UNIT-I GAS AND ARC WELDING PRCOESSES

1. What is the principle of Oxy-Actylene welding process ?

In Oxy-actylene welding process, acetylene is mixed in correct proportions in the welding torch and ignited, the flame resulting at the tip of the torch is sufficiently hot to melt and join the parent metal.

2. Mention the significance of three types of flames in the welding process.

Neutral flame is produced when approximately equal volumes of oxygen and acetylene are mixed in the welding torch and burnt at the torch tip. The temperature of neutral flame is 3260°C. It effects no chemical change in the molten metal and therefore will not oxidise or carburize the metal.

In Oxidising flame, the proportion of oxygen and hydrogen is (O_2:C_2H_2=1.5:1). The temperature of reducing flame is around 3480°C. Excess oxygen in the flame at high temperatures tend to combine with many metals to form hard, brittle, low strength oxides.

In Reducing flame, volume of oxygen supplied to the neutral flame is reduced. The temperature of Oxidising flame is around 3030°C. This flame does not consume available carbon, therefore its burning temperature is lower and the left over carbon is forced into molten metal. This produces very hard, brittle substance known as iron carbide.

3. What is a flux? (or) Why is flux needed in welding?

In high-temperature metal joining processes the primary purpose of flux is to prevent oxidation of the base and filler materials. Flux is a substance which is nearly inert at room temperature, but which becomes strongly reducing at elevated temperatures, preventing the formation of metal oxides. The role of a flux in joining processes is typically dual: dissolving of the oxides on the metal surface, which facilitates wetting by molten metal, and acting as an oxygen barrier by coating the hot surface, preventing its oxidation

4. List the advantages and disadvantages of gas welding process.

Advantages:

1. Applied to wide variety of manufacturing process.
2. Welder has considerable control over the temperature.
3. Rate of heating and cooling is relatively slow.
4. Cost of maintenance is low.

Disadvantages:

1. Heavy sections cannot be joined.
2. Flame temperature is less than the temperature of the arc.
3. Fluxes used in certain welding and brazing operations produce fumes
4. Gas flames takes long time to heat up.
5. Prolonged heating of the joint in gas welding results in a larger heat affected area.

5. State the applications of Oxy acetylene welding process.

1. For joining thin materials
2. Automobile and aircraft applications
3. In sheet metal fabrication plants.
4. Joining ferrous and non-ferrous metals. E.g. Carbon steels.

6. Write the principle of Carbon arc welding process.

Arc is maintained between the job and the carbon electrode. DC straight polarity is preferred to restrict electrode disintegration and the amount of carbon going into weld metal. The arc is struck by touching the

electrode with the job momentarily and then taking away the electrode a definite distance. Filler metal and flux may or may not be used, depending upon the type of joint and the material to be welded.

7. What are the different types of joint design?

The different types of joint design are 1) Plain butt 2) Bevelled butt 3) Lap 4) Corner 5) Flange 6) TEE

8. Mention the advantages and disadvantages of carbon arc welding process.

Advantages :
1. Heat input to the workpiece can be easily controlled.
2. Easy mechanization.
3. Welding cost is less compared other welding process.
4. More suitable for butt welding of thinner workpieces.

Disadvantages:
1. Carbon transfers from the electrode to weld metal, causing harder weld deposit in case of ferrous materials.
2. Absence of proper electrode geometry and in confined spaces arc blow results gives poor welds.
3. Separate filler metal is needed, which slows down the welding speed.

9. What is twin carbon-electrode Arc welding process?

The arc is produced between two carbon electrodes held in a special holder. Two electrodes touch mometarily, part away and thus an arc establishes. Current is switched on and by operating the mechanism of arc length adjustment. The size of the arc depends upon the distance between the electrode tips, electrode diameters and the welding current.

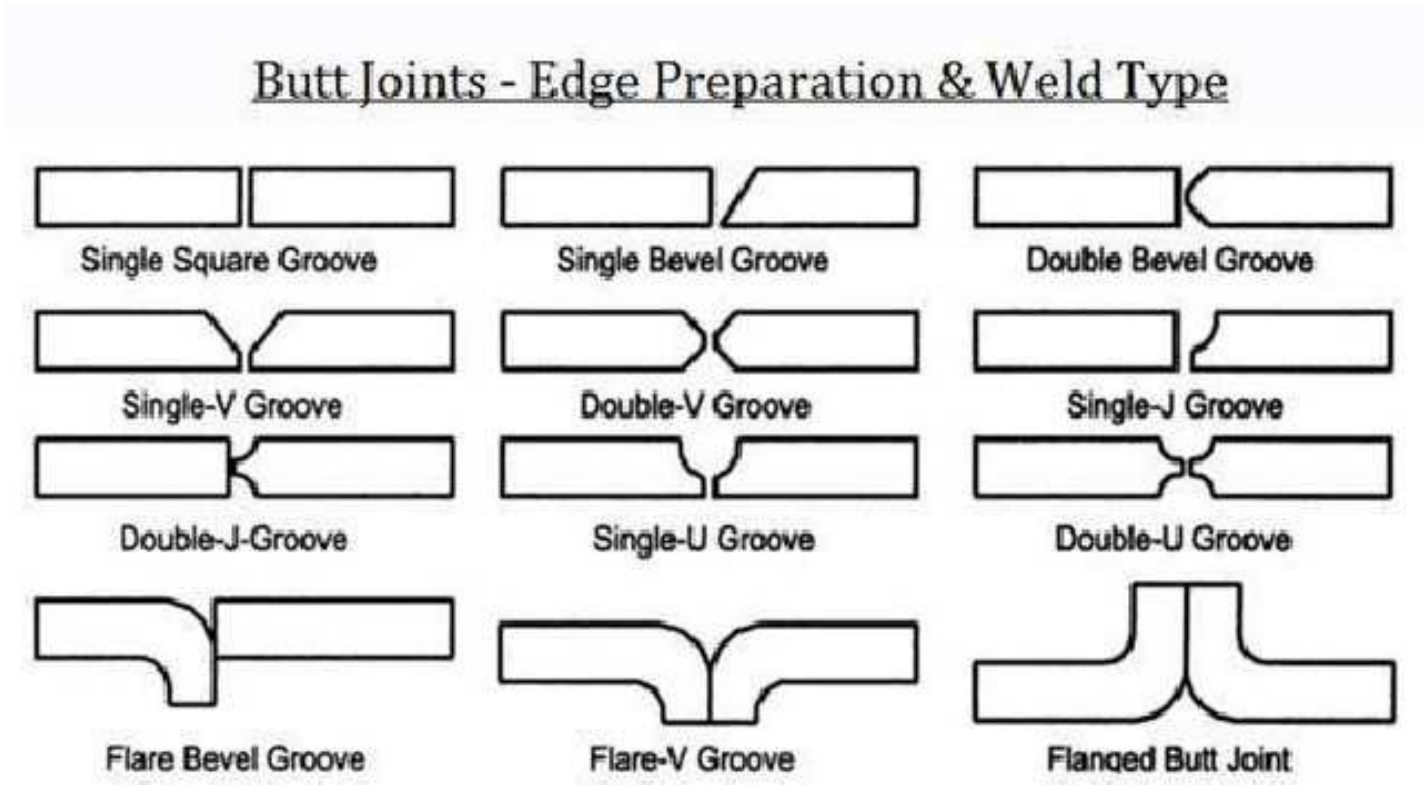
10. State the principle of flux shielded metal arc welding process.

