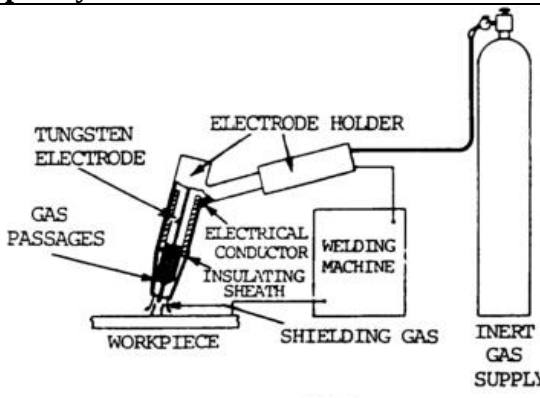
MODEL ANSWER

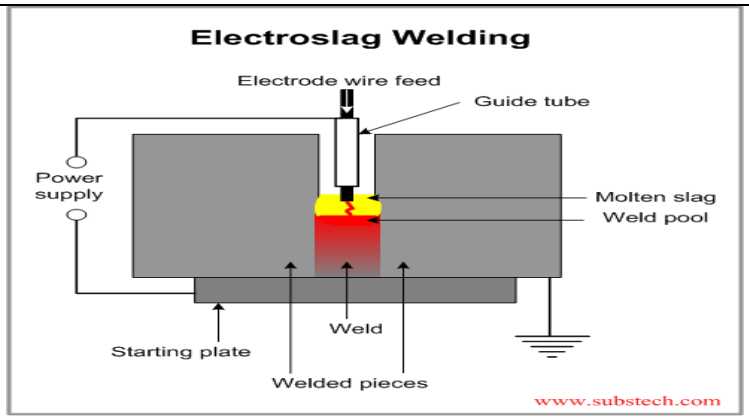
SUMMER– 17 EXAMINATION

Subject Title: Advance Welding Technology Subject Code: 17621

Important Instructions to examiners:

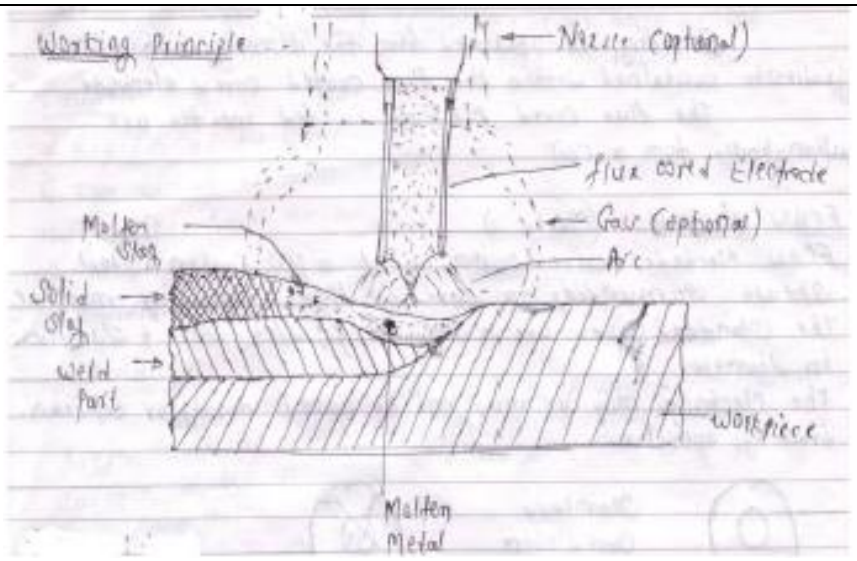
1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling 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.

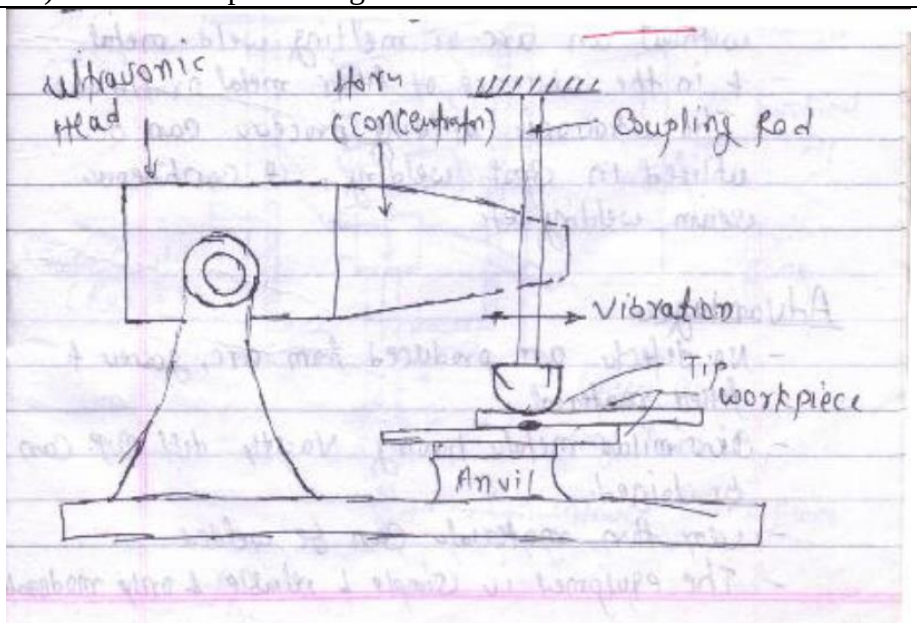
Q. No.	MODEL ANSWER	MARKS
1	**Attempt any five**	5 x 4
1.a	 NOTE A water-cooled welding torch is used when cooling from the inert gas shield is inadequate. Figure 10-33. Gas tungsten arc welding equipment arrangement. **Welding Torch** TIG welding torch includes three main parts namely non-consumable tungsten electrode, collets and nozzle. A collet is primarily used to hold the tungsten electrodes of varying diameters in position. Nozzle helps to form a firm jet of inert gas around the arc, weld pool and the tungsten electrode. The	2m 2m

