw in the weldment, as soon as the coil passes over the flow, there is a change in the coil impedance which can be wired to give a warning light or sound and thus the flaw and its location can be determined. Flaws Indicated Flaws at or close to the surface such as cracks, weld porosity, poor fusion or any linear discontinuity can be detected  Eddy Curent Testing	2m diagram	
c	**Advantages of NDT** 1. Tests are designed to maximize both tester &product safety 2. Since substances are not altered by NDT, they can continue to be used. That means less wasted samples. 3. 100 % inspection is possible 4.NDT test is reliable 5.NDT test will always most affordable option 6.Very little preparation is required 7In service testing is possible **Disadvantages of NDT** 1.Skilled manpower is required 2. Cost of equipment is high 3. Small flaws are difficult to detect in visual inspection 4. Ferromagnetic materials required for magnetic particles testing 5. Material must be good conductor of sound for ultrasonic testing 6. Source of radiography is required in radiography testing	2m any2 2m any2	**04M**
d	**Longitudinal Bend Test** The problems of weld mismatch can be avoided by using longitudinal bend specimens in which the weld runs the full length of the bend. The bend axis being perpendicular to the weld axis. In longitudinal bend test, all zones of the welded joint (i.e., weld, heat-affected zone and the base metal) are strained equally and simultaneously. This test is generally used for evaluations of joints in dissimilar metals. A bend test is an easy and inexpensive test to apply. The method is fast and shows most weld faults quite accurately.	2m Explianat ion	**04M**

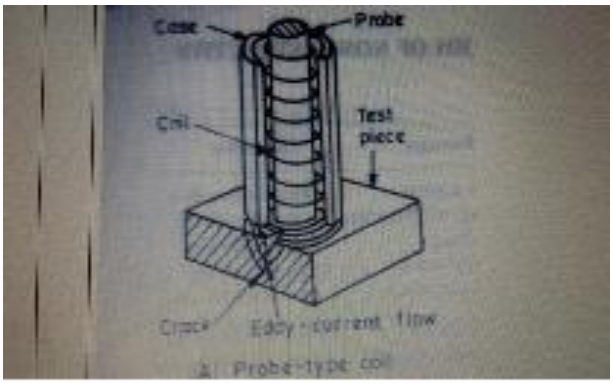
	 Weld runs full length of bend	2m diagram	
e	**Specimen Preparation for Nick Break Test** Firstly a sample piece is selected, size depends upon material being tested. The test specimen shall be cut transversely to the welded joint as shown in the figure 	2m 2m diagram	**04M**
f	**ASME –** American Society of Mechanical Engineers is a 120,000-member professional organization focused on technical, educational and research issues of the engineering and technology community. ASME conducts one of the world's largest technical publishing operations, holds numerous technical conferences worldwide, and offers hundreds of professional development courses each year. ASME sets internationally recognized industrial and manufacturing codes and standards that enhance public safety.	2m	**4m**

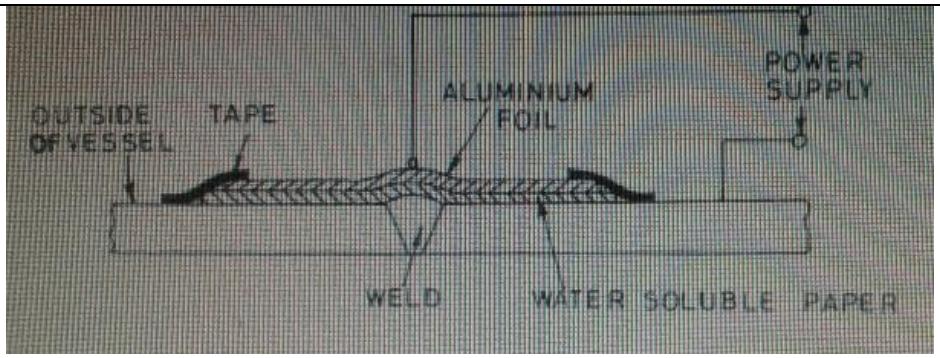
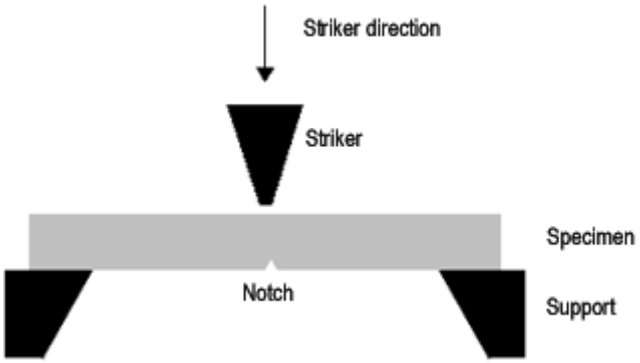
	ASTM - International, formerly known as the American Society for Testing and Materials (ASTM), is a globally recognized leader in the development and delivery of international voluntary consensus standards. Today, some 12,000 ASTM standards are used around the world to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence	2m	
5.	**Attempt any FOUR of the following**		**4x4=16**
a	Magnetic Particle Inspection- When a piece of metal is placed in magnetic field and the lines of magnetic flux get intersected by a discontinuity such as a crack or slag inclusions in a job, magnetic poles are induced on either side of the discontinuity The discontinuity causes an abrupt change in the path of magnetic flux flowing through the job normal to the 'discontinuity, resulting a local flux leakage field and interference with the magnetic lines, of force. Procedural steps involved are- (a) Magnetising the component part. (b) Applying magnetic particles on the component part. (c) Locating the defects Magnetic particle inspection MPT is used for testing material which can be easily magnetized MPT required equipment is cheap and robust and can easily be handled by semiskilled personnel without requiring elaborate protection such as that needed for radiography.  	2m 2m diag	**4m**
b	**Safety Precaution for Xray & Gamma Ray Testing** Radiographic testing can be used to detect internal defects in castings, welds or forgings by exposure the construction to x-ray or gamma ray radiation. 1.Investigators shall ensure that there is a one-to-one correlation between stock vials or sources and – 2.Use appropriate personal protective clothing and equipment including gloves, gowns or lab coats, and eye protection. 3.Use appropriate dosimeters - Practice contamination control at the	4m Any4	**4m**

