WINTER – 14 EXAMINATIONS

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

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.

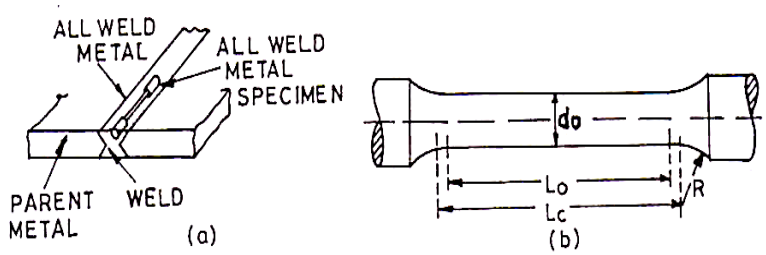
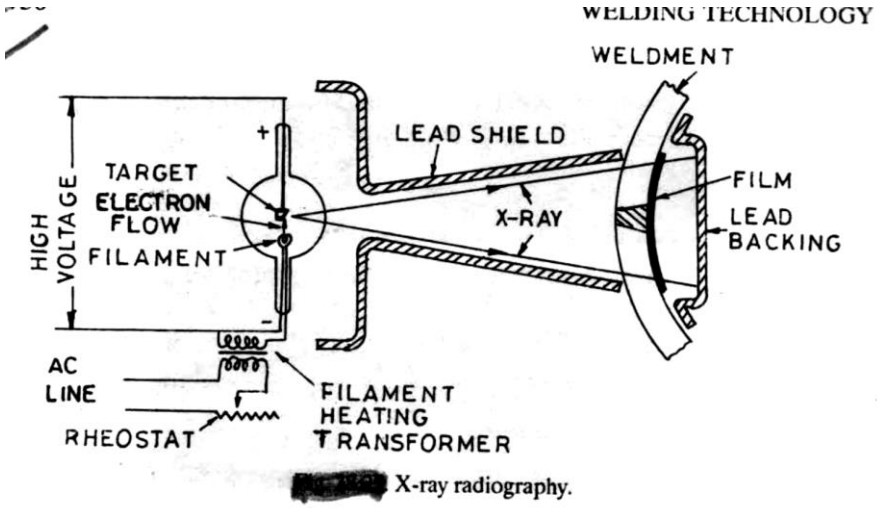
<table>
<tr><th>Q. NO.</th><th>MODEL ANSWER</th><th>MARKS</th><th>TOTAL MARKS</th></tr>
<tr><td>1</td><td>Attempt any five</td><td></td><td>20</td></tr>
<tr><td>a)</td><td>
<table>
<tr><th>Parameters</th><th>Line standard</th><th>End standard</th></tr>
<tr><td>1) Accuracy of measurement</td><td>Limited to +- 0.2mm for high accuracy, scale have to be used in conjunction with microscope</td><td>Highly accurate for measurement of close tolerances upto +- 0.001 mm.</td></tr>
<tr><td>2) Time of measurement</td><td>Quick and easy</td><td>Time consuming</td></tr>
<tr><td>3) Effect of use</td><td>Scale marking not subjected to wear but end of the scale is worn.Thus,it may be difficult to assume zero of scale as atum</td><td>Measuring faces get worn out. To take care of this end piece can be hardened. And of protecting type.</td></tr>
<tr><td>4) Other errors</td><td>Parallax error can occur</td><td>Improper wringing of step gauges may introduce error change in lab.temperature may lead to some error.</td></tr>
<tr><td>5) Manufacture and cost of equipment</td><td>Simple and low</td><td>Complex process and high</td></tr>
<tr><td>6) Example</td><td>Meter and yard,etc</td><td>Slip Gauges,Microometer, Etc.</td></tr>
</table>
</td><td>1 per point (any 4)</td><td>4</td></tr>
<tr><td>b)</td><td>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.

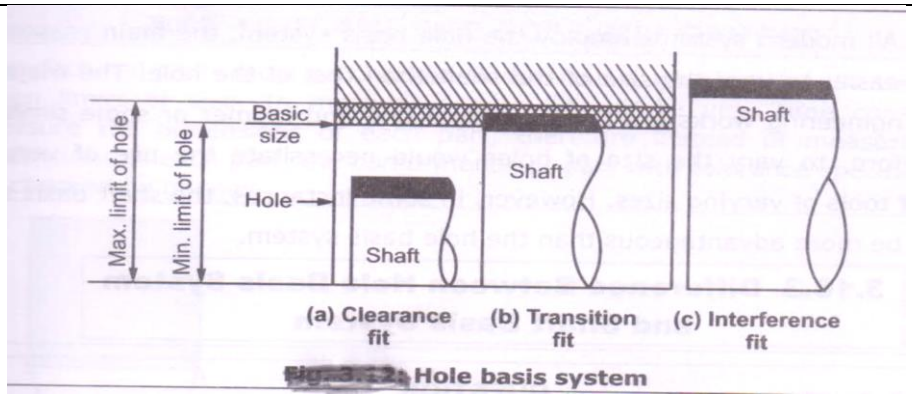
“NO GO" gauges should check only one part or feature of the component at a time.</td><td>4 mark</td><td>4 mark</td></tr>
<tr><td>c)</td><td>
<table>
<tr><th>Parameters</th><th>Inspection</th><th>Quality control</th></tr>
<tr><td>Scope</td><td>Inspection is a part of quality control.</td><td>Quality control is a broad term, it involves</td></tr>
</table>
</td><td>1 per point ~~(any 4)~~</td><td>4</td></tr>
</table>

