WINTER – 15 EXAMINATIONS

Subject Code: **17621** **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.

Q. NO.	MODEL ANSWER	MARKS	TOTAL MARKS
1	**Attempt any TEN**		20
a)	Following are the materials :- 1) Alluminium & its alloys 2) Copper & its alloys 3) Stainless steel 4) Magnesium 5) Carbon and low alloy steels	**2M (any 2)**	
b)	Metals with surface rust, dirt, soot, and other forms of corrosion can make the task of welding more difficult as well as produce weaker welds. Impurities on the surface of a base metal or filler material can increase porosity and even cracking. These impurities include dirt, grease, rust, paint, plastic, and other contaminants.	**2M**	
c)	The shielding gas often plays an important role in the productivity and quality of welding. As its name suggests, the shielding gas shields the solidifying molten weld from oxygenation as well as impurities and moisture in the air, which may weaken the corrosion-tolerance of the weld, generate porous results and weaken the durability of the weld by changing the geometrical features of the joint. The shielding gas also cools down the welding gun.	**2M**	
d)	Gas metal arc **welding** (GMAW), sometimes referred to by its subtypes metal inert gas (**MIG**) **welding** or metal active gas (MAG) **welding**, is a **welding** process in which an electric arc forms between a consumable wire electrode and the workpiece metal(s), which heats the workpiece metal(s), causing them to melt, and join.	**2M**	
e)	Flux cored electrode is a hollow tubular electrode which contains flux, it is consumable electrode which melts and also acts as a shield.	**2M**	
f)	**Electroslag Welding** is a welding process, in which the heat is generated by an electric current passing between the consumable electrode (filler metal) and the work piece through a molten slag covering the weld surface.	**2M**	
g)	Plasma is a fourth state of matter. Plasma is gas of positive ions and negative electron equal number of positive ions and negative electron.	**2M**	
h)	Laser beam welding/cutting is that joint is produced by heat obtain from the application of the concentrated coherent light beam impinging upon the surface to be joined/cut	**2M**	

i)	1) Pressure 2) Temperature 3) Resistance betwwen job and electrode	**2M**	
j)	Distortion in welding can be defined as the expansion and contraction of weld metal and adjust base metal during the heating and cooling cycle of welding process. It is an unintentional destruction of weld metal. Doing welding in one side of the part will cause much more distortion than if the welds are alternated from one side to other.	**2M**	
k)	Rail track:- Thermit welding Broken large gear thrash:- Arc welding	**2M**	
l)	1) Poly Vinyl Cloride 2) Acrylics 3) Polyamides 4) Acetates 5) Polyurathane	2M (any 2)	
m)	Before you start welding with most welding systems, surface preparation of the plastic is essential. This time-consuming work is necessary for a quality weld. Surface preparation reduces surface oxidation and other contaminants such as grease, dust or damage. Some people forget this important step, but with most systems, a quality weld needs surface preparation. To prepare the surface for welding, take a scraper and remove the first layer of the material. Keep this area clean and dust-free at all times and prepare only the area where you are working on.	**2M**	
n)	1) AWS CODES 2) API CODES 3) ASME CODES 4) BS CODES	2M (ANY 2)	
o)	1) Procedure Number 2) Process type 3) Consumable size, type and full condition 4) Consumable baking requirement, if applicable 5) Parent material grade and specification 6) Thickness range 7) Pate or pipe diameter range 8) Welding position and choice of welding technique	2M (ANY 4)	
2	**Attempt any FOUR**		**20**
a)	(1)Argon: It is the extensively used shielding gas because of its availability as far as fusion welding is concerned. 0.94%is the % argon by volume prevent in the atmosphere. It is used as a shield gas because of its low ionization potential, it forms stable and suite arc so there is less chance of spatter loss.	4M	

It has one disadvantage because of its lower ionization potential the voltage is reduced and less power in the arc is obtained. Because of that it does not give deeper penetration

(2)Helium:

It is the second most abundant available natural gas in the atmosphere.

It has higher ionization potential than argon.so it gives deeper penetration

It has high electrical resistance so the voltage required to produce more and because of that high heat is generated in the arc

It again increases the penetration properties

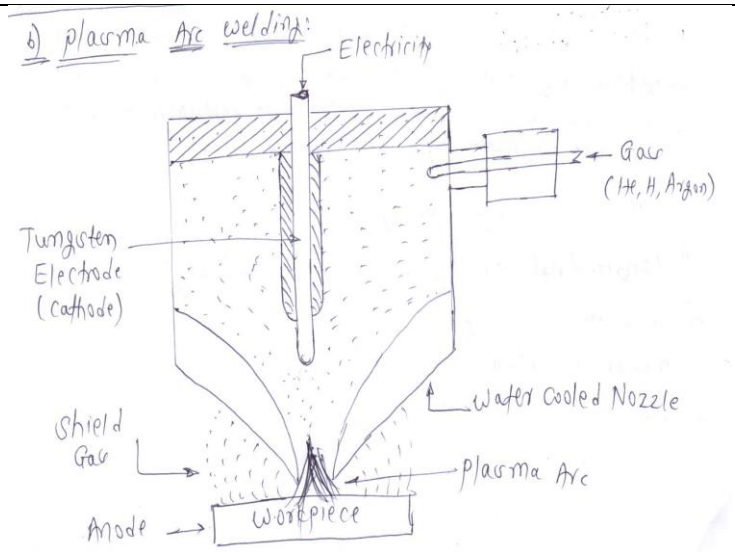
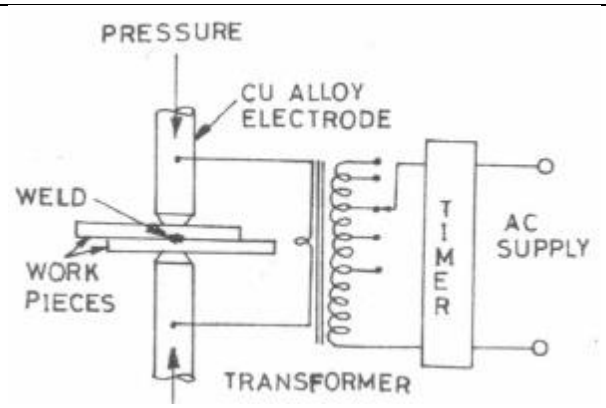
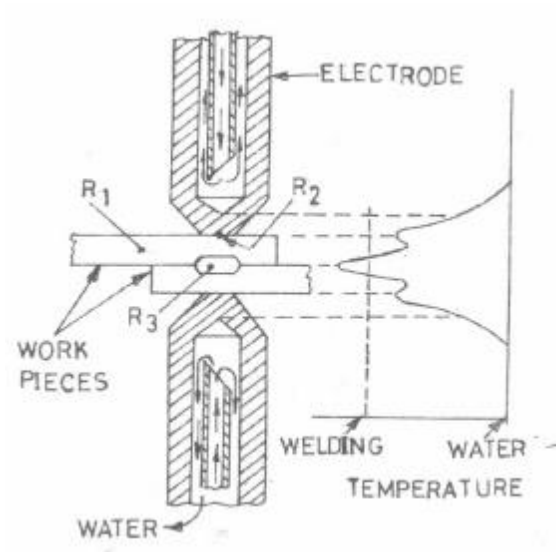
(3)CO2:

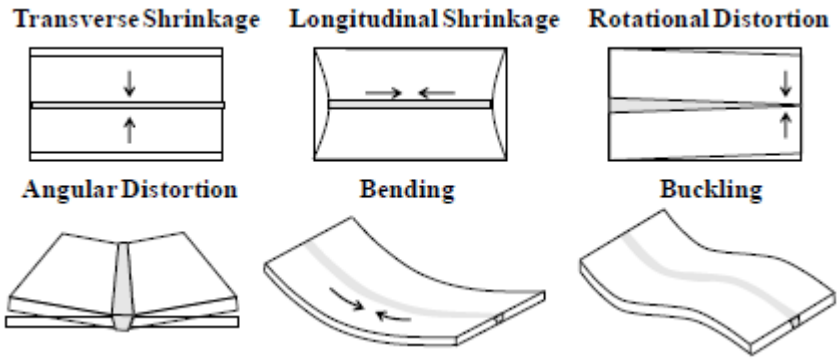
It is a combination of carbon and oxygen

The experiment shown that using straight CO2gives border and deeper penetration as well as there is a less chance of under cutting.

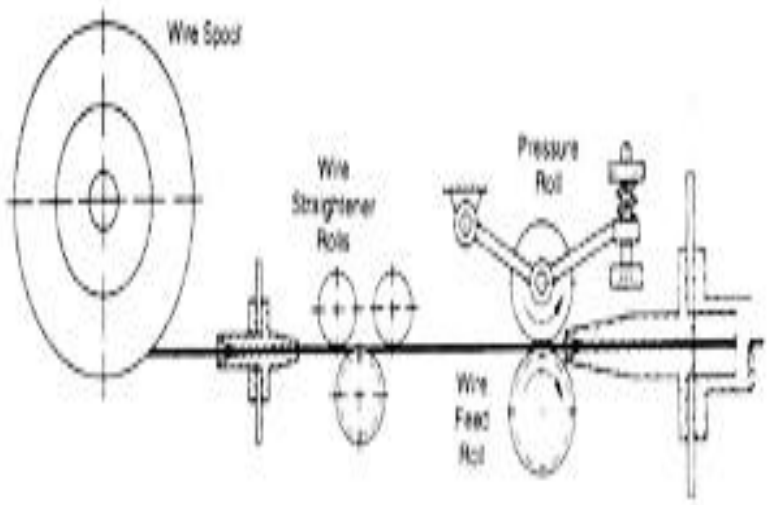
b) 4M

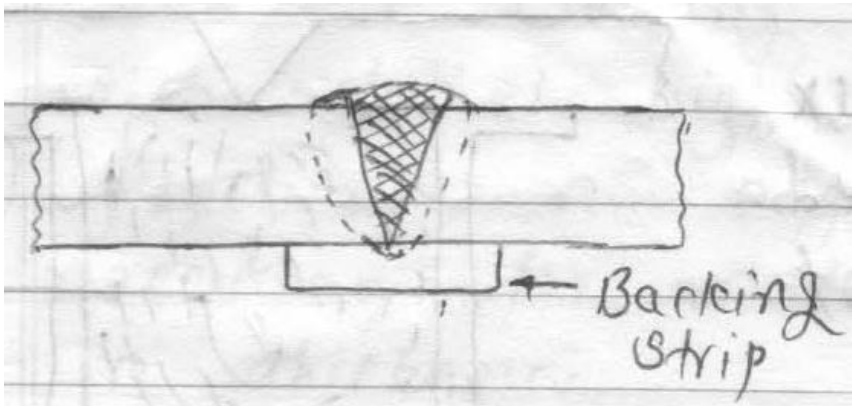
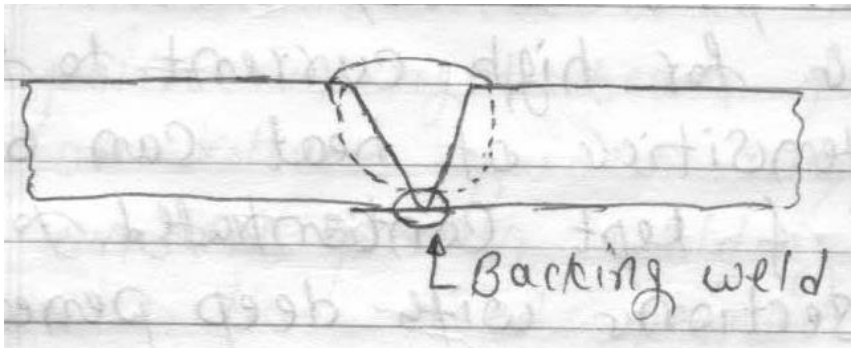
SR NO	FCAW	MIG
1	Flux cored arc welding (FCAW) is an electric arc welding process that uses an arc between a continuously fed flux-filled electrode and the weld pool.	Suitable for both thin and thick joints.
2	The electrode used in this process is flux coated.	Large deposition rates can be achieved
3	The electrode is hollow	Because no.of variable to be controlled process is quite complex than TIG
4	The flux contained in the hollow electrode acts as a sheilding	No separate filler rod required