To strike the electric arc, the electrode is brought into contact with the workpiece by a very light touch with the electrode to the base metal then is pulled back slightly. This initiates the arc and thus the melting of the workpiece and the consumable electrode, and causes droplets of the electrode to be passed from the electrode to the weld pool. As the electrode melts, the flux covering disintegrates, giving off shielding gases that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels from the electrode to the weld pool.

11. Define weaving in welding process.

Weaving implies giving side to side motion to the welding arc during transferring material to the joint to be welded. Weaving gives better fusin on the sides of the weld and enables the metal to built up or reinforced along any desired line.

12. List the different types of edge preparation.



13. Mention the factors affecting edge preparation.

Surface and edge of the plates to be welded are cleaned to remove the dirt, dust, paint, oil, grease etc. present on the surface either by mechanical or chemical methods. Use of chemical approach for cleaning the surface using hydrogen containing acid (sulphuric acid, hydrochloric acid etc.) sometimes introduce hydrogen in base metal which in long run can diffuse in weld and HAZ and facilitate crack nucleation & propagation (by HIC) besides making weldment brittle. Improper cleaning sometimes leaves impurities on faying surface, which, if are melted or evaporated during the welding then these impurities can induce inclusions in weld metal. Presence of inclusions in weld metal acts as stress raiser for nucleation and growth of cracks and so weakens the joint and lowers fatigue performance.

14. What is the principle of submerged arc welding?

The flux starts depositing on the joint to be welded. Flux serves as a shield and protects the molten weld pool from atmospheric contamination. Since the flux when cold is non-conductor of electricity, the arc may be struck either by touching the copper coated electrode (bare) with the work piece or by placing steel wool between electrode and job before switching on the welding current or by using a high frequency unit. The electrode at a predetermined speed is continuously fed to the joint to be welded. In semi-automatic welding sets the welding head is moved manually along the joint. In automatic welding a separate drive moves either the welding head over the stationary job or the job moves/rotates under the stationary welding head.

15. List the different types of equipment in submerged arc welding process.

The different types of equipments are 1) Welding head 2) Flux hopper 3) Welding power source 4) Flux 5) Electrode.

16. Define the term “weld backing”.

Submerged arc welding produces a large volume of highly fluid weld metal which needs to be supported (backed), until it solidifies when making butt welds in one pass where complete penetration is desired. Some of the methods are 1) Backing strips 2) Backing weld 3) Copper backing 4) Flux backing 5) Gas backing.

17. Differentiate TIG and MIG.

S.No.	TIG	MIG
1	Long non-consumable tungsten electrode welding rods and slowly feed them into the weld puddle. The welding process is slower.	MIG welding uses the filler metal wire itself to produce arc and in turn melts itself to add to weld pool. Wire or Electrode used is a Continuous feeding wire, which is a very aids for quicker putting down welds.
2	TIG welding on the other hand is more commonly used for your thinner gauge materials.	A range of material thicknesses can be welded from thin gauge sheet metal right up to heavier structural plates.
3	Power required is less.	Power required is more
4	Control over welding is better.	Control over arc and metal transfer in MIG welding is inferior to TIG welding.
5	Productivity is low and high quality welds are produced.	Productivity of MIG welding is significantly higher, but the quality is inferior to TIG

18. What is the principle of Plasma Arc welding process?

Plasma arc welding is an arc welding process wherein coalescence is produced by the heat obtained from a constricted arc setup between a tungsten/alloy tungsten electrode and the water-cooled (constricting) nozzle (non-transferred arc) or between a tungsten/alloy tungsten electrode and the job (transferred arc). The process employs two inert gases, one forms the arc plasma and the second shields the arc plasma. Filler metal may or may not be added.

19. State the principle of Electroslag welding process.

Electroslag welding (ESW) is a highly productive, single pass welding process for thick (greater than 25 mm up to about 300 mm) materials in a vertical or close to vertical position. (ESW) is similar to electrogas welding, but the main difference is the arc starts in a different location. An electric arc is initially struck by wire that is fed into the desired weld location and then flux is added. Additional flux is added until the molten slag, reaching the tip of the electrode, extinguishes the arc. The wire is then continually fed through a consumable guide tube (can oscillate if desired) into the surfaces of the metal workpieces and the filler metal are then melted using the electrical resistance of the molten slag to cause coalescence.