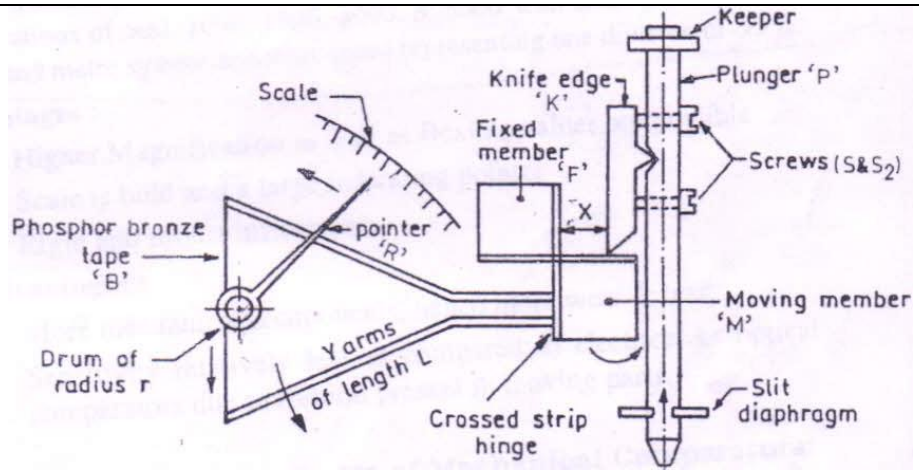
			inspection at particular stages.		
	Definition	Inspection is an act of checking materials, parts, components, or products at various stages in manufacturing and sorting out the faulty or defective items from good ones.	QC is an effective system for integrating Quality development, maintenance and improvement efforts of various groups 111 an organization to enable the productions to be carried out at most economic level.		
	Devices used	It involves use precision measuring devices like venire callipers, micrometre, etc. and devices such as tool maker's, microscope, profile projector, flaw detector, etc.	QC uses devices such as statistics, control charts, acceptance sampling, process capability study, YQR,YR, quality audits, etc.		
	Application	It is concerned with quality of past production to judge conference with specifications and sorting out defective items from good ones.	It is concerned with quality of future production. What is learnt from inspection is used as a basis to ascertain. Whether the quality meets the specifications or not.		
d)	Total quality management refers to the total involvement of staff in an organization together with suppliers, distributors and even customers in bringing about quality satisfaction by promoting quality cultures through quality circles, job enrichment and effective purchasing. <u>Importance of TQM:</u> TQM can be ensured in an organization through following steps : (a) Team effort of all the constituents towards achieving the common goal of enrichment in the quality standard. (b) Satisfying workers emotional and intellectual needs for providing them to have better working conditions which ultimately results in better quality of the product. (c) Installing motivation system, to include collective achievement and quality excellence. (d) Integrating and coordinating the activities of various departments in the organization to attain the desired goals economically. (e) Maintaining a sound quality system, to ensure each task, is performed correct.			2 mark 2 mark (any 4)	4 mark
e)	All weld metal test:			2 mark	4 mark

	1) A transverse Tensile Test specimen is cut from a welded butt joint (at right angle to the weld direction and is used to determine its transverse tensile strength. 2) In an all-weld metal tensile test, the specimen is prepared from all-weld metal [Fig. (a)]. 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 . 	2 mark (sketch)	
f)	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. 1) The portion of weld metal where defects are to be suspendered is exposed to X rays emitted from the tube. 2) A cossetle containing X ray film is place behind and in contact with weldment perpendicular to the rays. 3) During expose X rays penetrated the welded object and thus affect welded X- ray film. 4) The X- Ray photograph shows the existence of flaw, internal crack, Leak or any deformity with their exact location.  X-ray radiography.	2 mark 2 mark (sketch)	4 mark
g)	DIN codes means – Deutsches Institute for normung	2 mark-	4 mark

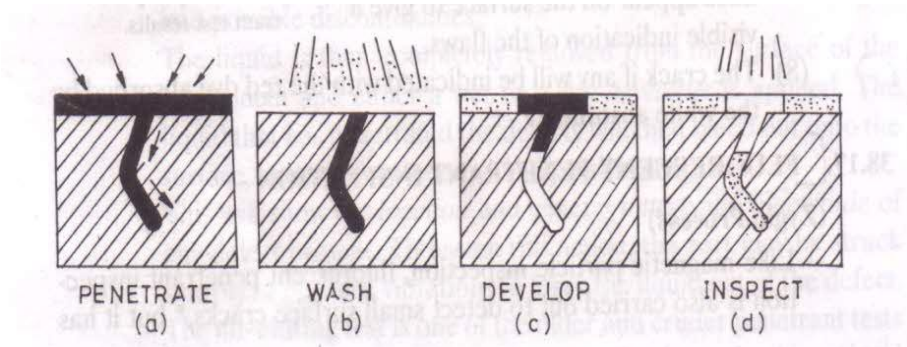
	German nation organisation for standardization ASTM CODES means – American society for testing and material	DIN 2 mark-ASTM	
2	**Attempt any four**		**16**
a)	Following are the list of Hardness test. 1.Rockwell hardness test 2.The Brinell Test 3. Vickers Hardness Test **Rockwell hardness test:** Procedure for measuring hardness by Rockwell hardness test: 1) Test piece is placed upon the machine. The machine dial is showing any reading. 2) Hand wheel is turned, thereby raising the test piece up against the steel ball indenter till the needle on the dial reads zero. This applies minor load. 3) Major load is applied by pressing the crank provided on the right-hand side of the machine. 4) Crank is turned in the reverse direction thereby withdrawing major load. But leaving minor load applied. 5) Hand wheel is rotated and the test piece is lowered. 6) At this stage, the hardness of the test piece material can be directly read from the dial scale. **The Brinell Test** - It consists of pressing a hardened steel ball into a test specimen. - According to ASTM specifications, a 10 mm diameter ball is used for the purpose. Lower loads are applied for measuring hardness of soft materials and vice versa. Procedure of Hardness Testing; -Specimen is placed on the anvil; the hand wheel is rotated so that the specimen along with the anvil moves up and contacts with the ball. - The desired load is applied mechanically (by a gear driven screw) or hydraulically (by oil pressure) and the ball presses into the specimen. - The diameter of the indentation made in the specimen by thepressed ball is measured by the use of a micrometer microscope, having a transparent engraved scale in the field of view. The indentation diameter is measured at two places at right angles to each other, and the average of the two readings is taken. - The Brinell hardness number (BH) which is the pressure per unit surface area of the indentation in kg per square metre, is calculated as follows: BHN= $W/[(\pi D/2)(D-\sqrt{\{D^2-d^2\}})]$ Where W is load on indenter, kg	1 mark for list 3 mark for any <u>one</u> hardness test	4 mark