	point of administration, in laboratories. 4.Radiation Safety Handbook - Survey administration areas to identify contamination and promptly clean it up 5. Handle sharps safely 6. Prevent puncture wounds from contaminated needles by recapping		
c	**Leak Test Under Fluid Pressure** Leak (or tightness) test: Under fluid pressure Leak refers to an actual discontinuity or passage through which a fluid flows or permeates. Leak testing is the determination of the rate at which a liquid or gas will penetrate from inside a tight component or assembly to the outside as a result of pressure differential between the two regions. Purpose: To test welded pressure vessels, tanks and pipelines to determine if leaks are present. Absolute tightness of all the welded joints can be tested this way. Procedure: The welded vessel, after closing all its outlets; is subjected to internal pressure using water, oil, air or gas (e.g. CO2), Hydraulic pressure, using water as the fluid, is the usual medium employed in this test. Oil if it is thin/hot will penetrate leaks that do not show up with water under equal pressure. Air will leak out more readily than water and gas (e.g. Hydrogen) will escape where air will not. Where feasible, it is better to use water or oil because there will be very less tendency for the parts to be violently thrown out in case of a sudden release of pressure. When using air/gas, failure of vessel can cause injuries to persons around	4m	**4m**
d	**Principle of Compression Test** Compression test is merely the opposite of the tension test with respect to the reaction of applied stress. The compression test can be done on the same machine on which the tension test is done like universal testing machine or some other machine which is designed specifically for the purpose. In general, brittle materials are good in compression than in tension and therefore, they are used for compressive loads. Due to this, compression test is mainly used to test brittle materials such as cast irons, concrete, stones, bricks and ceramic products. During testing, fracture occurs in brittle materials and therefore, the ultimate strength is determined corresponding to the fracture point; but no fracture occurs for ductile materials and hence ultimate strength is found out for some arbitrary amount of deformation	2m Principle	**4M**

	 **Compression Test**	2m diag	**4M**
e	**Principle of Impact Testing** Impact test determines the behavior of welds when subjected to high rates of loading usually in bending. Impact test gives relative toughness of the material. Toughness is defined as the resistance of a metal to fracture after plastic deformation has begun. Essential to study the behavior of welded objects under dynamic loading. The purpose of impact testing is to determine the amount of impact a specimen will absorb before fracturing. In an impact test, a specimen machined or surface ground and notched is struck and broken by a single blow in a specially designed testing machine (Fig.). The quantity measured is the energy absorbed in breaking the specimen by a single blow.  **Impact Testing**	2m Principle 2m diag	**4M**

