

**Model Answer**  
**End-Sem Examination-II, Winter 2025**

Academic Year: 2025-26	Semester: II
Class: F.Y.	Program: B.Tech
Branch Code:FYE	Pattern:2023
Name of Course: Joining Processes	Course Code: 2300118G

---

**Q.1 Classify welding processes based on the state of metal during joining.**

Welding processes can be classified into **two major categories**:

**1. Fusion Welding / Liquid-State Welding**

In this type, the **base metal is melted** at the joint. Filler material may or may not be used.

Examples:

- Gas Welding (Oxy-acetylene)
- Arc Welding (SMAW, TIG, MIG)
- Laser Beam Welding
- Electron Beam Welding
- Thermit Welding

**2. Solid-State Welding**

The metals are joined **without melting**; pressure and sometimes heat are used.

Examples:

- Forge Welding
- Friction Welding
- Ultrasonic Welding
- Diffusion Welding
- Cold Welding

**Q.2 (06 Marks) Explain soldering and its advantages and limitations.**

**Soldering:**

Soldering is a **low-temperature joining process** (below 450°C) in which two metals are joined using a filler metal called **solder** (usually Sn–Pb or lead-free alloys). It depends on **wetting and capillary action**.

**Advantages (Any Two)**

- Low temperature → no distortion of parts.
- Simple equipment and easy operation.

- Suitable for joining thin sheets and delicate components.
- Produces clean joints with good appearance.

### **Limitations (Any Two)**

- Low joint strength → not for heavy loads.
- Not suitable for high-temperature applications.
- Requires clean surfaces.
- Joints are less durable compared to welding/brazing.

**Q.3(a) Apply suitable methods to identify common welding defects on a welded plate. Explain your approach.**

### **Model Answer – Methods to identify defects:**

1. **Visual Inspection**
  - Detect surface defects: cracks, undercut, overlap, porosity.
2. **Dye Penetrant Test (DPT)**
  - Reveals surface-breaking defects such as cracks and pinholes.
3. **Magnetic Particle Testing (MPT)**
  - Detects surface and slightly subsurface defects in ferromagnetic materials.
4. **Radiographic Testing (X-ray)**
  - Identifies internal defects like blowholes, porosity, slag inclusions.
5. **Ultrasonic Testing (UT)**
  - Detects internal defects using high-frequency sound waves.

### **Approach:**

- Start with **Visual Inspection** for quick detection.
- Apply **DPT/MPT** for surface cracks and undercuts.
- Use **radiography or ultrasonics** for internal porosity, inclusions, or cracks.
- Compare findings with **welding standards (AWS/IS codes)** to judge severity.

**OR**

**(b) Apply destructive testing methods to check the quality of a welded specimen.**

### **Destructive Tests Used:**

1. **Tensile Test** – Determines ultimate tensile strength of welded joint.
2. **Bend Test** – Checks ductility and weld soundness.
3. **Impact Test** – Measures toughness of heat-affected zone (HAZ).
4. **Macro/Micro Examination** – Reveals weld structure, penetration, defects.
5. **Hardness Test** – Identifies changes in weld and HAZ hardness.

### **Application:**

- Prepare test specimens as per standards.
- Conduct tests and record values.

- Compare results with acceptable ranges.
- Conclude whether weld quality meets design requirements.

**(c) Summarise any four common welding defects and explain their causes and remedies.**

### **1. Porosity**

- **Cause:** Moisture, improper shielding gas, contaminated electrodes.
- **Remedy:** Use dry consumables, clean surface, improve shielding.

### **2. Cracks**

- **Cause:** High residual stresses, rapid cooling, poor joint design.
- **Remedy:** Preheat base metal, slow cooling, proper joint design.

### **3. Undercut**

- **Cause:** Excessive current, high travel speed.
- **Remedy:** Reduce current, maintain correct angle and travel speed.

### **4. Lack of Fusion**

- **Cause:** Low heat input, improper electrode angle.
- **Remedy:** Increase heat, use correct angle, clean joint edges.

**OR**

**(d) Apply NDT techniques to detect internal porosity in welds.**

**NDT Techniques for Internal Porosity:**

- 1. Radiographic Testing (RT)**
  - X-ray/Gamma rays show internal pores as dark spots on film.
  - Best method for detecting shape, size, and location of porosity.
- 2. Ultrasonic Testing (UT)**
  - Sound waves reflect from voids.
  - Provides depth and size information.

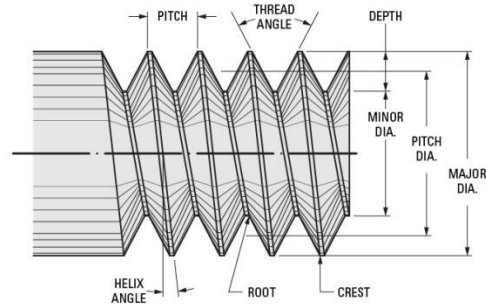
**Application:**

- Select RT for detailed pore mapping.
- UT used where radiography is difficult.
- Compare results with acceptance criteria standards.

**Q.4 (a) Apply thread terminology to check whether a bolt fits properly in a nut. What will you check?**

**Required Checks:**

1. **Major Diameter** – Outer diameter of bolt must match nut thread.
2. **Minor Diameter** – Determines core strength and clearance.
3. **Pitch Diameter** – Ensures proper fit and load distribution.
4. **Pitch** – Distance between threads must match.
5. **Thread Angle** – Standard (e.g.,  $60^\circ$  for ISO metric).
6. **Fit Class** – Tolerance class (e.g., 6g/6H).
7. **Thread Profile** – Should be free from damage/burrs.