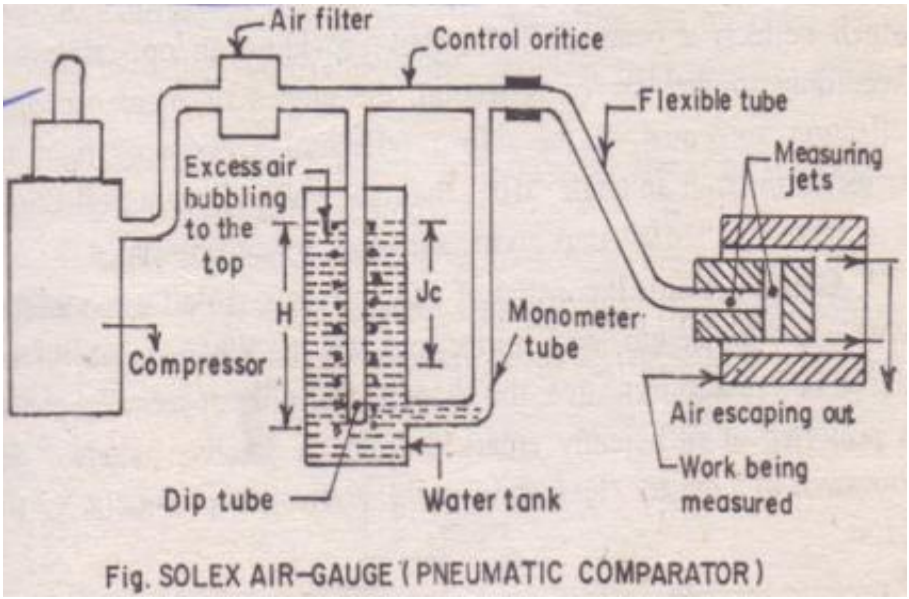
	D is diameter of steel ball, mm d is average measured diameter of indentation, mm - Brinell hardness test is best for measuring hardness of gray cast iron consisting of soft flake graphite, iron and hard iron carbide. **<u>Vickers Hardness Test</u>** - In Vickers hardness test, a known load (P) (from 1 to 120 kg) is applied for a specified time to the surface of the material througha square-base-pyramid diamond having 136° between opposite faces. - The two diagonals of the resulting square indentation on the test piece are measured with a micrometer macroscope and averaged,(D,mm). - The Vickers hardness number is calculated as follows VHN = $1.854P/D^2$ - Before conducting Vickers hardness test, the surface ofthe specimen should be flat and of sufficient polish so that any remaining scratches do not cause difficulty in locating the corners of the indentation when diagonals are measured. - The impression of Vickers indenter on the specimen being very small, peak (and not average) values of hardness can be determinedon the weld from root to face. In the same length of the specimen, more hardness readings can be taken with Vickers hardness test than with Brinell or Rockwell hardness test.		
b)	**Leak test by water soluble paper with Aluminium 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 both 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.	4 mark	4 mark
c)	**Necessity for planned inspection** Inspection planning is an essential aspect in the inspection function,enough inspection is abosoletly essential,it does not add to the value of the product. It s the activity of a) Selection of type for different stage in production flow. b) Planing inspection operation in detail. c) Designating the station at which inpection should take place. d) providing inspectors with the inpection specification,gauges,tools,test equipement and other information necessary for inpection.	1 mark for 1 point	4 mark
d)	Quality Control: Modern quality control is an integrated approach to the quality function in an organization. It is the basic approach with. objectives of providing a definite quality (characteristics) in the prodcct or service keeping the quality costs at an optimum. Based on the principles of probability & statistics, quality control is a modern decision-making tool employed by management to assure a desired quality level of manufactured goods or rendered services.	2 mark-defination	4 mark