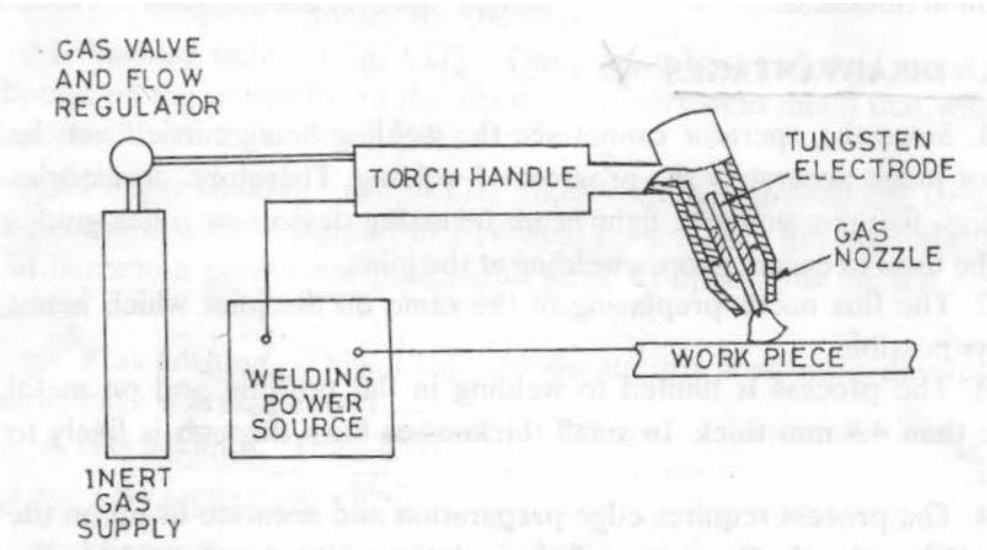
	diameter of the gas nozzle must be selected in light of expected size of weld pool so that proper shielding of the weld pool can be obtained by forming cover of inert gas. The gas nozzle needs to be replaced at regular interval as it is damaged by wear and tear under the influence of intense heat of the welding arc. Typical flow rate of shielding inert gas may vary from 5-50 liters/min.	
1.b	 **Working:-** **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.	2m 2m
1.c	**Equipment** (a)Welding power source and cables. (b)Welding torch and wire electrode coiled on a spool. (c)Wire feed mechanism and controls consisting of a pair of driving rolls, electric motor, etc. (d) Shielding gas cylinder, pressure regulator and flow meter. (e) Controls for switching 'On and off the current, electrode wire and inert gas. **Limitations:** 1. The process is slightly more complex as compared to TIG or stick	2m

	. electrode welding because a number of variables (like electrode stick out, torch angle, welding parameters, type and size of electrode, welding torch manipulation, etc.) are required to be controlled effectively to achieve good results. 2. Welding equipment is more complex, more costly and less portable. 3. Since air drafts may disperse the shielding gas, MIG welding may not work well in outdoor welding applications. 4. Weld metal cooling rates are higher than with the processes that deposit slag over the weld metal.	2m
1.d	**(i) Friction welding (FRW)** It is a solid-state welding process that generates heat through mechanical friction between work pieces in relative motion to one another, with the addition of a lateral force called "upset" to plastically displace and fuse the materials **(ii)Inertia Welding:** Inertia welding is similar to friction welding because both us friction to develop heat the temperature developed are below the melting point of the metals being welded but high enough to create plastic flow and intermolecular bonding It is a form of friction welding which utilizer K.E. stored in a flywheel system to supply the power required for all of the heating and much of the forging.	2m 2m
1.e	**Process equipment code (ASME)** The ASME Code section 8 is the construction code for pressure 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. 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	4m
1.f	**ADVANTAGES OF RESISTANCE WELDING** (i) Fast rate of production. (ii) No filler rod is needed. (iii) Semi-automatic equipment.	2m