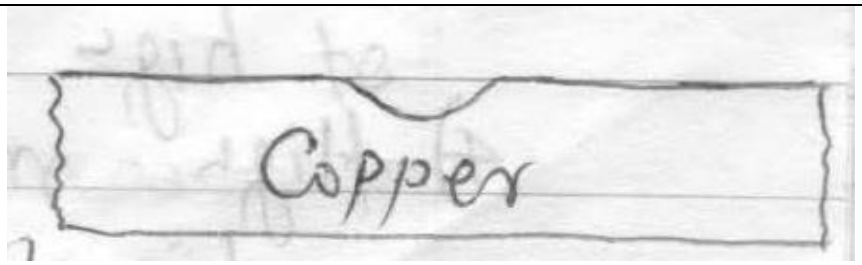
c)		4M	
d)	 	2M (dia)	

	The two factors or variables mainly responsible for resistance welding are 1. The generation of Heal at the place where two pieces are to be joined. 2. The application of pressure at the place where a weld joint is to be formed. 1. Heat - The heat, H, for electrical resistance welding is generated by passing a large electrical current (of the order of 3000 to 100,000 Amps with a voltage between 1 and 25 volts) through two pieces of metal that are touching each other Resistance, R - The total resistance of the system between the electrodes consists of (i) The resistance of the workpiece R} (Fig. 5.2). (ii) The contact resistance between the electrodes and the work, R2, and (iii) The resistance between the faying surfaces of the two metal pieces to be welded together, R3.	2M	
e)	FOLLOWING ARE THE TYPES OF DISTORTION • Longitudinal shrinkage • Transverse shrinkage • Angular distortion • Bowing and dishing • Buckling • Twisting  Contraction of the weld area on cooling results in both transverse and **longitudinal shrinkage.** Non-uniform contraction (through thickness) produces angular	2M (dia) 2M	

	distortion in addition to longitudinal and transverse shrinkage. For example, in a single V butt weld, the first weld run produces longitudinal and transverse shrinkage and rotation. The second run causes the plates to rotate using the first weld deposit as a fulcrum. Hence, balanced welding in a double side V butt joint can be used to produce uniform contraction and prevent angular distortion. Similarly, in a single side fillet weld, non-uniform contraction produces angular distortion of the upstanding leg. Double side fillet welds can therefore be used to control distortion in the upstanding fillet but because the weld is only deposited on one side of the base plate, angular distortion will now be produced in the plate.		
f)	Robotic welding is becoming increasingly attractive for job shops and contract manufacturers because experienced welders can oversee the productivity of more than one robotic welder at a time. Robotic welding offers the following advantages to manufacturers who need to change production tasks repeatedly: **1. Robotic welding allows you to use an available labor pool for a minimal price** **2. Higher yields and throughput** **3. Less post-weld cleanup** **4. Lower the cost of consumable materials** **5. Reduction in total time to market** **6. ROBOTIC WELDING ALLOWS TO USE FOR PRECISION WELd**	4M (any 4)	
3	**Attempt any FOUR**		

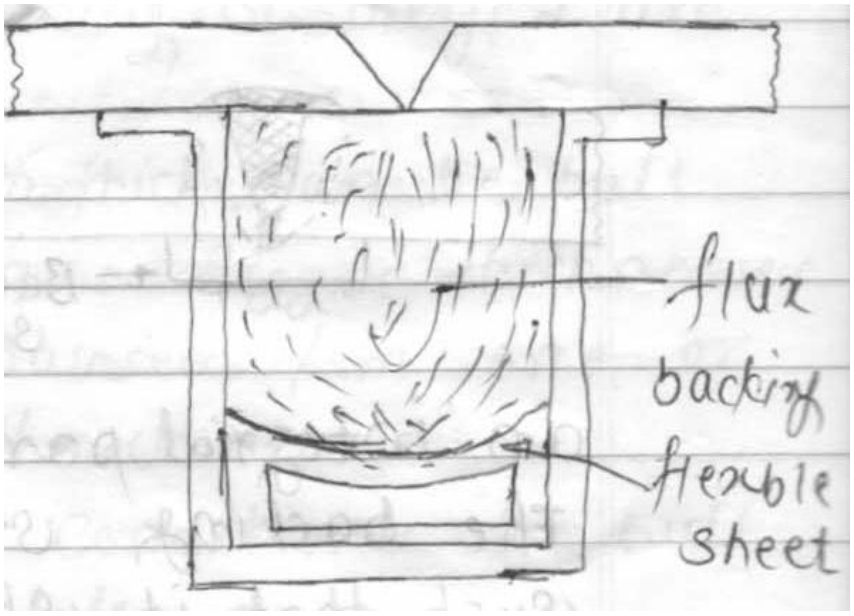
a)	 Schematic illustration of a wire feeder with two roll. Wire feed mechanism may deliver electrode to the torch at a constant speed or at different speeds. The wire spool, in manually operated units, is mounted elsewhere to facilitate welding over a bigger area whereas in automatic machines, the wire spool is fixed on the same carriage over which the torch is mounted *. The different diameters of the electrode wire are 0,8, L2, L6 mm, etc. A standard wire spool may have from 1 to 15 kgs of wire. Steel electrodes are generally copper coated. As far as possible the chemical composition of the workpiece and that of the electrode should be similar; of course there may be the addition of deoxidizers. Electrodes are available for welding aluminium, magnesium, nickel, their alloys, carbon, low alloy and stainless steels, etc. The function of a shielding gas is to protect the molten metal and the electrode end against atmospheric contamination. A number of shielding gases and gas mixtures, like argon (for welding AI, Mg, Cu, Ni, Ti), helium	Dia (2M) 2M	
b)	Weld Backing: Submerged arc welding producer a large volume of highly fluid weld metal which needs to be supported (backed) until.it solidifies when	2M	