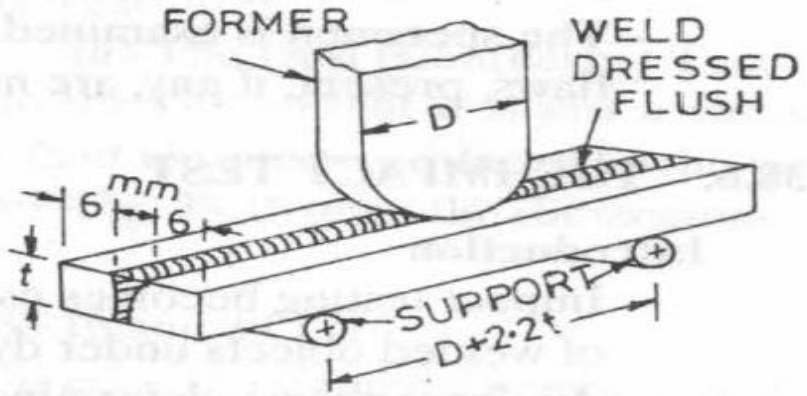
	Objectives: 1) To improve company's income by making the product force acceptable to the customers . 2) To achieve interchangeability in manufacturing in large scale production. 3) To produce optimum quality at minimum price. 4) To reduce company's cost through reduction of losses due to defects. 5) Developing quality conciousness in the organization. 6) To ensure customer's satisfaction with products of services of higher quality level, thus to build customer's goodwill, confidence and reputation of manufactures.	2 mark- any 4 objectives	
e)	 Hole basis system • In this system, the design size of hole.. whose lower deviation(fundamental deviation) is zero, is assumed as basic size and different clearances or interferences are obtained by varying the limits of the shaft to have differentclass of fit • In other words, the limits of the hole are kept constant and those of the shaft are varied so as to obtain the necessary fit. • In this system, the hole has constant high and low limits for all fits of the same accuracy grade and for the same basic size. • As it is very easy,covenient and less costly to make holes of correct sizes by using drills, reamers etc., this system is preferred in industries. • It is also much easier to vary shaft sizes according to the fit required, by adjustable methods such as grinding and turning. • Also, inspection of shafts carv be done easily and rapidly with the help of adjustable gauges. Direct external measurement is easier than internal measurement	1mark- diagram 3 mark explanation	4 mark

f)	 The instrument has as usual all the features of mechanical comparator in the form of plunger attached with sensing element, supports for spindle's frictionless movement, lever magnification arrangement, pointer, scale etc. However the magnification details inside will reveal clearly the working of the instrument. (Ref. Fig.) *An arm A with its other end extending into Y shape is attached to the moving member with effective length L Now if the distance of flexible hinged pivot and edge is then first magnification = L/x * At the top of phosphor bronze band or ribbon B is attached which Passes around a-small drum or bush of radius 'r' attached to pointer scale. If the length of the pointer is R, then second magnification is R/r *therefore overall magnification. M= l/s X R/g The magnification can be changed by effectively changing fulcrum distance x which can be done by either tightening or loosening the two screws SI &. S2 or by changing ratio of r/R i.e. changing dia of drum of ribbon winding or pointer radius R.	2 mark – diagram 2 mark- explanation	4 mark
3	**Attempt any four**		**16**
a)	**Characristics 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.	1 mark for 1 point	4 mark
b)	Tolerances on a dimension may either be unilateral or bilateral. **1**. Unilateral Tolerance : In this system, the dimension of a part is allowed to vary only on one side of the basic size, i.e. tolerance lies wholly on one side of the basic size either above or below it .	4 mark	4 mark

	Bilateral Tolerance: In this system, the dimension of the part is allowed to vary on both the sides of the basic size, i.e. the limits of tolerance lie on either side of the basic size, but may not be necessarily equally dispose about it . **2.** For unilateral tolerances, a case may occur when one of the limits coincide with the basic size. For bilateral tolerances, a case hardly may occur when one of the limits coincide with the basic size a sthe two limit dimensions are above and below nominal size, (i.e. on either side of the nominal size) .		
c)	**Quality of design** refers to the differences in the specification for products which have the same use. Quality of conformance on the other hand refers to the ability to maintain the specified quality of design. **Quality of conformance:** The quality of conformance is concemed with how well the manufactured product conform to the quality of design.	2 mark- quality of design 2 mark- quality of conformnc	4 mark
d)	**Duties of Inpector** (1)Interpretation of specification: Product specification provide std.for test and inpection.It provide procedural instrictoion for the operation as how to test the compent. (2)Measurement of product: It is the duty of inpector to segrate defective goods and thus ensure that the customers receive only goods of adequate quality. (3)Comparision with standards: It is the duty of the inpector to compare the quality manuals which is used for the inpection and mfg. the product with IS standard or BIS standard,so company can mfg. the product as per standard,so uniformity can be maintained. (4)Judging conformity: Inspector must know the how many compents from the lot are accepted through the sampling inpection plan. (5)Recording data: Inpectors should maintain the records for evaluation of individual machine or worker performance. (6)Disposition of product: Inpectors sort out the defective parts,the aim is to establish the causes of scrap and reworkand disposition of product is also importance,so that inpectors must so these work as in future,eliminate the cause and ensure a better quality product.	1 mark – 1 point	4 mark
e)	FLUORESCENT-PENETRANT INSPECTION (Zyglo Process) - Like magnetic particle inspection, fluorescent penetrant inspection is also 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. <u>Operational Steps</u> (i) Clean the surfaces of the object to be inspected for cracks etc. (ii) Apply the fluorescent penetrant on the surface by either dipping,	2 mark- st**e**ps	4 mark