	(iv) Less-skilled workers can do the job. (v) Both similar and dissimilar metals can be welded. (vi) High reliability and reproducibility are obtained. (vii) More general elimination of warping or distortion of parts. **DISADVANTAGES OF RESISTANCE WELDING** (i) The initial cost of equipment is high. (ii) Skilled persons are needed for the maintenance of equipment and its controls. (iii) In some materials, special surface preparation is required. (iv) Bigger job thicknesses cannot be welded.	2m
1.g	**Defination:-** **Distortion** or deformation can occur during **welding** as a result of the non-uniform expansion and contraction of the **weld** and base metal during the heating and cooling cycle. **FOLLOWING ARE THE TYPES OF DISTORTION** • Longitudinal shrinkage • Transverse shrinkage • Angular distortion • Bowing and dishing • Buckling • Twisting	2m 2m
2	**Attempt any Four**	4 x 4
2.a	- In Submerged arc welding processes instead of a flux covered electrode granular flux and bare electrode is used. - Arc between the electrode and job is the heat source and remains under the flux. - The flux server as a shield and protective molten weld pool from atmospheric contamination. - Alloying elements may be added as per requirement along with flux. -Substances evolving a large amount of gases during welding are never mixed with the flux. -Flux with fine and coarse particle sizes are recommended for welding heavier and smaller thicknesses respectively.	4m

2.b	 Working principal FCAW is a process in which joint is produced by heating the work piece with an electric arc between a continuous tabular consumable electrode and work. The electrode is flux cored i.e. the flux is contained within the electrode which is hollow. The flux inside the wire provided the necessary shielding of the weld pool FCAW utilizer the heat of an arc between a continuously fed consumable flux cored electrode and the work piece which is to be joined. The heat of the arc melts the surface of base metal and the end of the electrode. The metal melted off the electrode is transferred through the arc to the work piece	2m 2m
2.c	**Advantages** 1) No Heat is applied and no melting occurs. 2) Permits welding o thin to thick sections 3) Pressure used are lower, welding time are shorter. 4) **Limitations:** 1) Process is limited to lap joints. 2) But welds cannot be made because there is no means of supporting the work pieces and applying clamping	2m 2m
2.d	Definition:- Resistance welding is a group of welding processes wherein coalescence is produced by the heat obtained from resistance of the work to the flow of electric current in a circuit of which the work is a part and by the application of pressure. No filler metal is needed.	2m

	Applications:- 1) Automotive / auto suppliers 2) Electrical / electronics 3) Aerospace / air plane 4) Train carriage / rail 5) Radiator / container 6) Domestic hardware 7) Medical instruments 8) Nuclear equipment 9) Food and drink 10) Other metal processing industries	2m (any two)
2.e	 Ultrasonic welding will join similar or dissimilar metals by the introduction of high frequency vibratory energy (20000 to 60000 Hz) into overlapping metals into the area to be joined. No flux or filler metals are used, no electrical current passes through the weld metal & usually no heat is applied. The parts to be joined are clamped together between a welding tip & a supporting member under low static pressure.	2m 2m
2.f	1) The light generated by welding is extremely bright, working directly on welding arc even for a short time causes arc eye therefore it is recommended to use welding cap and welding screen or welding mash	4m(any four)

	or goggle. 2) Al.alloys vapour and zinc coating are poisonous exposure can result in heavy metal poisoning flue like symptoms. The zinc coating should be removed before welding and one can wear charcoal mask. 3) Covering of arms and legs is essential because strong ultraviolet light emitting from MIG may cause sun sum. 4) Welding gloves are required to be wear. 5) Ear protection device to avoid too much noise. 6) Clean atmosphere i.e. Surrounding is required because molten metal may split several feet may catch fire **7)** Use our common sense while welding.	
3	**Attempt any two**	2 x 8
3.a	GTAW, frequently called as TIG welding process, is normally used for good quality and precision welding. It is an arc welding process where in joint is produced by heating the job with an electric arc between a tungsten electrode and the job. No flux is used A shielding gas is used to avoid atmospheric contamination of the molten weld pool.  	2m