UNIT II RESISTANCE WELDING PROCESSES

1. Write basic principle of the resistance welding process.

Electric resistance welding (**ERW**[1]) refers to a group of welding process such as spot and seam welding that produce coalescence of faying surfaces where heat to form the weld is generated by the electrical resistance of material combined with the time and the force used to hold the materials together during welding.

2. Mention the different types of Resistance welding process.

Different types of Resistance welding process are Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes

3. State the terminologies used in a resistance welding cycle.

The terminologies used in resistance welding cycle are : 1) off time 2) Squeeze time 3) Weld time 4) Forge time

4. List the resistance welding variables.

Different types of welding variables 1) Welding current 2) Weld Time 3) Pressure control

5. What are the resistance welding equipments?

Resistance welding equipments comprises of electrical circuit, Contactor, timers and mechanical system for the application of desired pressure.

6. Write short notes on the heat balance in the resistance welding process.

In resistance welding, the parts to be welded are supplied with electric current by means of direct contact between the parts and the welding electrodes. As the current flows through the parts, resistance to flow of electric current produces welding heat. Combination of welding force and heat produces a strong weld at the interface. The weld nuggets will develop closer to the electrode with smaller diameter due to the higher current density or electrode with high resistivity tip due to reduced thermal conductivity hence heat dissipation.

7. Mention the factors influencing the selection of joint design.
Factors influencing joint design are 1) Edge distance 2) overlap 3) Fitup 4) Accessibility 5) Electrode marking or indentation 6) Welding sections of unequal thickness 7) Weld strength

8. Define the term ‘fitup’ in the resistance welding process.

The overlapping parts for spot welding should fit well with very little or no visible gap between them at the interface, otherwise a part of the force exerted will be spent in closing the gap and thus may not be adequate to form a sound and strong weld.

9. Define the term ‘Weld Nugget’.

In resistance spot welding, "the welding of overlapping pieces of metal at small points by application of pressure and electric current" creates a pool of molten metal that quickly cools and solidifies into a round joint known as a "**nugget**."

10. How is weldability evaluated for resistance welding process?

Weldability is evaluated based on Resisitvity, thermal conductivity and melting point

$$\%\text{weldability} == \frac{\text{Re}\,sistivity}{Thermal.conductivityXMelting\,.\,point} x100$$

11. Mention the variants of Resistance spot welding process.

The variants of resistance welding process are :

1) series welding
2) Multiple spot welding
3) Pulsation welding

12. What are the different types of Resistance seam welding process?

Different types of seam welding process are:

(i) Roll spot and stitch welding (ii) Mash seam welding (iii) Foil-butt seam welding

13. Mention the applications of seam welding process

Applications:

1) Leak proof joints in tanks and boxes
2) Welding thin materials ranging from 2.2 mm – 5.0 mm
3) Welding materials of low hardenability rating – hot rolled grades of low alloy steels
4) Making flange welds for watertight tanks

14. Define the projection welding process.

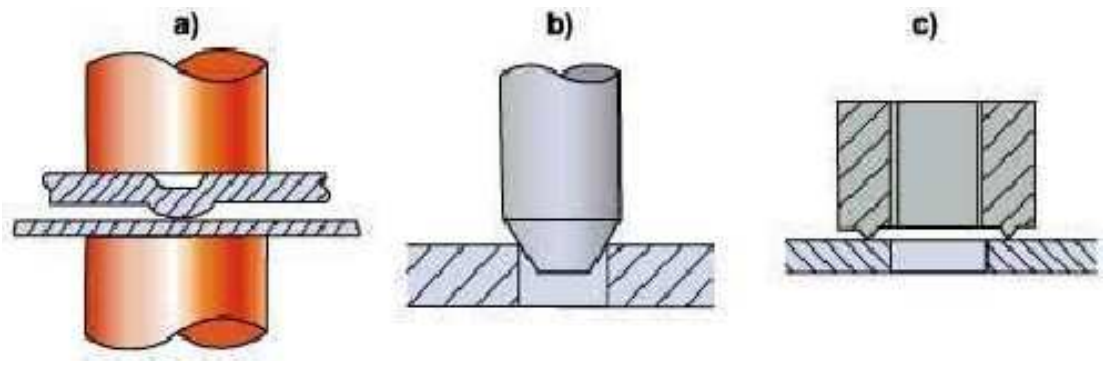
Projection welding is an electric resistance welding process that uses small projections, embossments, or intersections on one or both components of the weld to localize the heat and pressure. By doing so, weld current and force is focused into the small area of the projection, and heat is obtained from the resistance to the flow of the welding current. Due to this heat, the projections collapse and the parts are weld together.

15. List the different types of projection welding process.

(a) Embossed Projections

(b) Stud-to-Plate Projections

(c) Annular Projections



15. Define the term ‘Metal fibre’ welding process.

Metal fibre resistance welding process is a variant of projection welding process in which metal fibre is used instead of projection points. Metal fibre is genrally a felt material which is produced from a small piece of filler material by pressing.

17. State the principle of operation in flash butt welding process.

Flash butt welding is a type of resistance welding without using any filler metal. It is used for joining two metal parts together using heat and force. Each of the two parts to be joined are clamped against an electrode, usually a copper alloy.

18. Mention the applications of Flash Butt Welding process.

1) Railway Lines (Flash butt welding machines are often transported to the work site on a road-rail vehicle)
2) Chains
3) Steel wheels
4) Sheets or rods of steel in rolling mills
5) Starter Rings
6) Busbar

19. What is the principle of percussion welding process ?

Percussion welding creates a high temperature arc that is formed from a short quick electrical discharge. Immediately following the electrical discharge, pressure is applied which forges the materials together. This type of joining brings the materials together in a percussive manner.