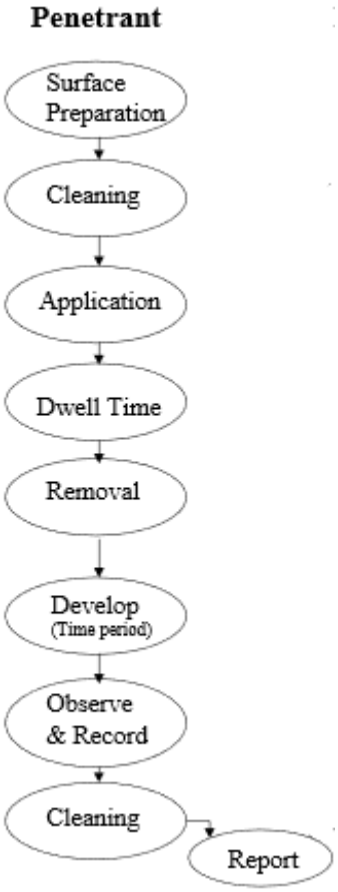
	spraying or brushing. Allow a penetration time up to one hour. The fluorescent penetrant is drawn into crack by capillary action [Fig. (a)]. (iii) Wash (the surface) with water spray to remove penetrant from surface but not from crack [Fig. (b)]. (iv) Apply the developer. The developer acts like a blotter 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 which is between the visible and ultraviolet in the spectrum. Black light causes penetrant to glow in dark [Fig. (d)].  	2 mark-sketch	
f)	Leak test by gas. 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. 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. Application (1) Leak refers to an actual discontinuity or passage through which a fluid flows or permeates. (2) 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. 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.	3 mark-explanation 1 mark-application	4 mark
4	**Attempt any four**		**16**
a)			

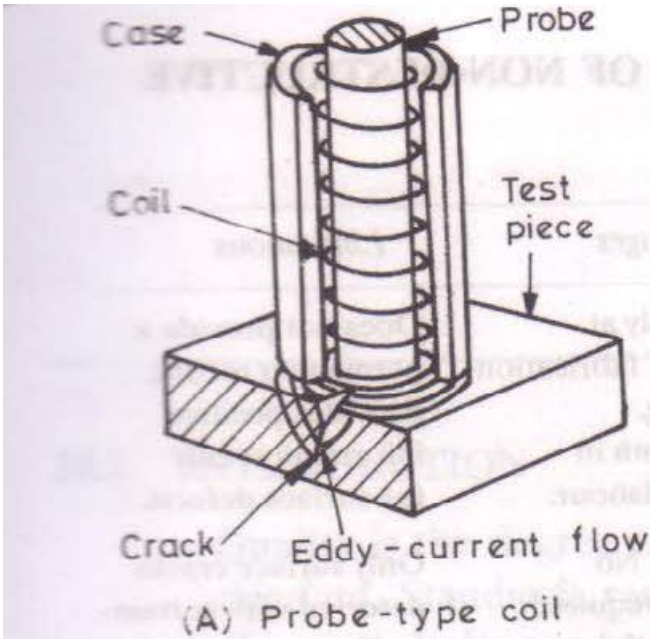
	Comparator has highest magnification is pnumatic comparator.  Fig. SOLEX AIR–GAUGE (PNEUMATIC COMPARATOR) Working Principle: This is designed for internal and external measurements. The arrangement used in the pneumatic comparator [Solex pneumatic gauge] is to pass high pressure air after filtering through a flow valve. There is a tank in which water is filled up to a certain level, a dip tube is immersed into it upto a depth corresponding to the air pressure required. Since the air is sent at a higher pressure than the required one, some of it will leak out of the dip tube and the air moving towards the control orifice will be at the desired and constant pressure (H). The air at reduced pressure then passes through the control orifice and escapes from the measuring jets. The back pressure in the circuit is indicated by the head of water displaced in the manometer tube. The tube is graduated to show changes of pressures resulting from changes in the internal diameter of the work being measured,This instrument is capable of measuring to the accuracy of microns.	2 mark-sketch 2 mark-working	4 mark
b)	**Leak test under fluid pressure** Procedure: The welded vessel, after closing all its outlets; is subjected to internal pressure using water, oil, . 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 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.	4 mark	4 mark

	When using air/gas, failure of vessel can cause injuries to persons around.		
c)	Acoustic emission (AE) is defined as the class of phenomenon where by transients elastic waves are generated by the rapid release of energy from localized source like places of transient relaxation of stress and strain fields. Principle of AET: AE signals generated by discontinuities in material under a stimulus such stress, temperature etc. Proper analysis of these signals can be providing information concerning detection.	4 mark	4 mark
d)	 Longitudinal bend test. Longitudinal Bend Test - The problems of weld mismatch (as described in transverse bend test can be avoided by using longitudinal bend specimens in which the weld runs the full length of the bend specimen (Fig.); 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.- Specimens for longitudinal bend test are prepared in the same manner as for transverse bend tests.	2 mark-sketch 2mark-explanation	4 mark
e)	Following are the major provision in DIN standard for the inspection of pressure vessel. Note :Any two code from following or other than following are allowed. • DIN 2615-1:1992 Steel butt-welding pipes fittings; tees with reduced pressure factor • DIN 2615-2:1992	4mark-2code	4 mark