	Welding current water and inert gas supply are turned on the arc is struck either by touching the electrode with a scape metal tungsten piece or using a high frequency unit. In the first method arc is initially struck on as cap metal piece and then broken by increasing the arc length. This procedure repeated twice or thrice arms up the tungsten electrode The arc is then struck between the electrode and per cleaned job to be welded. This method avoids breaking electrode tip .joint contamination and tungsten In the second method a high frequency current is superimposed in the welding current. The welding torch is brought nearer to the job when electrode tip reaches within a distance of 2 to 3 mm from the job a spark lump across the are gap between the electrode and the job. The air path gets ionized and arc is stabilized After striking the arc it is allowed to impinge on the job and molten weld pool is created. The welding is started by moving the torch along the joints as in oxyacetylene welding. The shielding gas is allowed to impinge on the solidifying weld pool for a few second after the arc is generated this will avoid atmospheric contamination. **ADVANTAGES** 1. No flux is used; hence there is no danger of flux entrapment when welding refrigerator and air conditioner components. 2. Because of clear visibility of the arc and the job, the operator can exercise a better control on the welding process. 3. This process can weld in all positions and produces smooth and sound welds with less spatter. 4. TIG welding is very much suitable for high quality welding of thin materials (as thin as 0.125 mm). 5. It is a very good process for welding nonferrous metals (aluminum etc.) and stainless steel. **APPLICATIONS**	2m 2m

	1. Welding aluminum, magnesium, copper, nickel and their alloys, carbon, alloy or stainless steels, inconel, high temperature and hard surfacing alloys like zirconium, titanium etc. 2. Welding sheet metal and thinner sections. 3. Welding of expansion bellows, transistor cases, instrument diaphragms, and can-sealing joints. 4. Precision welding in atomic energy, aircraft, chemical and instrument industries. 5. Rocket motor chamber fabrications in launch vehicles.	2m
3.b	**Welding Code** The specific content and requirements of a welding code or standard can vary in detail, however, there are a number of elements within these types of documents which are common and which will examine. This is found at the beginning of the document and is important as it will normally provide a description as to the type and extent of welding fabrication for which the document was developed and intended to be used. It may also provide information relating to the limitations for the use of the document. Care should be taken to use codes and standards that are applicable for your particular application. **PIPING WELDING CODES:- (ASME)** ASME is the registered trademark of The American Society of Mechanical Engineers. The ASM.E B31 Code for Pressure Piping consists of a number of individually published Sections, each an American national Standard, under the direction of ASME Committee B31, Code for Pressure Piping. Rules for each Section have been developed considering the need for application of specific requirements ASME is the registered trademark of The American Society of Mechanical Engineers. The AS1\1.EB31 Code for Pressure Piping consists of various types of pressure piping. Applications considered for each Code Section include: B31.1 Power Piping: piping typically found in electric power generating stations, in industrial and institutional plants, geothermal heating systems, and central and district heating and cooling systems; B31.3 Process Piping: piping typically found in petroleum refineries, chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic	4m 4m

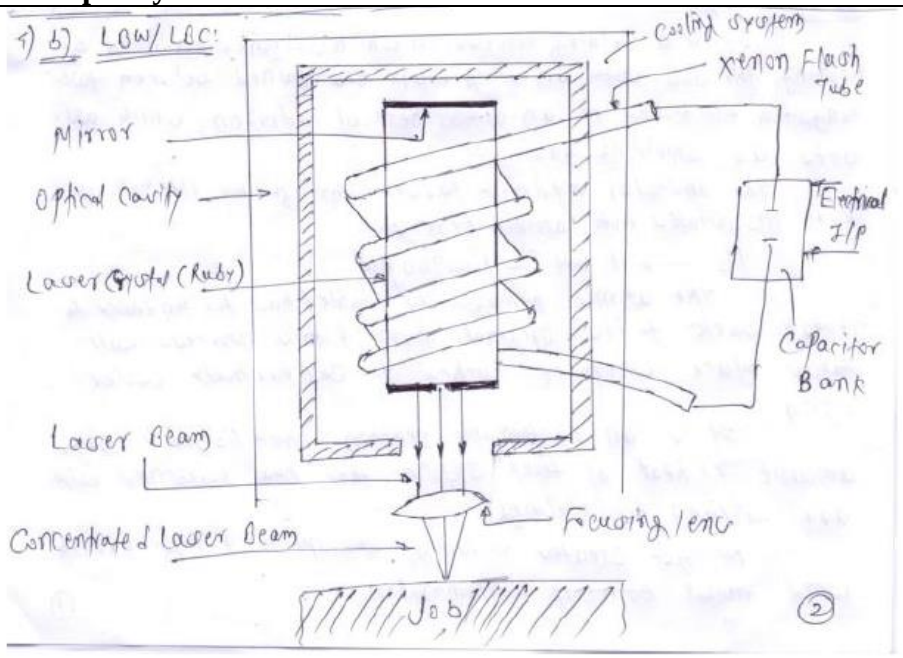
	plants, and related processing plants and terminals; B31.8 Gas Transportation and Distribution Piping Systems: piping transporting products which are predominately gas between sources and terminals, including Compressor, regulating, and metering stations; and gas gathering pipelines.	
3.c	**Factors influencing choice of welding technique** 1. Size & thickness of the plate 2. Material of the plate 3. Position or location where welding is to be done. 4. Matching strength 5. Tolerance of dilution (absorption of base material into weld metal). 6. Machinability 7. Tolerance of high cooling rates 8. Weldability at low heat inputs 9. Colour matching 10. Sufficient ductility to absorb welding strains **Precautions in welding** - Containers which had held conbustionable or inflammable materials should be welded only after exercising proper precautions. - Fire extinguishers or sand should be available at hand. - Do not weld in confined spaces without adequate ventilation or individual respiratory equipment. - When welding inside boilers or other confined spaces, the gas cylinders must be kept outside and the hose and its attachments thoroughly inspected for leakage -Gas flame should not be allowed to play even momentarily on the cylinders or their attachments.. - Never do any chipping or grinding without suitable goggles. - Do not weld painted or galvanized surfaces in a badly ventilated space. - Do not use matches for lighting torches. This may result in hand burns. - Never attempt to relight a blow pipe that has blown out without first closing both valves and relighting in the proper manner. - If welding or cutting is to be stopped temporarily, release the pressure adjusting screws of the regulators by turning them to the left. - Use goggles with non-flammable lenses and frames - Close the torch valves and release the pressure adjusting screws.	4m (any 4) 4m(any four)
4	**Attempt any Four**	4 x 4
4.a	(1)Argon: It is the extensively used shielding gas because of its availability as far as	4m