	making butt welder in one pass where complete penetration is desired. The following methods are used to sack up the welds: (1)Backing strips:  The weld penetrate and fuse with the backing strip which temporarily or permanently becomes an integral part of the weldments. The backing strip metal should be such that it should not contaminate the weld metal. (2)Backing weld:  One or two layer of weld metal is applied on the underside of the seam to support weld metal that will be deposited from the opposite side. (3)Copper backing:	2M	

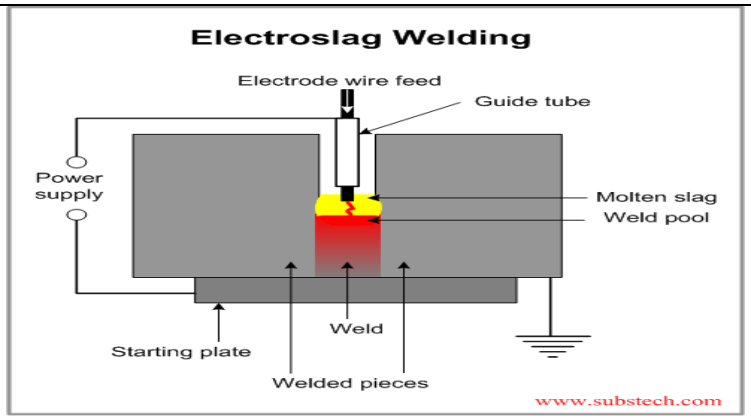
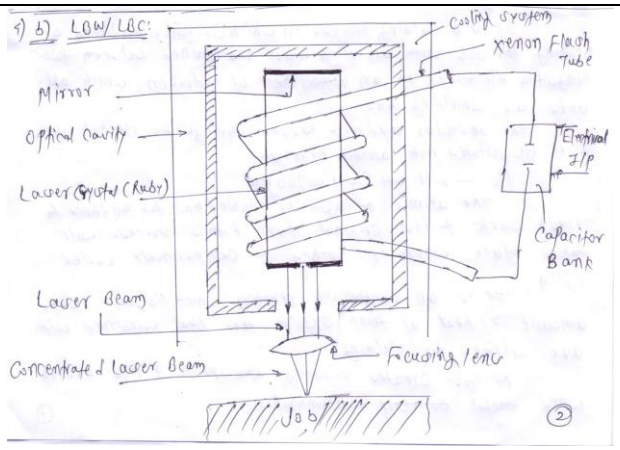


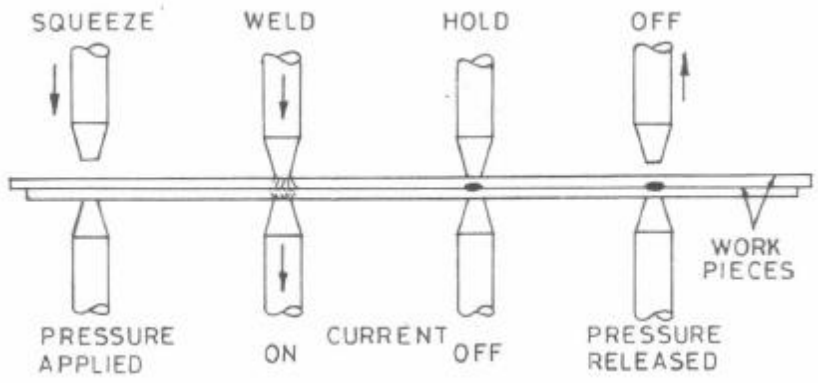
Bar grooved or ungrooved straight or circular is used to support molten weld pool. Such a bar does not fuse and became a permanent part of weld .Copper chills molten metal rapidly.

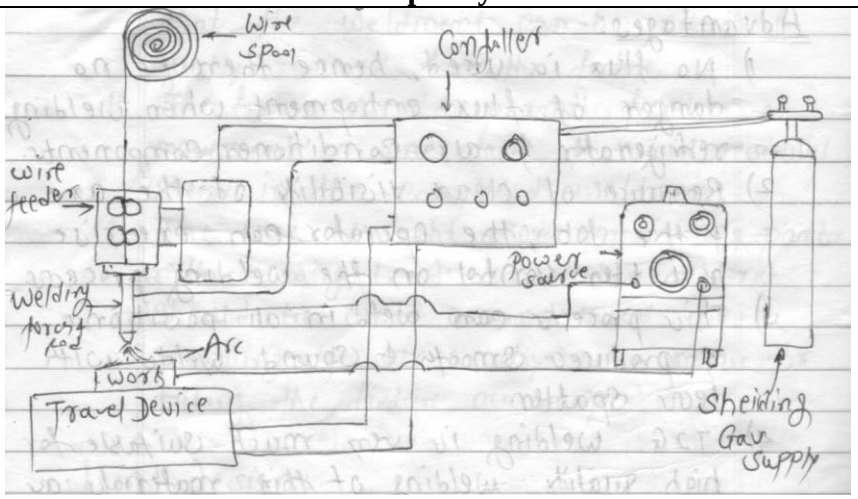
(4)Flux backing:

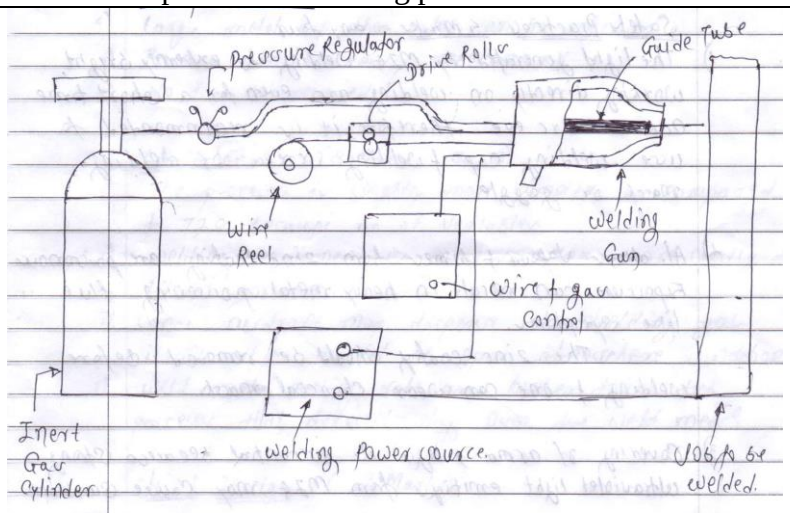


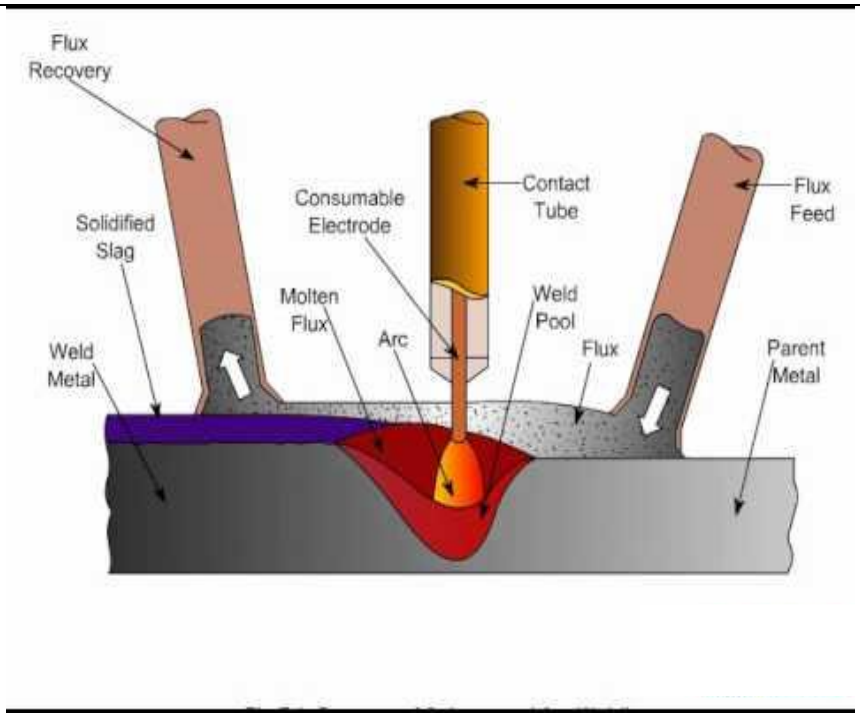
Moderate flux pressure is developed on the back side of the weld.

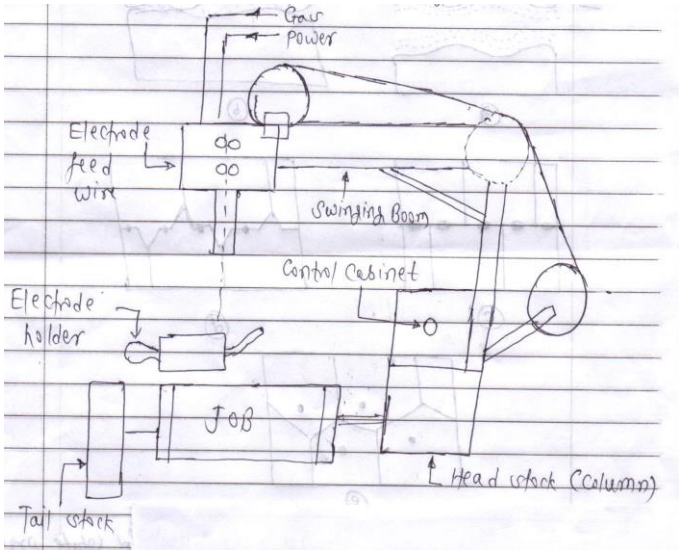
c)	 • **Electroslag Welding** is a welding process, in which the heat is generated by an electric current passing between the consumable electrode (filler metal) and the work piece through a molten slag covering the weld surface. • Prior to welding the gap between the two work pieces is filled with a welding flux. Electroslag Welding is initiated by an arc between the electrode and the work piece (or starting plate). Heat, generated by the arc, melts the fluxing powder and forms molten slag. The slag, having low electric conductivity, is maintained in liquid state due to heat produced by the electric current.	4M	
d)	 Working:(2M) • Laser beam welding/cutting is that joint is produced by heat obtain from the application of the concentrated coherent light beam impinging upon the surface to be joined/cut • Laser is device which creates intense beam that can impart tremendous energy on a small area to produce fusion for welding/cutting purpose. • It consists of ruby crystal which contains at chromium in dispersed condition. The ends of their rods are like mirror and	2M 2M	