f	**DIN: Deutsches Institute for Normung** German institute for standardization.DIN is a german registered association head quarters in berlin.It is the German national organization for standardization.There are currently thirty thousand DIN standards, covering almost all fields of technology. **IBR (Indian Boiler regulation)** The IBR covers the design, fabrication, inspection, testing and certification of: – Boilers or any boiler part including feed piping and fittings or vessels attached Boiler Components steam piping feed piping economizers super heaters valves, including safety valves any mounting or fitting or any external or internal part of a boiler which is subjected to pressure exceeding one Kg/cm square gauge Steam receivers, separators, steam traps, accumulators and similar vessels Heat exchangers, converters, evaporators and similar vessels in which steam is generated Materials, e.g. forgings, castings, tubes, pipes, plates, welding consumables	2m 2m	**04M**
6.	**Attempt any FOUR of the following:**		**4X4=16**
a	**Eddy Current Testing** EC testing works on the principles of electromagnetic induction. In this technique, a coil (also called probe or sensor) is excited with alternating current. Following the Ampere's law, this current generates primary magnetic field in the vicinity of the coil. When an electrically conducting material is brought close to this coil, eddy currents are induced in the material. <u>Principle of Operation:</u> An A.C. coil is brought up close to the weldment to be tested. The A.C. Coil induces eddy currents in the welded object. These eddy currents produce their own magnetic field which opposes the field of the A.C. coil. The result is an increase in the impedance (resistance) of the A.C. Coil. Coil impedance can be measured. If there is a flaw in the weldment, as soon as the coil passes over the flow, there is a change in the coil impedance which can be wired to give a warning light or sound and thus the flaw and its location can be determined. Flaws Indicated Flaws at or close to the surface such as cracks, weld	2m	**4m**

	porosity, poor fusion or any linear discontinuity can be detected  Eddy Current Testing	2m diag	
b	**Advantages of Ultrsonic Testing** 1.It is a fast and reliable method of non-destructive inspection. 2. This method of locating flaws with metal objects is more sensitive than radiography. 3.The minimum flaw size which can be detected is equal to about 0.1% of the distance from the probe to the defect. 4.Big weldments can be systematically scanned for initial detection of major defects. 5.Ultrasonic inspection involves low cost and high speed of operation. 6.The sensitivity of ultrasonic flaw detection is extremely high, being at a maximum when using waves of highest frequency **Disadvantages of Ultrasonic Testing:** 1.Surface to be tested must be ground smooth and clean. 2.Skilled and trained operator is required. 3.It is not suited to the examination of weldments of complex shape or configurations 4.Surface must be accessible to transmit ultrasound 5.Coarse grained materials are difficult to inspect	2m Any2 2m Any2	
c	**Leak test by water soluble paper with Aluminimum foil:** In this method the vessel to be tested is pressurized with water and Al foil is laid over the widest strip of water soluble paper and bath are struck with a tape over a welded seam. If a leak exists the water soluble strip will dissolve and the Al foil strip will be in electrical contact with the vessel the flow of current indicates leakage in the pressure vessel	2m Explianation	**4M**

		2m diag	
d	**Charpy Test** The purpose of impact testing is to determine the amount of impact a specimen will absorb before fracturing. In an impact test, a specimen machined or surface ground and notched is struck and broken by a single blow in a specially designed testing machine The specimen is placed in the vise so that it is just a simple beam supported at the ends. **Test Procedure** The swinging pendulum weight is raised to standard height depending upon the type of specimen to be tested. With reference to vise holding the specimen, the higher the pendulum, the more potential energy it has got As the pendulums released, its potential energy is converted into kinetic energy until it strikes the specimen The Charpy specimen is hit behind the V notch  Charpy Test **Charpy Test Report** Material / Impact / Toughness / Percent Ductility To determine the percent ductility of the fracture, examine the specimens after testing under a microscope	2m Test process 2m diag	**4M**

e	Hardness Test: Resistance of metal to plastic deformation, usually by indentation **Types of Hardness Test** Rockwell hardness test. Brinell hardness. Vickers. Knoop hardness. **Purpose of Hardness Test** 1) The hardness test gives an idea of the resistance to wear of the weld metal. This is important with respect to the components which have been built up' and have to withstand abrasive wear. 2) Hardness values can give information about the metallurgical changes caused by welding. In the case of medium-and high carbon steels and cast iron, the heat-affected zone or weld junction may become hard and brittle because of the formation of martensite. 3) Hardness values in a welded joint are usually sensitive to such conditions of welding, as (i) The process used. (ii) Heat input. (iii) Preheat (iv) Electrode composition. (v)Plate thickness. 4) Hardness values indicate whether the correct welding technique and pre- and post-heat-treatments have been carried out. 5) The hardness of welds is particularly important if the welds must be machined	2m Any 2 2m Any 2	**4m**
f	**Pressure Vessel Codes as per ASTM** International, formerly known as the American Society for Testing and Materials (ASTM), is a globally recognized leader in the development and delivery of international voluntary consensus standards. Today, some 12,000 ASTM standards are used around the world to improve product quality, enhance safety, facilitate market access and trade, and build consumer confidence A20/A20M Specification for General Requirements for Steel Plates for Pressure Vessels A435/A435M Specification for Straight-Beam Ultrasonic Examination of Steel Plates A577/A577M Specification for Ultrasonic Angle-Beam Examination of Steel Plates A578/A578M Specification for Straight-Beam Ultrasonic Examination of Rolled Steel Plates for Special Applications	4m four code	**4m**