	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. 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:** - One of the shielding gases used predominantly in welding steel.CO2 is ac compound of two different elements carbon and oxygen. It exhibited inert gases charatices at room temperature by showing stability in both reacting with other elements, but it is reactive gas at welding temperature. -The experimental results showed that using straight carbon dioxide produces broader, deeper penetrating; welds. The bead contour is fairly uniform and there is no evidence of undercutting. - The chief disadvantage of using straight CO2 gas for shielding is its low electrical conductivity, which produces an unstable violent arc, This condition create a lot of spatter problems, which are most undesirable when appearance of the weld area is of particular importance.	
4.b	**Limitations:-** 1. Since the operator cannot see the welding being carried out, he cannot judge the progress of welding 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. **Applications** 1. Fabrication of pipes, penstocks, pressure vessels; boilers, structural shapes, rotary kilns, rail road, and earth moving equipment, cranes, bridge	2m 2m

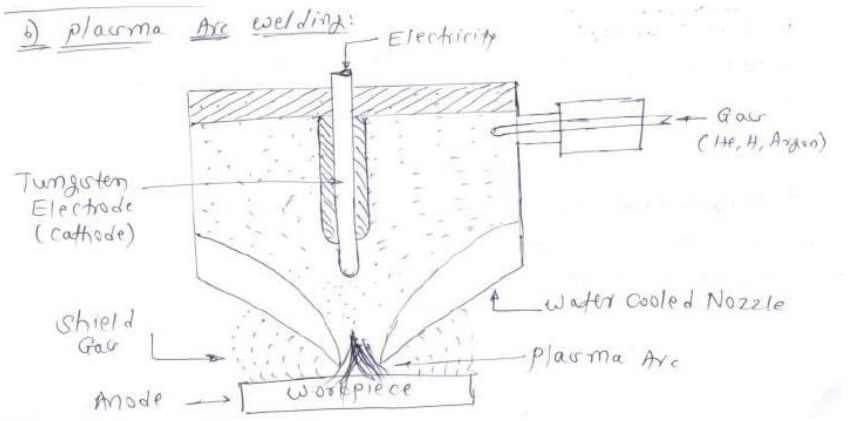
	girders and under structure of railway coaches and locomotives. 2. Automotive, Aviation, ship-building and nuclear power industry. 3. Rebuilding of worn out part and depositing wear resisting alloys. Hard facing of tractor rollers and idlers, and crane pulleys. 4. For welding metals like mild steel, medium and high tensile low alloy steels.	
4.c	Advantages: 1. Joint preparation is often much simpler than for other welding processes. 2. Much thicker steels can be welded in single pass and more economically. Thicknesses up to 450 mm in plain and alloy steels can be welded without difficulty. 3. Electroslag welding gives extremely high deposition rates. 4. Residual stresses and distortion produced are low. 5. Flux consumption as compared to that in submerged arc welding is very low. 6. During the electroslag process, since no arc exists, no spattering or intense arc flashing occurs. **Disadvantages:** 1. Submerged arc welding is more economical than electroslag welding for joints below 60 mm. 2. In electroslag welding, there is some tendency toward hot cracking and notch sensitivity in the heat-affected zone. 3. It is difficult to close cylindrical welds. 4. Electroslag welding tends to produce rather large grain size. 5. Welding is carried out in vertical uphill position,	2m 2m
4.d	**I Plastic welding** : welding for semi-finished plastic materials is described as a process of uniting softened surfaces of materials, generally with the aid of heat (except solvent welding). Welding of thermoplastics is accomplished in three sequential stages, namely surface preparation, application of heat and pressure, and cooling. **ii Ceramics welding** The ceramic welding process was developed and originally designed for the repair of glass furnaces. Ceramic welding is applied during furnace operation by conveying a dry mixture of refractory aggregate and oxidizable particles together through specially designed water cooled. The oxygen rich stream of powder contacts the hot furnace refectory lining where the metals oxidize during a highly exothennic reaction. **iii.** Composite materials	4m(1m each)