20. State the significance of high frequency welding process.

The predominant application of High-Frequency Resistance Welding is for continuous manufacturing of **pipe and tubing**. These are generally prepared for welding in a continuous roll forming strip mill where the flat strip is gradually shaped to a round form. In the weld area the open edges of the formed strip are **brought together** by pressure rolls, to form a vee with the apex at the weld point. Here a set of pressure forge rolls squeezes the edges, **forge welding** them together with expulsion of excessive metal and impurities. The main two versions differ in the **way of application** of High-Frequency welding current.

UNIT III SOLID STATE WELDING PROCESS

1) Mention the different types of solid state welding process.

The different types of solid state welding are 1) Friction stir welding 2) Explosion welding 3) Forge welding 4) Cold welding 5) Diffusion welding 6) Ultrasonic welding 7) Inertia welding

2) What are the major components in the friction welding machine ?

The major components of the friction stir welding are: 1) Driven head 2) Clamping arrangements 3) Rotating and upsetting mechanisms 4) Controls 5) Braking mechanisms

3) List the variants in the friction welding process.

The variants of friction welding are

1. Inertia welding 2. Friction welding

Sub-variants of friction stir welding are:

a) Hybrid friction stir welding b) Friction stir spot welding c) Friction stir surfacing d) Miscellaneous welding

4) Briefly mention the principle of Friction stir welding (FSW) process .

A constantly rotated non-consumable cylindrical-shouldered tool with a profiled probe is transversely fed at a constant rate into a butt joint between two clamped pieces of butted material. The probe is slightly shorter than the weld depth required, with the tool shoulder riding atop the work surface.

Frictional heat is generated between the wear-resistant welding components and the work pieces. This heat, along with that generated by the mechanical mixing process and the adiabatic heat within the material, cause the stirred materials to soften without melting. As the pin is moved forward, a special profile on its leading face forces plasticised material to the rear where clamping force assists in a forged consolidation of the weld.

This process of the tool traversing along the weld line in a plasticised tubular shaft of metal results in severe solid state deformation involving dynamic recrystallization of the base material.

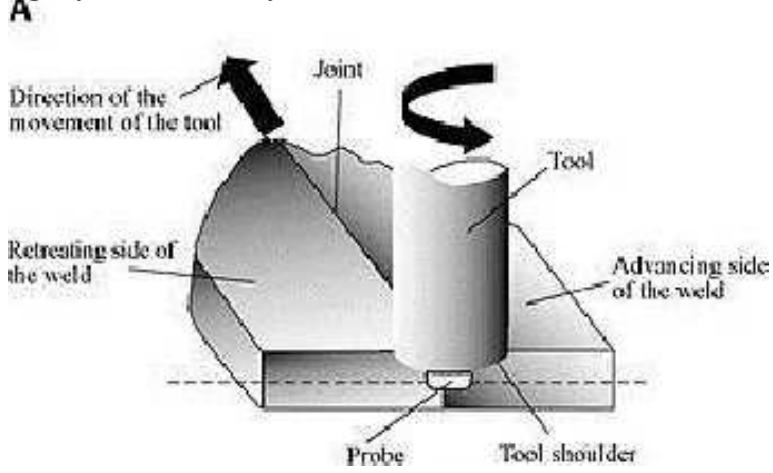
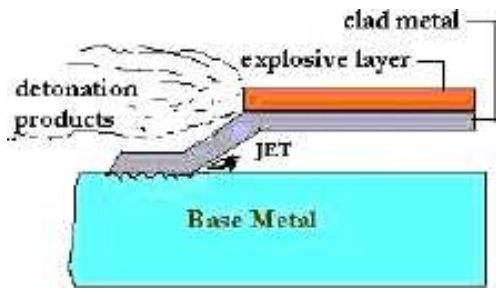


Fig. 1.Schematic of FSW

5) Mention the principle of explosive welding.



Explosion welding (EXW) is a solid state (solid-phase) process where welding is accomplished by accelerating one of the components at extremely high velocity through the use of chemical explosives. This process is most commonly utilized to clad carbon steel plate with a thin layer of corrosion resistant material (e.g., stainless steel, nickel alloy, titanium, or zirconium). Due to the nature of this process, producible geometries are very limited. They must be simple. Typical geometries produced include plates, tubing and tubesheets.

Fig. 2 Schematic of explosive welding

6) What is phenomenon of 'surface jetting'?

Welds made with collision velocities above the critical value have a wavy interface as shown in figure. Welding such an interface have better mechanical properties than those with flat interface. In such welds, a phenomenon known as surface jetting is also observed so that a small jet of metal is formed from the two impacting components. Such a jet is freely expelled at the edge of the joint, however, if it is trapped it results in rippling effect.

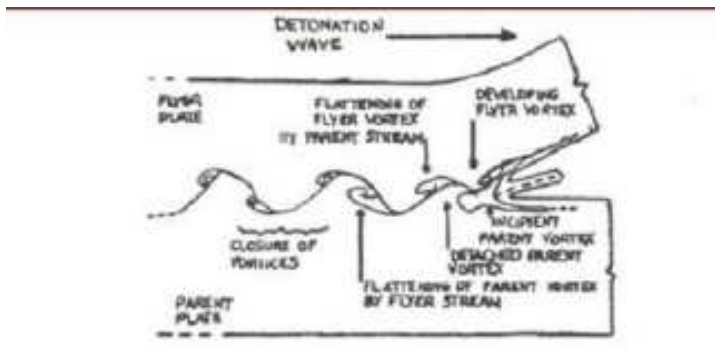


Figure3 . Surface Jetting

7) List the basic components involved in Explosion welding process.
The basic components in this process are:
1. Target plate 2. Flyer plate 3. Buffer plate 4. Explosive or detonator

8) State the process variables in explosive welding process.
The process variables in explosive welding process are 1) Impact velocity 2) Stand-off distance 3) Angle of approach.