	one end has a tiny hole. • At the outside of the crystal one flash tube is fixed containing insert gas. It is de----for producing thousands of flashesh per second which further converts electrical energy into light energy. • Capacitor bank which strikes electrical energy energizes flash tube by an triggering system because of that xenon transforms a high proportion of electrical energy into white light flashes • As ruby is exposed to intense light flashes chromium atomic to excite and pumped to high energy level because of that they form radiation in the form of red Fluor cent light. When that red light escape through mirror through a small hole and by focusing on a narrow laser beam on optical lenses produces intense spot of laser on the job • Optical energy as it impacts on the work piece converts into heat energy.the temperature generated can be made sufficient to melt materials to be welded or cu		
e)	NOTE:- This que is very vauge so explaination of any one resistance welding can be considered. **Resistance welding** is defined as a process whereby force is applied to surfaces in contact and in which the heat for **welding** is produced by the passage of electric current through the electrical **resistance** at, and adjacent to, these surfaces. Spot Welding:-  Spot welding is a resistance welding process in which overlapping sheets are joined by local fusion at one or more spots by the heat generated by resistance to the flow of electric current through workpieces that are held together under force by two electrodes, one above and the other below the two overlapping sheets Examples:- If two plates are required to be butt welded.	2m (dia) 2m	

f)	API1104:- American Petroleum Institute (AP!) Standard 1104 – Welding of Pipelines and Related Facilities This standard was prepared by a formulating committee that included representatives of the American Petroleum Institute, the American Gas Association, the Pipe Line Contractors Association, the American Welding Society, and the American Society for Nondestructive Testing, as well as representatives of pipe manufacturers and individuals associated with related industries. BS4515-1: specifies requirements for the welding of carbon, carbon manganese and low alloy steel pipelines with specified minimum yield strengths not exceeding 555 N/mm^{2}and designed in accordance with PD 8010-1 and PD 8010-2 BS 4515-1 applies to pipes of outside diameter 21.0 mm and larger having a thickness of 3.0 mm or greater and is applicable to transmission pipelines for gases, liquids or slurries, both on land and offshore. Information on hyperbaric welding and on brazing and aluminothermic welding of anode bonding leads, and recommendations for the welding of corrosion resistant alloy clad and lined pipelines, are provided.	2M 2M	
4	**Attempt any FOUR**		
a)	 Automatic Welding: In automatic welding some of the activities are carried out without manual work. In this type of welding the control of welding variable and relative movement between the welding head and work are automatic Usually a single switch working through sequencing device operator the control for power and consumables like wire and gas This may also bring crater filling device, if incorporated, into action automatically.fig.shows a block diagram for a typical automatic	2M (dia) 2M	

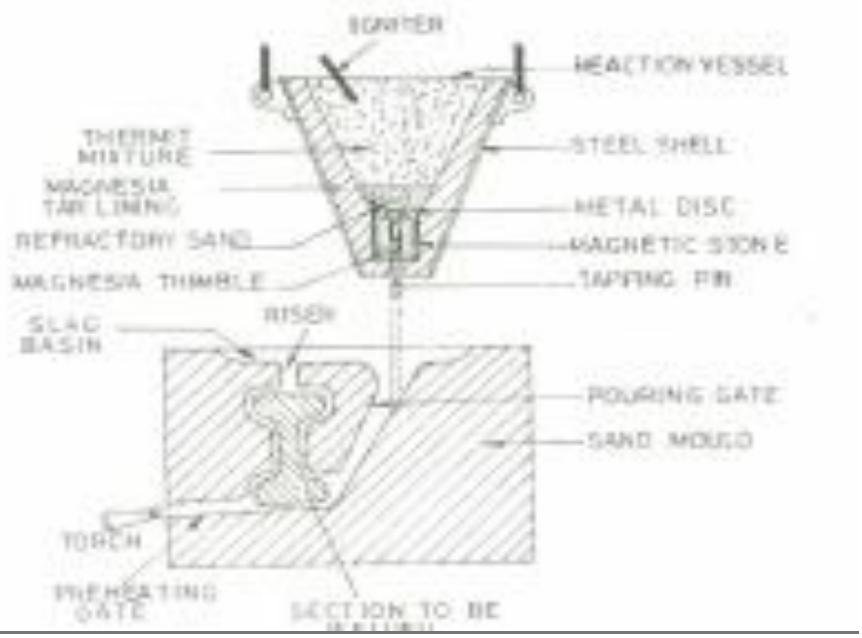
	welding system. As soon as welding is started first in manual way automatic welding controls the variables like arc voltage, welding current. Wire feed rate etc. to control the arc length in the case of arc welding processes and to control the depth of molten metal and slag pool in electro slag welding. On the other hand it also controls the relative motion between the welding head and the work to attain the desired welding speed. The automatic welding system is most popular with SAW and ESW processer; It is also used to a limited extent with GTAW, GMAW, FCAW and plasma arc welding process.		
b)	 • Switch ON the electrical current, insert gas supply and water • The arc is strucked by the any one method. • By scratching the electrode by scrap metal work piece as usual practice • In the second method electrode is touched to the job. It is refracted and then move forward to carry out welding • About 15mm length of the electrode is projected from the torch before striking the arc. During welding torch remain about 10 to 12mm away from the job and arc length is kept between 1.5mm to 4mm • Normally forehand technique is used, the angle made by torch with the horizontal is 70^0 • The welding Gun is moved in forward manner steadily to achieve good welding.	2m (dia) 2M	