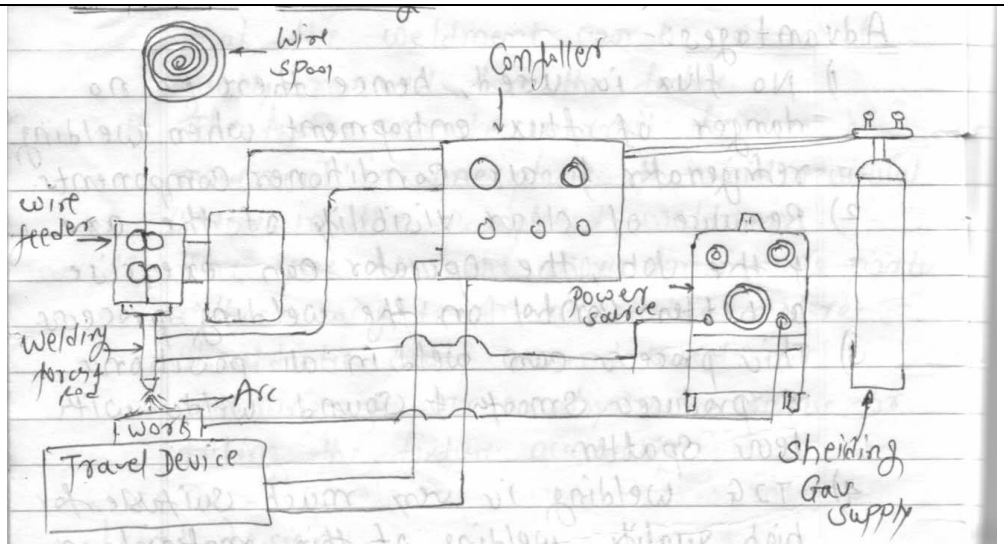
<table>
<tr><td></td><td>The most widely applied methods for the production of composite materials and composite parts are based on casting techniques such as the squeeze casting of porous ceramic preforms with liquid metal alloys and powder metallurgy methods. On account of the excellent physical, mechanical and development properties of composite materials, they are applied widely in aircraft technology and electronic engineering, and recently in passenger-car technology also.

iv Welding of alloys
All the common arc processes are applicable in Welding-alloy-steel, the selection being determined mostly by economic and practical considerations. However certain precautions must always be considered: low hydrogen consumables, preheat and post heat to drive hydrogen away and to avoid cold cracking, besides controlling the microstructures formed.
Gas Tungsten Arc Welding is considered best capable of controlling hydrogen content to the minimum and is therefore the process of choice for critical Welding-alloy-steel applications. for useful advice.</td><td></td></tr>
<tr><td>4.e</td><td><table>
<tr><td>SR NO</td><td>FCAW</td><td>MIG/TIG</td></tr>
<tr><td>1</td><td>Flux cored arc welding (FCAW) is an electric arc welding process that uses an arc between a continuously fed fluxfilled electrode and the weld pool.</td><td>Suitable for both thin and thick joints</td></tr>
<tr><td>2</td><td>The electrode used in this process is flux coated</td><td>Large deposition rates can be achieved</td></tr>
<tr><td>3</td><td>The electrode is hollow</td><td>Because no.of variable to be controlled process is quite complex than TIG</td></tr>
<tr><td>4</td><td>The flux contained in the hollow electrode acts as a sheilding</td><td>No separate filler rod required</td></tr>
</table></td><td>4m(any four)</td></tr>
<tr><td>4.f</td><td>Structural Welding Codes:- (AWS D 1.1)
This code contains the requirements for fabricating and erecting welded steel structures. When this code is
Stipulated in contract documents, conformance with all provisions of the code shall be required, except for those
Provisions that the Engineer or contract document specifically modifies or exempts.</td><td>4m</td></tr>
</table>

	All standards (codes, specifications, recommended practices, methods, classifications, and guides) of the American Welding Society (AWS) are voluntary consensus standards that have been developed in accordance with the rules of the American National Standards Institute (ANSI). When AWS American National Standards are either incorporated in, or made part of, documents that are included in federal or state laws and regulations, or the regulations of other governmental bodies, their provisions carry the full legal authority of the statute. In such cases, any changes in those AWS standards must be approved by the governmental body having statutory jurisdiction before they can become a part of those laws and regulations. In all cases, these standards carry the full legal authority of the contract or other document that invokes the AWS standards. Where this contractual relationship exists, changes in or deviations from requirements of an AWS standard must be by agreement between the contracting parties. AWS American National Standards are developed through a consensus standards development process that brings together volunteers representing varied viewpoints and interests to achieve consensus.	
5	**Attempt any Four**	4 x 4
5.a	 Working:(2M) • Laser beam welding/cutting is that joint is produced by heat obtain	2m dia.