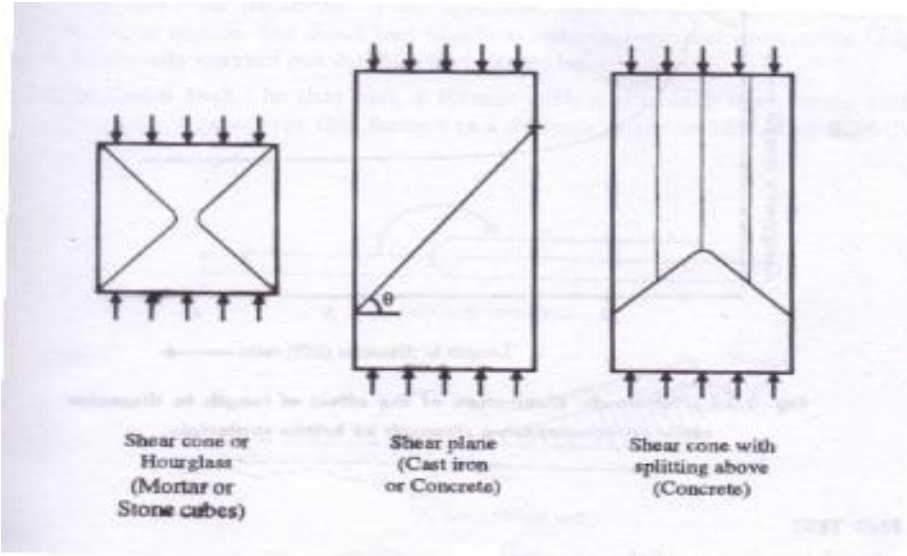
	Steel butt-welding pipe fittings; tees for use at full service pressure • DIN 2616-1:1991 Steel butt-welding pipe fittings; eccentric reducers with reduced pressure fac • DIN 2616-2:1991 Steel butt-welding pipe fittings; reducers for use at full service pressure • DIN 2617:1991 Steel butt-welding pipe fittings; caps • DIN 2618:1968 Butt welding steel fittings; welding saddles, nominal pressure • DIN 2619:1968 Butt welding steel fitting; bends for welding, nominal pressure 16 • DIN 2826:1994 Hose fittings with clamp unit for steam and hot water, ON 15 up to ON 50, up • DIN 2848:2002 . Flanged steel pipes and flanged steel or cast iron fittings with lining - PN 10, • DIN 2856:1986 Capillary solder fittings; assembly dimensions and testing • DIN 2873:2002 Flanged fitting pipes and flanged steel glass lined - PN 10 and PN 25 • DIN 2874:2002 Steel flanged pipes and steel and cast iron flanged fittings lined with PTFE 01 specifications • DIN 2875:2002 Flanged steel pipes and flanged steel fittings with hard or soft rubber lining • DIN 2876:2002 Flanged steel pipes and flanged steel fittings glass lined - Technical specifics • DIN 2950:1983 Malleable cast iron fittings • DIN 2980:1977 Screwed steel pipe fittings • DIN 2981:1982 Threaded steel pipe fitting; fittings with long screw thread • DIN 2982:1977 Screwed steel pipe fitting; parallel nipples, taper nipples		
f)	ASME Codes for pipes Note :Any two code from following or other than following are allowed. B31 Code for pressure piping, developed by American Society of Mechanical Engineers - ASME, covers Power Piping, Fuel Gas Piping, Process Piping, Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids, Refrigeration Piping and Heat Transfer Components and Building Services Piping. ASME B31 was earlier known as ANSI B31.	4mark- 4code	4 mark

	B31.1 - 2001 - Power Piping B31.2 - 1968 - Fuel Gas Piping B31.3 - 2002 - Process Piping B31.4 - 2002 - Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids B31.5 - 2001 - Refrigeration Piping and Heat Transfer Components B31.8 - 2003 - Gas Transmission and Distribution Piping Systems B31.8S-2001 - 2002 - Managing System Integrity of Gas Pipelines B31.9 - 1996 - Building Services Piping B31.11 - 2002 - Slurry Transportation Piping Systems B31G - 1991 - Manual for Determining Remaining Strength of Corroded Pipelines ASME Codes for pressure vessels. Note :Any two code from following or other than following are allowed. ASME codes & standards for pressure vessels. Division 1: • 5 Standards from the B1 Series on screw threads • 13 Standards from the B16 Series on pipe flanges and fittings • 9 Standards from the B18 Series on hex bolts • B36.10M — Welded and Seamless Wrought Steel Pipe • B36.19M — Stainless Steel Pipe • NQA-1 — Quality Assurance Program Requirements for Nuclear Facilities • PCC-1 — Guidelines for Pressure Boundary Bolted Flange Joint Assembly • PCC-2 — Repair of Pressure Equipment and Piping • PTC 25 — Pressure Relief Devices • QAI-1 — Qualifications for Authorized Inspection Division 2: • API 579-1/ASME FFS-1 — Fitness-For-Service • 3 Standards from the B1 Series on screw threads • 9 Standards from the B16 Series on pipe flanges and fittings • 4 Standards from the B18 Series on hex bolts • B36.10M — Welded and Seamless Wrought Steel Pipe • B36.19M — Stainless Steel Pipe • NQA-1 — Quality Assurance Program Requirements for Nuclear Facilities • PCC-1 — Guidelines for Pressure Boundary Bolted Flange Joint Assembly • PTC 25 — Pressure Relief Devices • QAI-1 — Qualifications for Authorized Inspection		

	Division 3: • API 579-1/ASME FFS-1 — Fitness-For-Service • 3 Standards from the B1 Series on screw threads • 4 Standards from the B16 Series on pipe flanges and fittings • 7 Standards from the B18 Series on hex bolts • B36.10M — Welded and Seamless Wrought Steel Pipe • B46.1 — Surface Texture (Surface Roughness, Waviness and Lay) PTC 25 — Pressure Relief Devices		
5	**Attempt any two**		**16**
a)i)	For non-magnetic materials, dye penetrant must be used as shown below;  Advantages : 1. It is non destructive testing so can be applied to many no of objects. 2. It is not hazards. 3. It is simple to use no special equipment is required. 4. No skilled worker is required. 5.Cost of test is less. Limitations: 1.Test preparation is required.	2 mark – describe 1 mark – Any 2 adv. 1 mark – Any 2	4 mark