9) List the applications of explosive welding process.

- The explosive welding are used for making lap joints
- Aluminium and Copper can be welded to stainless steel, Aluminium to Nickel alloy, Stainless steel to Nickel.
- Cladding of plates and cylinders
- Can weld metals which are incompatible for fusion welding.
- Fabrication of heat exchangers
-

10) State the principle of diffusion welding.
Diffusion welding (DFW) is a solid state welding process by which two metals (which may be dissimilar) can be bonded together. Diffusion involves the migration of atoms across the joint, due to concentration gradients.

11) Write down the applications of diffusion welding.
DFW is usually used on sheet metal structures. Typical materials that are welded include titanium, beryllium, and zirconium. It is usually used on low volume workpieces mainly for aerospace, nuclear, and electronics industries. In many military aircraft diffusion bonding will help to allow for the conservation of expensive strategic materials and the reduction of manufacturing costs. Some aircraft have over 100 diffusion-bonded parts, including; fuselages, outboard and inboard actuator fittings,landing gear trunnions, and nacelle frames.

12) Define cold welding process.
Cold welding or contact welding is a solid-state welding process in which joining takes place without fusion/heating at the interface of the two parts to be welded. Unlike in the fusion-welding processes, no liquid or molten phase is present in the joint. It was then discovered that two clean, flat surfaces of similar metal would strongly adhere if brought into contact under vacuum. Newly discovered micro and nano-scale cold welding has already shown great potential in the latest nanofabrication processes.

13) Mention the applications of Cold welding process.
Perhaps the greatest use of cold pressure welding has been for joining of wire, foil to wire, wire to bi-metals, and sealing of heat sensitive containers such as those containing explosives (detonators for example). Rod coils are butt welded to permit continuity in post-weld drawing to smaller diameters. In the electronics industry, cold welding processes are used to seal tin plated steel crystal cans and copper packages for heat sensitive semiconductor devices. Glass packages are also sealed using an indium or tin alloy interlayer.

An interesting application of the process is underground wire servicing where joins need to be made in hostile environments, such as in the presence of explosive gases.

14) Define 'Forge welding' process.
Forge welding (FOW) is a solid-state welding process that joins two pieces of metal by heating them to a high temperature and then hammering them together. It may also consist of heating and forcing the metals together with presses or other means, creating enough pressure to cause plastic deformation at the weld surfaces. The process is one of the simplest methods of joining metals and has been used since ancient times. Forge welding is versatile, being able to join a host of similar and dissimilar metals.

15) State the principle of 'Ultrasonic Welding' process.

Ultrasonic-welding is a solid state process. It achieves the joining of metals or plastics by locally applying vibratory energyto workpieces pressed together. The energy of vibration produces a local relativeparallel displacement at the interface between two metal abutting surfaces. The motion breaks and disperses surface oxides and causes intimate metal to metal contact that results in a weld.

16) List the applications of Ultrasonic welding process.

- Wire terminations and splicing in electrical and electronics industry - Eliminates need for soldering
- Assembly of aluminum sheet metal panels
- Welding of tubes to sheets in solar panels
- Assembly of small parts in automotive industry
-

17) State the components in the Ultrasonic welding process.

An Ultrasonic-welding system includes:

- an electronic power supply that elevates the frequency of the electrical current [from that of the grid to that required by the process, typically from 15 to 40 kHz (kilo Hertz)].
- a piezoelectric transducer that transforms electrical into mechanical energy.
- an acoustic coupling device or booster that modifies the shape and magnitude of the vibrations, and
- a weld tool called horn or sonotrode that transmits the oscillations to the materials to be welded, clamped together by pressure unto the stationary anvil.
-

18) Mention the process parameters in the Ultrasonic welding process.

Some of the process parameters are : 1) **Amplitude 2) Downspeed 3) Alignment/leveling of horn 4) Welding/hold force 5) Trigger force 6)** welding mode

20) List the materials that can be welded in the Ultrasonic Welding process.

Ultrasonics can also be used to weld metals, but are typically limited to small welds of thin, malleable metals, e.g. aluminum, copper, nickel.

21) What is 'Roll welding' process ?

Roll-welding, also called Roll Bonding, is a process that joins together a stack of sheets or plates.
The stack is fed through a cold rolling mill under sufficient pressure to produce significant deformation and solid state welding. Metals should be ductile, like copper, aluminium, low carbon steel, nickel.

UNIT IV OTHER WELDING PROCESS

1) Write the principle of operation of thermit welding process.

Thermit welding is based on casting and foundry practice and consists essentially of providing, by means of chemical reaction, a volume of molten weld metal which is poured into the joint to be welded

2) Mention the different types of thermit mixtures.

The different types of thermit mixtures are

1. Plain thermit
2. Mild steel thermit
3. cast iron thermit
4. thermit for welding rails
5. thermit for welding electric connections

3) State the advantages and limitations of thermit welding process.

Advantages:

1) Heat required for welding is obtained from the chemical reaction of the hermit mixture. Hence, no costly power supply is required.

2) The process is best suitable, particularly in remote locations where sophisticated welding equipments and power supply cannot be arranged.

Limitations:

1).thermit welding is applicable only to ferrous metal part of heavy sections

2). The process is not economical if used to weld cheap metals or light parts

4) List the uses and applications of thermit welding.

Thermit welding is mainly used in repair and welding of large forgings and castings, pipes, mill housings and heavy rail sections.

5) What is the principle of Atomic Hydrogen Welding?