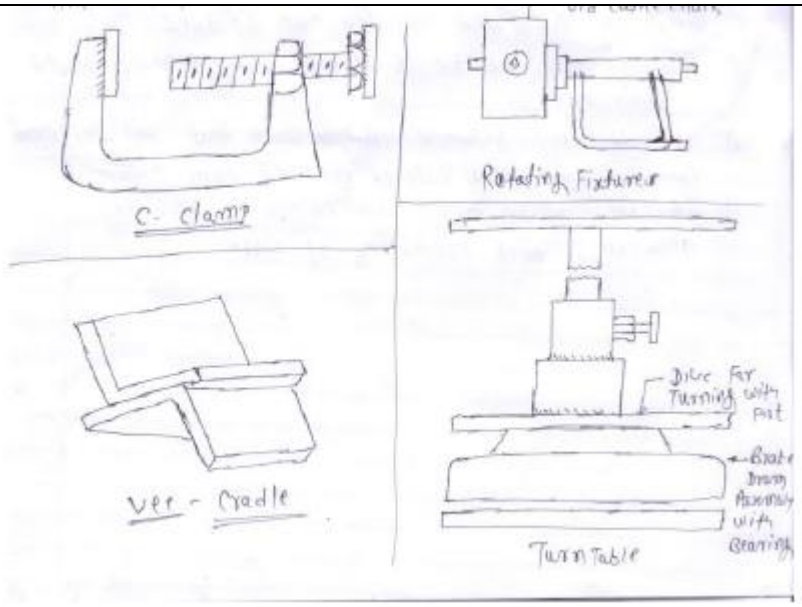
	from the application of the concentrated coherent light beam impinging upon the surface to be joined/cut • Laser is device which creates intense beam that can impart tremendous energy on a small area to produce fusion for welding/cutting purpose. • It consists of ruby crystal which contains at chromium in dispersed condition. The ends of their rods are like mirror and 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	2m expl.
5.b	Following are the equipments used in latest welding **1) Welding cycle controller:-** The basic function of this component is to control the weld time, squeeze time etc . for prcise method. **2) Workpiece Positioning Sensor:-** The basic function of this component is to position the workpiece in the correct manner . **3) Modern Jigs & Fixtures:-** The welding fixtures are usually designed to hold one specific assembly. **4) Electrode Feed Controller:** Tt will control the electrode feed rate. **5) Fume Extracters:** The gases which are generated during the welding can be removed by using fume extracters.	4m (any 4)

5.c	 Working:- • Plasma is gas of positive ions and negative electron equal number of positive ions and negative electron. • In PAW joint is produced by striking an arc in between tungsten electrode and water cooled nozzle. • When the laser are passed through arc and nozzle they get ionize and becomes plasma • The laser generally used are argon, helium and hydrogen • Non consumable tungsten within a water cooled nozzle is enveloped by a gas.the gas is forced to an electric arc through a constraint opening at the end of water cooled nozzle. Temperature have been reported to 10000 to 300000C as comparison oxyacetylene welding is limited to 36000C Advantages:- 1. Both thin as well as thick weld joints can be made 2. Strong, uniform and dense weld can be produced. 3. High welding rates 4. No filler material is required	2m dia. 2m expl.

5.d	 In Automatic welding some of the activities are carried out without manual work In this type of welding the control of welding variables and relative movement between the welding head and the work are automatic Usually a single switch working through a sequencing device operates the control for power and consumable like wire and gas This may also bring crater filling device, it incorporated into action automatically Fig shows a block diagram for atypical automatic welding system As soon as welding is started first in manual way automatic welding control the arc length in the case of arc welding processes and to control the depth of molten and slag pool in electro slag welding on the other hand it also controls the relative motion between the welding head and work to attain the desired welding speed The automatic welding system is most popular with SAW, and ESW processes. It is also used to a limited extent with GTAW,GMAW,FCAW and Plasma arc welding process	2m dia. 2m expl.