	2. Penetrant is required. 3. only surface defects can be find out.not uused for subsurface defects. 4.Surface to be tested must be ground smooth and clean.	disadv.	
a)ii)	EDDY CURRENT TESTING Principle of Operation - 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 deter-mined. - Flaws at or close to the surface such as cracks, weld porosity, poor fusion or any linear discontinuity can be detected  	3mark explanatio n 1 mark sketch	4 mark
b)	MAGNETIC PARTICLE INSPECTION : i)Basic principle: When a piece of metal is placed in magnetic field and the lines of magnetic fluxget intersected by a discontinuity such as a crack or slag inclusions in a job, magnetic poles are induced on either side of the distontinuty. 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 is local fluxdisturbance can be detected by its effect upon magnetic particles which are attracted to the region of discontinuity and pile up and bridge over the	2 mark-for each 4-sub question	8 mark

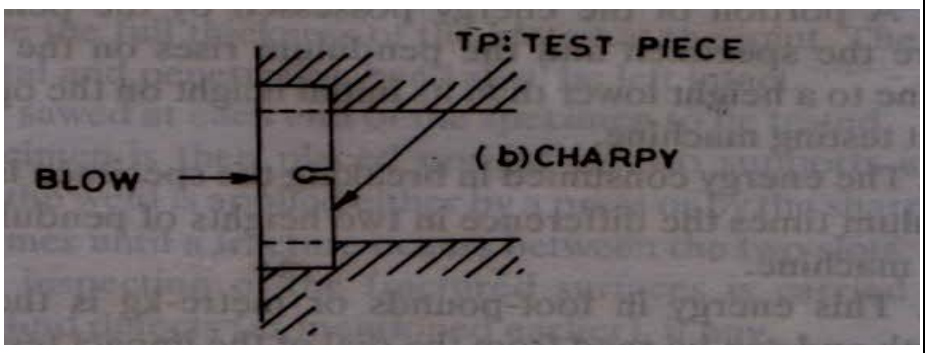
	discontinuity ii)Flaws detected: The defects commonly revealed by magnetic particle inspection are quenching cracks, thermal cracks, seams, laps, grinding cracks, overlaps, non-metallic inclusions, fatigue cracks, hot tears, etc. iii)Scope and limitation: Scope: • Can detect both surface and near sub-surface defects. • Can Inspect parts with Irregular shapes easily. • Precleanlng of components Is not as critical as It is for some other Inspection methods. Most contaminants within a flaw will not hinder flaw detectability. • Fast method of inspection and indications are visible directly on the specimen surface. Limitations: • Cannot Inspect non-ferrous materials such as alumlnum, magnesium or most stainless steels. • Inspection of large parts may require use of equipment with special power requirements. • Some parts may require removal of coating or plating to achieve desired Inspection sensitivity. • Limited subsurface discontinuity detection capabilities. Maximum depth sensitivity Is approximately 0.6'' (under Ideal conditions). • Post cleaning, and post demagnetization is often necessary. • Alignment between magnetic flux and defect is important iv)Sensitivity: Maximum sensitivity of indication is obtained when the discontinuity lies in a direction normal to the applied magnetic field and when the strength of magnetic field is just enough to saturate the section being inspected		
c) i)	**Nick break Test :** Procedure - The test specimen shall be cut transversely to the welded joint and shall have the full thickness of the plate t at the joint. The excess weld metal and penetration bead shall be left intact. - Slots are sawed at each end of the specimen to be tested - The specimen is then placed upright on two supports and the force on the weld is applied either by a press or by the sharp blows of a hammer until a fracture occurs between the two slots. - A visual inspection of the fractured surfaces is carried out in order to find defects (as mentioned earlier), if any. If any defect exceeds 1.5 rom in size or the number of gas pockets	4 mark	4 mark

	exceeds one per square cm, the piece has failed the test.		
c)ii)	Principal of COMPRESSION TEST • Theoretically, compression test is merely the opposite of the tension test with respect to the rection 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 compressiveloads. 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)  	3mark-explanation 1 mark-sketch	4 mark
6	**Attempt any two**		**16**
a) i)	THE ETCH TEST - An etch test involves inspecting the welded test specimen after polishing and etching the same with a chemical reagent e.g., a dilute acid. - There are two types of etch tests, namely (i) Macro-etch examination, (ii) Micro-etch examination. **<u>Purpose</u>** (a) Macro-etch examination: - Macro-examination gives a broad picture of the specimen by studying relatively large sectioned areas.	1 mark-types 3mark-explanation	4 mark