Atomic hydrogen welding (AHW) is an arcwelding process that uses an arc between two metal tungsten electrodes in a shielding atmosphere of hydrogen. The process was invented by Irving Langmuir in the course of his studies of atomic hydrogen**.**

6) State the different equipments in the atomic welding process.

The equipments are : 1) Welding torch with tungsten electrodes and cable 2) Hydrogen gas supply 3) AC power source

7) List the advantages and disadvantages of the Atomic Hydrogen Welding (AHW).

The advantages are :

1) High concentration of heat makes qui9ck weld
2) Work can be easily moved, without extinguishing, since 2 tungsten electrodes maintain the arc.
3) No flux is used
4) Uniform dense, dense, ductile welds can be produced

The disadvantages are :

1) Less welding speed compared to MIG welding
2) Uneconomical
3) Process cannot be used for depositing large quantities of metals

8) Mention the radiant energy process used for welding.

The radiant energy welding process are 1) Electron Beam Welding (EBW) 2) Laser Beam Welding (LBW)

9) State the principle of electron welding process.

Workpiece are joined together by the heat obtained from a high velocity electron beam impinging On the work piece

10) Mention the sequence of Electron Beam Welding (EBW) .

The sequence is as follows 1) Joint preparation 2) Workpiece cleaning 3) Fixturing of workpiecec 4) Workpiece demagnetization 5) Settin up workpieces 6) Pump down 7) Pre-heating of workpiecec 8) Weld schedule 9) Welding

11) List the different types of environment in which EBW is carried out.

The different types of environment are: 1) Hard vacuum 2) Partial vacuum 3) Atmosphere

12) Compare vacuum and atmospheric welding systems in EBW.

S.No	Vaccum welding	Atmospheric welding
1	Vaccum welding assures degasification and decontamination	Inert gas shielding protects the molten weld
2.	Size of the weld depends on the size of the vacuum	Considerably wider welds are produced. Large workpiece can be welded
3.	Metal vapours obstruct the free passage of the beam.	Metal vapours do not spoil the beam gun
4.	Time taken for setting is more.	Time taken is comparitvely less.

13) State the equipments in EBW equipment.

1) Electron beam gun
   *Tungsten filament *Cathode
   *Anode *Focusing coil
2) Vacuum pumping system
   *work chamber
   *vacuum pump

14) What are the safety precautions to be taken for electron beam welding?

Protection must be provide against
1) The electron beam itself
2) The high voltages involved in generating the electron beam
3) X-rays produced by impinging of the beam on the workpiece

15) List the process variables in EBW.

Variables that control electron beam welding are
1) Accelerating voltage 2) Beam current
3) Distance from gun to work 4) Focusing current

16) Mention the advantages of Electron Beam Welding.

1) No filler metal is required
2) Clean weld is produced
3) The process yields high penetration
4) Penetration can be easily controlled by accelerating beam voltage, beam current &beam focus

17) State the principle of Laser Beam Welding (LBW).

Welding process wherein coalescence is produced by the heat obtained from the application of a concentrated coherent light beam impinging upon the surfaces to be joined.

18) List the different types of lasers used for LBW.

1) Ruby laser 2) Gas laser
3) Liquid laser 4) Semi-conductor laser

19) Mention the advantages and disadvantages of LBW.

Advantages:
1) Weld can be made inside transparent glass or plastic housings
2) Areas not readily accessible can also be welded
3) It is possible to weld heat treatment alloys without affecting their heat treatment condition

4) Unlike electron beam it operates in air, no vacuum is required

Disadvantages:

1) The major drawback to laser beam welds is the slow welding speeds
2) Materials such as magnesium tends to vaporize and produce severe surface voids

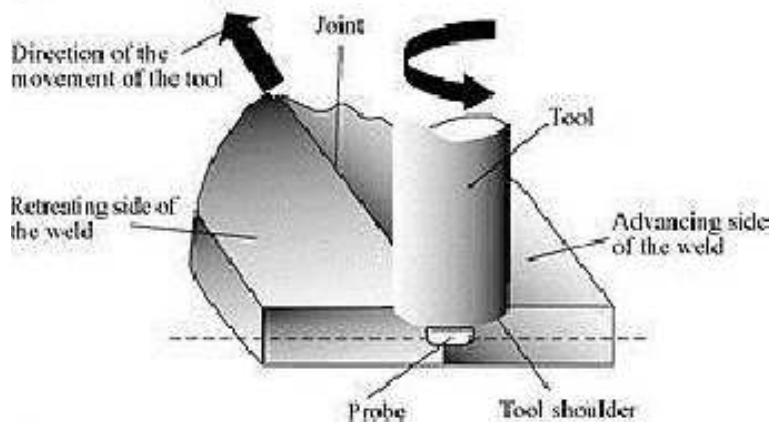
20) What are the applications of Laser Beam Welding (LBW) ?

1) Laser is high energy light beam that can both weld and cut metals
2) For connecting leads on small electronic components and in integrated circuitry in the electronic industry
3) To join hard high melting point metal alloys
4) In space and aircraft industry for welding light gauge materials

21) Briefly mention the principle of Friction stir welding (FSW) process .

A constantly rotated non-consumable cylindrical-shouldered tool with a profiled probe is transversely fed at a constant rate into a butt joint between two clamped pieces of butted material. The probe is slightly shorter than the weld depth required, with the tool shoulder riding atop the work surface. Frictional heat is generated between the wear-resistant welding components and the work pieces. This heat, along with that generated by the mechanical mixing process and the adiabatic heat within the material, cause the stirred materials to soften without melting. As the pin is moved forward, a special profile on its leading face forces plasticised material to the rear where clamping force assists in a forged consolidation of the weld. This process of the tool traversing along the weld line in a plasticised tubular shaft of metal results in severe solid state deformation involving dynamic recrystallization of the base material.