5.e	MIG WELDING	TIG WELDING	4m(any four)
	1. This welding is known as metal inert gas welding.	1. This is known as tungsten inert gas welding.	
	2. Metal rod is used as electrode and work piece used as another electrode	2. Tungsten rod is used as electrode.	
	3. It is gas shielded metal arc welding.	3. It is gas shielded tungsten arc welding.	
	4. Continuous feed electrode wire is used which are fast feeding.	4. Welding rods are used which are slow feeding.	
	5. MIG requires consumable metallic electrode	5. It used non consumable tungsten electrode	
	6. Electrode is feeded continuously from a wire reel.	6. It does not require electrode feed.	
	7. Filler metal is compulsory used.	7. Filler metal may or may not be used.	
	8. MIG is comparatively faster than TIG.	8. TIG is a slow welding process	
5.f	The factor affecting of selection of welding fixture. 1) Strength and weight of the fixture 2) Ease of positioning of fixture 3) Quickness of positing /Installing the fixture 4) Simplicity in design of fixture 5) Cost of fixture		4m(any four)

	6) Accuracy of working of fixture 7) Rate of heat dissipation of fixture.	
6	**Attempt any Four**	4x4
6.a	(i) Application of Atomic hydrogen welding 1. The process can be used for the welding of most of the metals and alloys like plain carbon steel, alloy steel, stainless steel, aluminum, copper, nickel and their alloys. 2. For surfacing dies and tools. (ii)Application of Diffusion welding (i) Fabrication of reactor components in atomic energy industries. (ii) Fabrication of honeycomb, rocket engines, helicopter rotor hub, turbine components, etc., in aerospace missile and rocketry industries. Two controversial aerospace vehicles have brought diffusion bonding into the light - the B-1 bomber and space shuttle. (iii) Fabrication of composite materials.	2m 2m
6.b	- Butt, fillet and plug welds and surfacing are carried out using submerged arc process. - Plates up to 19 mm thick can be butt welded in one-pass. Bigger thicknesses require multiple passes from one or both sides of the joint. - Typical welding conditions for butt welds in steel plate are: Square butt weld, plate thickness 12.7 mm, root opening 4.8 mm, current 1100 Amps, voltage 34 volts, electrode dia. 5.6 mm, steel backing strip 9.5 mm thick, 25.4 mm wide, welding speed 8 mm/second. Single electrode, one pass. -Fillet welds up to 9.5 mm in throat size can be made in the horizontal position with one pass.	4m
6.c	• A C- clamp is good enough for most welding jobs. It can be quickly and cheaply made in the shop • A simple but effective Vee rest for supporting short bars or pieces of pipe for welding on the bench is shown in fig. • Rotating fixture for making circumferential welds or for building up rollers, rings,valves,drilling bite and axles are very valuable as they speed up the job.	2m

		2m
6.d	**WELDING REPAIR** Manual metal arc or metal inert gas welding Repairing the rail running surface using manual metal arc (MMA) or metal inert gas (MIG) welding should be carried out using a specified process as set. **MAINTENANCE OF WELDED joint** a) This section prescribes the minimum requirements for inspection and response to rail and welded joint conditions. For non-welded joints see section 8.0. b) Known defects shall be positively identified in track with indelible marking. c) Defects other than those described in this sub-section may be identified in track. These defects should be responded to, taking into account both the underlying causes of the defect and its impact on the integrity of the track structure. d) Inspection, assessment and maintenance actions of rail and welded rail joints shall include the specific conditions shown in table	4m
6.e	**Micro welding:-** Micro Arc Welding is the short and long-run service provider delivering	4m

	hand held micro TIG and micro laser welding repair work. Micro welding is the name given to the process that has evolved from traditional TIG welding (or more recently termed GTAW), using the technology of electric current being applied to the work piece to generate heat at the point of the *arc gap.* At the point of the arc gap, a molten pool is established and the filler rod is introduced into the molten pool. The difference between traditional TIG and micro welding is that micro welding is done at extremely low amperages (usually less than 10 amps) in combination with fine control of the amperage range, along with the aid of a high-powered (10-20X or more) microscope. **Problems**:- As Micro welding is a state of the art process that is used for welding small areas. Often the micro weld requires the surrounding area to be minimally effected by heat, requiring precise heating of the weld to only allow proper fusion of the joint. Micro welding requires the use of miniature TIG welding equipment (Gas Tungsten Arc) that is not much larger than a pen. Micro TIG welding is the latest in tool welding technology. **Methods:-** GMAW GTAW Micro laser welding	
6.f	(i)APPLICATIONS OF FCAW 1. FCAW is widely used on medium thickness steel fabricating work where the fine-wire GMAW process would not apply and where the fit-up is such that SAW would be unsuitable. 2. FCAW is also used for surfacing and for build-up. 3. FCAW has been widely used for welding in bridges, high rise buildings, ship building and offshore drilling platforms. 4.Other applications of FCAW are as follows: - Main frames on bulldozers,	2m(any two)

	- Bulldozer blades, - Rotating frames for shovels and cranes, - Tractor frames (ii) APPLICATIONS OF ELECTRO SLUG WELDING 1. Heavy plates, forgings and castings can be butt welded. 2. Where plates or castings of uniform thickness are involved or if they taper at a uniform rate, electroslag welding has virtually replaced hermit welding, being much simpler. 3. Following alloys can be welded: Low carbon and medium carbon steels. High strength structural steels. High strength alloy steels such as stainless steel and nickel alloys.	2m(any two)