c)	 WORKING:- Similar to MIG welding, SAW involves formation of an arc between a continuously-fed bare wire electrode and the workpiece. The process uses a flux to generate protective gases and slag, and to add alloying elements to the weld pool. A shielding gas is not required. Prior to welding, a thin layer of flux powder is placed on the workp iece surface The arc moves along the joint line and as it does so, excess flux is recycled via a hopper. Remaining fused slag layers can be easily removed after welding. As the arc is completely covered by the flux layer, heat loss is extremely low. This produces a thermal efficiency as high as 60% (compared with 25% for manual metal arc). There is no visible arc light, welding is spatter-free and there is no need for fume extraction.	2M (dia) 2M	
d)	Self-shielded, flux-cored wires, commonly referred to as Innershield wires, are often described as "a stick electrode that is inside out". Just like covered or stick electrodes, they rely solely on their slag system and the gases produced from chemical reactions in the arc to protect the molten metal from the atmosphere . The flux ingredients in the core perform multiple functions, which include:	4M	

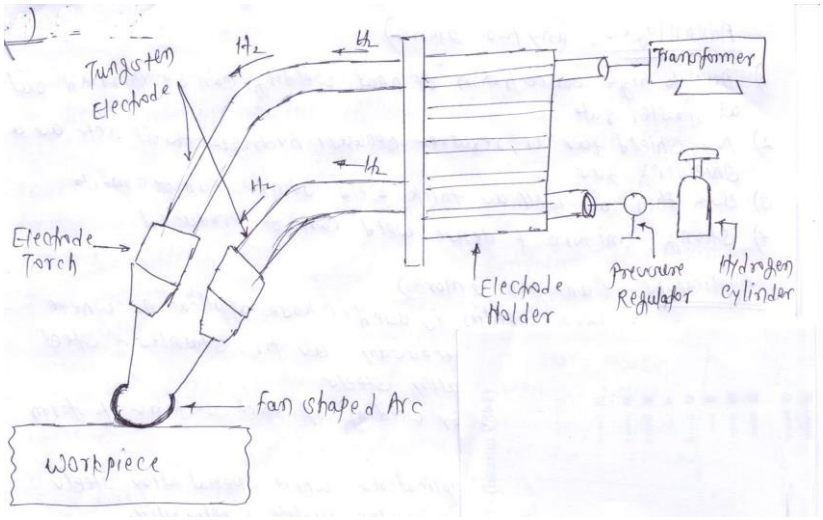
	1) They deoxidize and denitrify the molten metal. 2) Forms a protective slag, which also shapes the bead and can hold molten metal out-of-position 3) . Adds alloying elements to the weld metal to produce desired mechanical properties. 4) Affects welding characteristics (i.e. deep penetration characteristics and high deposition rates)		
e)	**Ultrasonic welding:-** It is a solid state welding process in which joint is produced by the local application of high frequency vibratory energy to the workpieces as they are held toghether under pressure. An ultrasonic welding is completed in about 0.5 to 1.5 seconds. This process is quite costly because of initial investment cost is very high. **Diffusion Welding**: It is a solid state welding process in which the joint is produced by the application of pressure and elevated temperatures to carefully cleaned and mated surfaces so that they actually grow toghether by atomic diffusion. This process will takes more time. This process is quite cheaper..	2M 2M	
f)	 Explanation	2M (dia) 2M	

	Manipulators are singularly the most variable piece of equipment directly associated with automatic welding. They can be designed to weld sequentially different procedure on the same weldment It provide consistency and accuracy by bring the welding head nearer to the work piece. It mainly consists of column, boom,electrical equipment and hand control box. Column can perform leftward and rightward and also up and down movement to meet weld need. Hand control box is designed to control the operation.		
5	**Attempt any FOUR**		
a)	**Working:** The workpiece to be welded is placed on the worktable. The non-consumable tungsten electrode and the workpiece are connected to the power supply (A.C or D.C). As the electrode is brought near the workpiece (leaving a small air gap), an arc is produced. This arc is used for melting and welding the workpiece. Tungsten has high melting point (3422 °C). Hence, tungsten electrode does not melt during the welding process. In tungsten inert gas welding, filler rod may or may not be used. The usage of filler rod depends on the nature of the workpiece to be welded. If filler rod is used, it is continuously melted by the arc and fed into the weld pool. Inert gas supply is constantly provided around the electrode during the welding process. The inert gas forms a gas shielding around the weld. It protects the weld from the external atmosphere.	4M	
b)	**Advantages:-** 1. Molten flux provides very suitable conditions for high current to	2M	

	flow. Great intensities of heat can be generated and kept concentrated to weld thicker sections with deep penetrations. 2. Because of high heat concentration, considerably higher welding speeds can be caused. 3. Because of high heat concentration and high welding speeds weld distortion is much less. 4. High metal deposition rates can be achieved. Single pass welds can be made in thick plates with normal equipment. 5. Welding is carried out without sparks, smoke, flash or spatter. 6. Weld metal deposit possesses uniformity, good ductility, corrosion resistance and good impact strength. **Limitations:-** 1. Since the operator cannot see the welding being carried out, he cannot judge the progress of we3lding accurately. Therefore accessories like jigs and fixtures, pointers, light beam focusing devices or roller guides may be used for proper welding at the joint. 2. The flux needs replacing of the same on the joint which is not always possible. 3. The progress is limited to welding in flat position and on the metal more than 4.8 mm thick. In small thicknesses burn through is likely to occur. 4. The process requires edge preparation and accurate fit up on the joint. Otherwise the flux may spill through the gap and arc may burn the workpiece edges. 5. Flux is subjected to contamination that may cause weld porosity.	2M	
c	Electroslag welding can be divided in to two types ie conventional electroslag welding and consumable electrosalg welding. **In conventional** electroslag welding a non-consumable guide tube is used to direct the electrode into molten slag bath. Current is conducted to the electrode wire by the guide tubes. The electrode wire & gide tubes requires repeated oscillations horizontaly to weld very thick workpiece. This method is used to weld 18-400 mm thick metal pieces.	2M	