A



22) **23)** Fig. 1.Schematic of FSW\

22) List the different types of underwater welding process.

i. Dry welding
ii. Wet welding

23) What is 'hyperbaric' welding?

Hyperbaric welding is the process of welding at elevated pressures, normally underwater. Hyperbaric welding can either take place *wet* in the water itself or *dry* inside a specially constructed positive pressure enclosure and hence a dry environment. It is predominantly referred to as "hyperbaric welding" when used in a dry environment, and "underwater welding" when in a wet environment. The applications of hyperbaric welding are diverse—it is often used to repair ships, offshore oil platforms, and pipelines. Steel is the most common material welded.

24) State the principle of cavity welding.

- Cavity welding is another approach to weld in water free environment.
- Conventional arrangements for feeding wire and shielding gas
- Introducing cavity gas and the whole is surrounded by a trumpet shaped nozzle through which high velocity conical jet of water passes.
- It avoids the need for a habitat chamber and it lends itself to automatic and remote control.
- The process is very suitable for flat structures.

25) What are the characteristics of a good underwater welding process?

1)Associate inexpensive welding equipments and low welding cost
2)Decreased electrical hazards
3) Permit good visibility

4) Easy operation
5)Produce good quality wleds
6) Permit welding in all positions

26) List the applications of underwater welding process.

The following are the applications

- Offshore construction for tapping sea resources.
- Temporary repair work caused by ship's collisions, or unexpected accidents.
- Salvaging vessels sunk in the sea.
- Construction of large ships beyond the capacity of existing docks.
- Maintenance of oil rigs.

27) What are the three basic functions of automation?

The basic functions are 1)Physical function
2) Programming function
3) Control function

27) Classify welding automation.

The four welding automations are

1) Welding mecahnization
2) General Purpose welding automation
3) Welding programming automation
4) Welding or motion programming automation (Robotics)

28) What are the benefits of automation in welding?

The advantages are :

1) Consistent weld quality
2) Reduced variable welding cost
3) Predictable welding production rates
4) Increased arc time
5) Lower parts cost

UNIT V – DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS

1. What are the requirements of joint design ?

The requirments of joint design are :

1) Control distortion
2) Minimize residual stresses
3) Facilitate good workmanship
4) Achieve proper weld strength
5) Reduce welding cost
6) Result in greater reliability

2. Mention the considerations for joint design.

The important considerations are 1)Safety 2) Service 3) Quality 4) Cost or economy

3. List the different types of welding joints.

Five types of welding joints 1) butt, 2) corner, 3) edge, 4) lap, and 5) Tee

4. Mention the types of Butt joint.

The types are as follows:

1) Square 2)Single Vee 3) Single bevel 4) Single J 5) Single U 6) Double Vee 7) Double bevel 8) Double J 9) Double U

5. List the types of corner joint.

The types are 1) Full open corner joint 2) Half open corner joint 3) Closed corner joint

6. Mention any four characteristics of lap joint.

The following are the characteristics of lap joint :

1) Single fillet and double fillet joints are used on all thickness
2) Double fillet joint is better as compared to single fillet when the joint is subjected severe loading
3) Single fillet joints are not not recommended on plates under bending, fatigue or impact loading condition.

7. What is a plug weld?

A plug weld is used to fasten two pieces of metal together using a welder. When joining the pieces, a hole is drilled into the top piece and it is laid over the bottom one. A weld is then made by running a bead inside of the drilled hole, thereby holding the two pieces together. When doing auto body repair, this type of weld is often used when replacing body panels. The finished result resembles a spot weld in that it is circular.

8. Define the term fillet welds.

Fillet welding refers to the process of joining two pieces of metal together whether they be perpendicular or at an angle. These welds are commonly referred to as Tee joints which are two pieces of metal perpendicular to each other or Lap joints which are two pieces of metal that overlap and are welded at the edges.

9. What are the factors considered for locating weld joints?

The following are the factors:

1) Economic layout and preparation and low scrap loss in material
2) Accessibility of joint
3) The possibilities of subassembly.
4) Appearance
5) Shrinkage and distortion
6) Ease of assembly with simplicity in fixtures.

10. Mention the parameters for selection of welding joints.

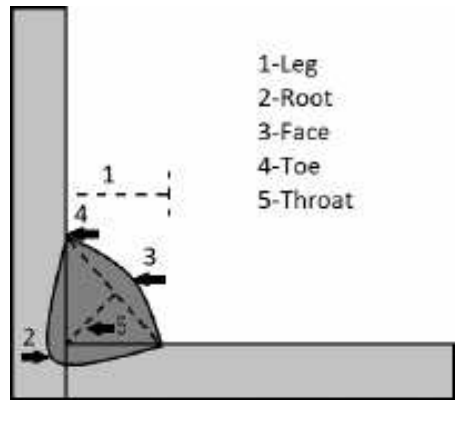
1) Current
2)Length of arc
3)Angle
4) Manuplation speed

11. List the various factors affecting the strength of a welded joint.

The following are the factors affecting the strength of welding :
1) Type of joint and weld 2) Size of weld 3) Location of the weld to the parts joined 4) Strength of the deposited weld metal 5) skill of welder 6) Type of equipment used for welding

12. What is weld throat?

The throat of the weld is the distance from the center of the face to the root of the weld. Typically the depth of the throat should be at least as thick as the thickness of metal you are welding.



Fillet welding refers to the process of joining two pieces of metal together whether they be perpendicular or at an angle. These welds are commonly referred to as Tee joints which are two pieces of metal perpendicular to each other or Lap joints which are two pieces of metal that overlap and are welded at the edges.