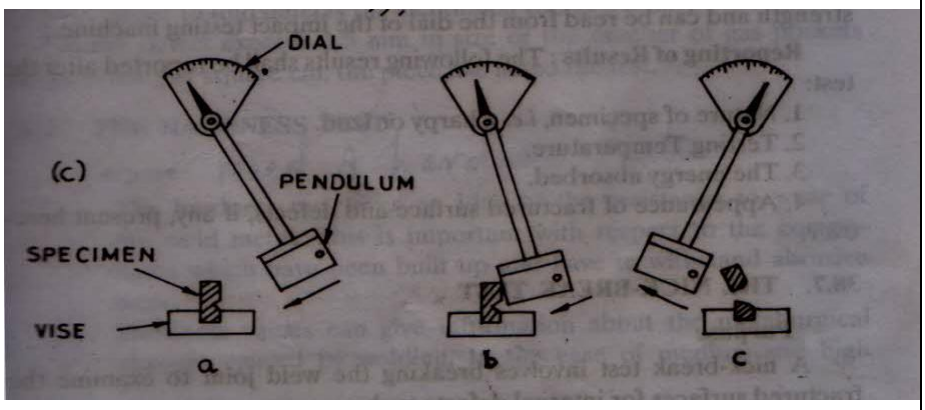
	- Macro-examination reveals in welded specimen (i) Cracks, (ii) Slag inclusion, (iii) Blowholes, (iv) Shrinkage porosity, (v) Penetration of the weld, (vi) The boundary between the weld metal and the base metal, etc. (b) Micro-etch examination: After preparing the specimen by polishing and etching, it is examined under a microscope at magnifications from X20 to X2000. - Micro-etch examination involves areas much smaller than those considered in macro-etch examination and brings out information that can never be revealed by macro-examination. - Micro-examination determines in a welded specimen (i) Cracks and inclusions of microscopic size. (ii) Grain boundaries and solidification structures of weld metal, heat affected zone and the base metal. (iii) Distribution of micro-constituents in the weld metal. (iv) The quality of heat-treatment, etc.		
ii)	THE ETCH TEST Preparation of Test Specimen (i) The specimen shall be the full thickness of the material at the welded joint and the weld-reinforcement and penetration bead shall be left intact. The specimen shall contain a length of the joint of at least 10 mm and shall extend on each side of the weld for a distance that includes the heat- affected zone and some base metal portion (Fig.) (ii) Specimen after being cut from the plate is filed or ground to obtain flat surface en the specimen. iii) Intermediate and fine grinding is carried out using emery papers of progressively finer grades, i.e., of grades, 200 grit, 320 grit, 400 gr t and 600 grit (from coarse to fine). (iv) Rough and fine polishing of the specimen" is carried ou on a rotating polishing wheel. Fine polishing removes the scratches and very thin distorted layer remaining on the specimen from the rough polishing stage. (v) Etching. The specimen is then etched in order to make visible the grain boundaries, heat affected zone, the boundary between the weld metal and parent metal, etc. Etching imparts unlike appearances the metal constituents and thus makes metal structure apparent under the microscope	4 mark	4 mark
b)	The Charpy specimen is placed in the vise so that it is just a simple beam supported at the ends whereas lzod specimen is placed in the vise such that it is in the form of a cantilever. Fig. gives the dimensions of Charpy test specimen. Test Procedure: 1) The swinging pendulum weight is raised to standard height	4 mark-procedure	8 mark

depending upon the type of specimen to be tested.

2) With reference to the vise holding the specimen, the higher the pendulum, the more potential energy it has got.
3) As the pendulum is released, its potential energy is converted into kinetic energy until it strikes the specimen.
4) The Charpy specimen is hit behind the V notch while the Izod specimen, placed with the V notch facing the pendulum, will be hit above the V notch.
5) A portion of the energy possessed by the pendulum is used to rupture the specimen and the pendulum rises on the other side of the machine to a height lower than its initial height on the opposite side of the impact testing machine.
6) The energy consumed in breaking the specimen is the weight of the pendulum times the difference in two heights of pendulum on either side of the machine.
7) This energy in foot-pounds or metre-kg is the notched impact strength and can be read from the dial of the impact testing machine.



2 mark-sketch



Reporting of Results: The following results shall be reported after the test:
1. Nature of specimen, i.e. Charpy or Izod.
2. Testing Temperature.
3. The energy absorbed.
4. Appearance of fractured surface and defects, if any, present hereover

2 mark-reporting result

c)

	Gamma ray Radiography	X - ray Radiography
1	Gamma ray radiography can inspect more thicker section than that of by X-ray radiography	Less thicker section can be inspected by X – ray radiography than of gamma ray radiography
2	Section which varying in thickness can be easily satiation examinations by using Gamma rays	X – Ray radiography provided better result for welded section of uniform thickness.
3	Gamma rays are not counties to direct the smaller defect in the components	X – ray is better than gamma ray to detect smaller defect in section lesser than 50mm
4	Gamma ray radiography is a tome consuming method than X –ray radiography	X – ray radiography is rapid than gamma ray radiography
5	Number of objects can be inspected at a time	Only one part can be inspected ar a time

4 mark for comparision (1 mark for each point.)

Safety precautions to be taken in Gamma ray radiography:
Investigators shall ensure that there is a one-to-one correlation between stock vials or sources and

- Use appropriate personal protective clothing and equipment including gloves, gowns or lab coats, and eye protection.
- Use appropriate dosimeters
- Use time, distance, and shielding strategies to minimize dose during administration of radionuclides, housing animals in CCM, and housing animals in the laboratory
- Practice contamination control at the point of administration, in CCM and in laboratories. Radiation Safety Handbook
- Survey administration areas to identify contamination and promptly clean it up
- Handle sharps safely. Prevent puncture wounds from contaminated needles by recapping

2 mark – any 2 safety precaution.

ϒ –gamma rays radiography
Advantages
1.A permanent record of defects in a welded object is obtained.
2. Reference standards for defects are available. -
3. Low initial cost.
4. This is a very good method for testing at the site.
Disadvantages
1. Trained operator is required.
2. The method involves radiation hazards.
3. ϒ-ray source loses strength continuously.
4. ϒ-ray radiography possesses lower sensitivity and definition than X-ray.

2 mark - 2 adv & 2 disadv.

8 mark