	In consumabe guide electroslag welding a consumable guide tube is used ie both the electrode wire and its guiding member melt & supply the filler metal. Welding current is carried out by the guide tube. The machine uses single or multiple wire feeds with or without oscillations to complete the weld	2M	
d	Dia:-  Working:- **Exothermic welding**, also known as **exothermic bonding**, **thermite welding** (**TW**), and **thermit welding**, is a welding that employs molten metal to permanently join the conductors. The process employs an exothermic reaction of a thermite composition to heat the metal, and requires no external source of heat or current. The chemical reaction that produces the heat is an aluminothermic reaction between aluminium powder and a metal oxide. In exothermic welding, aluminium dust reduces the oxide of another metal, most commonly iron oxide, because aluminium is highly reactive. Iron(III) oxide is commonly used: $$\mathrm{Fe_2O_3 + 2\ Al \longrightarrow 2\ Fe + Al_2O_3}$$ The products are aluminium oxide, free elemental iron, and a large amount of heat. The reactants are commonly powdered and mixed	2m (dia) 2m (dia)	

	with a binder to keep the material solid and prevent separation.		
e	An alloy steel contains elements such as chromium, nickel, vanadium, molybdenum, tungsyten, cobalt, boron , copper in amounts greater than normally are present. Weldability of alloy steel is dependent upon the composition and the hardenability those exhibiting low hardenability being welded with relative ease, while those of high hardenability requires preheating and postheating. Sections of 6mm or less may be welded with mild steel filler metal and may secure joint strengthapproximately basemetal strength by virtue of alloy pick up in the weld metal and weld reinforcement. Alloys of higher strength requires filler metals of mechanical properties matching the base metal	4M	
f)	• Procedure Number • Process type • Consumable size, type and full condition • Consumable baking requirement, if applicable • Parent material grade and specification • Thickness range • Pate or pipe diameter range • Welding position and choice of welding technique	4M (any 4)	
6	**Attempt any FOUR**		
a)	**Disadvantages of Tungsten Inert Gas Welding:** 1. Tungsten inert gas welding is a slow process. 2. Highly skilled labour is needed. 3. Welder is exposed to huge intensities of light. 4. TIG welding is more expensive when compared to MIG welding. **Applications of Tungsten Inert Gas Welding:** TIG Welding is used for welding a variety of metals. Some of them are: 1. Stainless steel 2. Alloy steel 3. Aluminium 4. Titanium 5. copper	2M (any 2) 2M (any 2)	

	6. magnesium 7. nickel alloys		
b)		4M (ANY 4)	
c)	Advantages of Resistance Welding: • High welding rates; • Low fumes; • Cost effectiveness; • Easy automation; • No filler materials are required; • Low distortions.	4M (any4)	
d)	In general, the welder has little influence on the choice of welding procedure but assembly techniques can often be crucial in minimising distortion. The principal assembly techniques are: • tack welding • back-to-back assembly • stiffening • welding procedure 1)Tack welding Tack welds are ideal for setting and maintaining the joint gap but can also be used to resist transverse shrinkage. To be effective, thought should be given to the number of tack welds, their length and the distance between them. With too few, there is the risk of the joint	4M	

	progressively closing up as welding proceeds. In a long seam, using MMA or MIG, the joint edges may even overlap. It should be noted that when using the submerged arc process, the joint might open up if not adequately tacked. 2)Back-to-back assembly By tack welding or clamping two identical components back-to-back, welding of both components can be balanced around the neutral axis of the combined assembly (Fig. 2a). It is recommended that the assembly is stress relieved before separating the components. If stress relieving is not done, it may be necessary to insert wedges between the components (Fig. 2b) so when the wedges are removed, the parts will move back to the correct shape or alignment. 3)Stiffening Longitudinal shrinkage in butt welded seams often results in bowing, especially when fabricating thin plate structures. Longitudinal stiffeners in the form of flats or angles, welded along each side of the seam (Fig. 3) are effective in preventing longitudinal bowing. Stiffener location is important: they must be placed at a sufficient distance from the joint so they do not interfere with welding, unless located on the reverse side of a joint welded from one side. 4)Welding procedure A suitable welding procedure is usually determined by productivity and quality requirements rather than the need to control distortion. Nevertheless, the welding process, technique and sequence do influence the distortion level.		
e)	Computer aided welding design will improve the understanding of the fundamentals of welding, while computer aided welding design will optimise design efforts. Because computer programme offers accurate information and on a fingertip access to technological options . Computer if used in welding then it become quick and easy processing it will take less time for welding. If the human involvement is reduced to some extent obviously the efficiency and productivity will be increased. Computers will use microprocessors in which the programme may be fed which will guide and control the welding process. There are very less chances of welding defects.	4M	
f)	Process equipment code (ASME) The ASME Code section 8 is the construction code for pressure	4M	

	vessel and cover design, manufacturing and pressure vessel inspection and testing in the manufacturing shop. This code section addresses the mandatory requirement, specific prohibitions, and non-mandatory guided for pressure vessel material design fabrication, examination,inspection,testing,certification and pressure relief. In this article you will learn about different subsection s and guidelines for the use and application of this code. For ASME code section 8 Scope and boundaries, review the pressure vessel definition article You may ASME code section 8 has three division. Division 1 covers pressure up to 3000psi,Division 2 Has an alternative rule and covers up to 1000psi and Division 3 can be used for pressure higher than 10000psi		