13. Classify aluminium alloys.

The classification of aluminium alloys are
1)Wrought alloy 2) Cast alloys

14. Mention the welding process used for aluminium and its alloys.

1) Aluminium does not show any colour change on heating andf out of experience 2)Aluminium has got high coefficient of linear expansion
3)Aluminium is weak when hot and thus extra care is required

15. List the solid state welding process used for welding aluminium alloys.

The different types of solid state welding are 1) cold welding 2) explosive welding 3)Diffusion welding 4)Ultrasonic welding.

16. Why Aluminium castings undergo welding process?

The reasons for Aluminium castings:

a. Correct foundry defects
b. Repair castings broken in service.

17. State the variables affecting the welding characteristics of copper alloys.

The following are the variables affecting the characteristics:

a. Higher thermal conductivity
b. Thermal expansion
c. Susceptibility for hot cracking
d. Oxidation
e. Fluidity of molten copper

18. Mention the welding process used for welding copper.

The High thermal conductivity Of Copper Means That Not Only Are High Heat Input Shielding Gases Required Thickness Increase But Preheat Necessary At Section Thickness Exceeding 2mm A Very Rough Guide Recommended Pre Heat And Welding Current Levels Is Given In The Table For Tig And Mig Welding

19. List the welding process used for joining brass material.

The welding process are : 1) TIG welding 2) MIG welding 3) Shielded Metal arc welding 4) Oxy acetylene gas welding

20. Mention the different groups of stainless steels.

1)Ferritic stainless steel
2)Martensitic stainless steel
3)Duplex stainless steel
4)Austenitic stainless steel

21. List the weldability considerations for austenitic stainless steels.

Following are the weldability considerations for austenitic stainless steels:
1)Electrical resistance
2) Melting point
3) Thermal conductivity
4) Thermal expansion

22. Mention the methods used for welding straight chromium (Ferritic and martensitic) stainless steels.

Following are the methods of welding Ferritic and martensitic stainless steels

a. Shielded Metal Arc welding
b. TIG welding
c. MIG welding
d. Submerged Arc welding
e. Resistance welding

23. List the weldability considerations for austenitic stainless steels.

1. Most stainless steels are considered to have good weldability and may be

welded by several welding processes including the arc welding processes, resistance welding, electron and laser beam welding, friction welding and brazing.

2. The coefficient of thermal expansion for the austenitic types is 50%greater than that of carbon steel and this must be considered to minimize distortion.

3. The low thermal and electrical conductivity of austenitic stainless steel is generally helpful in welding.

24. List the destructive testing methods of weldments.

1. Macro Etch Testing
2. Fillet Weld Break Test
3. Transverse Tension Test
4. Guided Bend Test

25. Why is testing and inspection carried out after the jobs?

Workplace inspections help prevent injuries and illnesses. Through critical examination of the workplace, inspections identify and record hazards for corrective action. Joint occupational health and safety committees can help plan, conduct, report and monitor inspections. Regular workplace inspections are an important part of the overall occupational health and safety program.

26. Why is Guide bend test done?

The bend test is a simple and inexpensive qualitative test that can be used to evaluate both the ductility and soundness of a material. It is often used as a quality control test for butt-welded joints, having the advantage of simplicity of both test piece and equipment.

27. What the different types are of etch test?

The different types are of etch test are

1. Macro-etch test
2. Micro-etch test

28. List the defects identified from Macro-etch test.

i. Cracks
ii. Slag inclusion
iii. Blowholes
iv. Shrinkage porosity
v. Penetration of the weld

29. List the methods of Non-destructive testing.

1. AET - Acoustic Emission Testing
2. ART - Acoustic Resonance Testing
3. ET - Electromagnetic Testing
4. IRT - Infrared Testing
5. LT - Leak Testing
6. MT - Magnetic Particle Testing
7. PT - Dye Penetration Testing
8. RT - Radiographic Testing
9. UT - Ultrasonic Testing
10. VT - Visual Testing (VI - Visual Inspection)

30. Why is stethoscopic test done?

The stethoscope is an instrument used for auscultation, or listening to sounds produced by the body. It is used primarily to listen to the lungs, heart, and intestinal tract. It is also used to listen to blood flow in peripheral vessels and the heart sounds of developing fetuses in pregnant women.

31. Mention the principle involved in Radiography test.

Radiographic Testing (RT), or industrial radiography, is a nondestructive testing (NDT) method of inspecting materials for hidden flaws by using the ability of short wavelength electromagnetic radiation (high energy photons) to penetrate various materials.

In radiographic testing, the part to be inspected is placed between the radiation source and a piece of radiation sensitive film. The radiation source can either be an X-ray machine or a radioactive source (Ir-192, Co-60, or in rare cases Cs-137).

32. State the principle of ultrasonic testing.

Ultrasonic Testing (UT) uses high frequency sound energy to conduct examinations and make measurements. Ultrasonic inspection can be used for flaw detection/evaluation, dimensional measurements, material characterization, and more. To illustrate the general inspection principle, a typical pulse/echo inspection configuration as illustrated below will be used.

33. What is eddy current test?

Eddy-current testing (also commonly seen as eddy current testing and ECT) is one of many electromagnetic testing methods used in nondestructive testing (NDT) making use of electromagnetic induction to detect and characterize surface and sub-surface flaws in conductive materials.

34. List the advantages and limitations of eddy current test.

The advantages are

i. Sensitivity to surface defects..
ii. Can detect through several layers.
iii. Can detect through surface coatings
iv. Accurate conductivity measurements.
v. Can be automated.
vi. Little pre-cleaning required.
vii. Portability.

The Limitations are

i. Very susceptible to magnetic permeability changes.
ii. Only effective on conductive materials.
iii. Will not detect defects parallel to surface.
iv. Not suitable for large areas and/or complex geometries
v. Signal interpretation required.
vi. No permanent record (unless automated