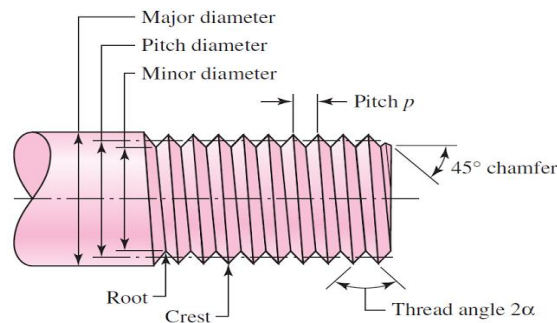


OR

(b) Identify and label major, minor, and pitch diameter of a bolt in a given diagram and explain their significance.

**Significance:**

- **Major Diameter:** Determines bolt size and maximum load capacity.
- **Minor Diameter:** Affects tensile stress area.
- **Pitch Diameter:** Governs tightness and accuracy of fit.



**Terminology of Screw Threads**

(c) Suggest a suitable locking device to prevent loosening of a bolt in a vibrating machine.

**Suitable Locking Devices:**

- **Spring Washer** – Provides tension to prevent loosening.
- **Lock Nut / Jam Nut** – Two nuts tightened together.
- **Castle Nut with Cotter Pin** – Mechanical locking.
- **Nyloc Nut** – Nylon insert prevents vibration loosening.
- **Split Pin / Locking Plate** – Positive locking.

**Explanation:**

These devices prevent rotation caused by vibration by adding friction or mechanical locking.

**OR**

**(d) Compare lap joint and butt joint with suitable sketch.**

<b>Parameter</b>	<b>Lap Joint</b>	<b>Butt Joint</b>
<b>Definition</b>	Two plates overlap each other and are welded.	Two plates are placed edge-to-edge and welded.
<b>Plate Arrangement</b>	Plates are <b>overlapped</b> .	Plates are <b>aligned in the same plane</b> .
<b>Strength</b>	Moderate; may have stress concentration.	High strength when properly penetrated.
<b>Ease of Preparation</b>	Simple, minimal edge preparation.	Requires edge preparation (beveling) for thick plates.
<b>Weld Type Used</b>	Mainly <b>fillet welds</b> .	Mainly <b>groove welds</b> .
<b>Material Usage</b>	Requires <b>extra material</b> due to overlapping.	Economical—no extra overlap required.
<b>Applications</b>	Sheet metal work, automobile bodies, thin plates.	Pressure vessels, pipelines, structural components.
<b>Appearance</b>	Not as neat due to overlap.	Cleaner finish as plates join in one plane.
<b>Load Handling</b>	Good for shear loads.	Good for tensile loads.
<b>Suitability for Thick Plates</b>	Not preferred for thick plates.	Best suited for thick plates with full penetration.

**Q.5**

**(a) Explain the steps involved in Thermit Welding and its main applications.**

**Steps in Thermit Welding:**

1. Clean the joint ends.
2. Assemble mould around joint.
3. Place thermit mixture in crucible.
4. Ignite mixture using magnesium ribbon.
5. Molten metal flows into mould and fills joint.
6. Allow solidification and remove mould.
7. Finish the welded surface.

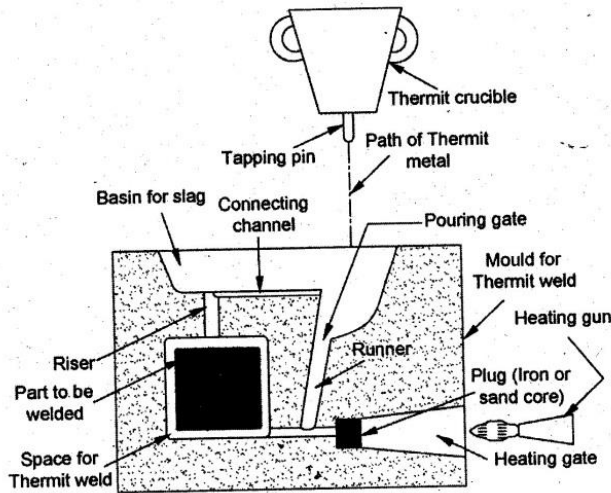


Figure 2.27 Thermit welding

**Applications:**

- Rail track joining
- Heavy section castings
- Repair of broken machine frames
- Large structural members

**OR**

**(b) Compare Laser Beam Welding and Electron Beam Welding.**

<b>Laser Beam Welding (LBW)</b>	<b>Electron Beam Welding (EBW)</b>
Uses laser light energy	Uses high-velocity electrons
Works in air	Requires vacuum
Lower penetration	Very deep penetration
Suitable for reflective metals	Limited for highly reflective materials
Less equipment cost	Expensive due to vacuum chamber

**(c) Describe at least four industrial applications of modern welding processes.**

**Applications:**

1. **Aerospace:** Titanium, aluminum alloy welding.
2. **Automotive:** Body panels (MIG/Spot Welding).
3. **Electronics:** Micro-joining using laser/EBW.
4. **Shipbuilding:** Large steel structure welding.
5. **Railways:** Thermit welding for rails.
6. **Nuclear Industry:** High-precision EBW.

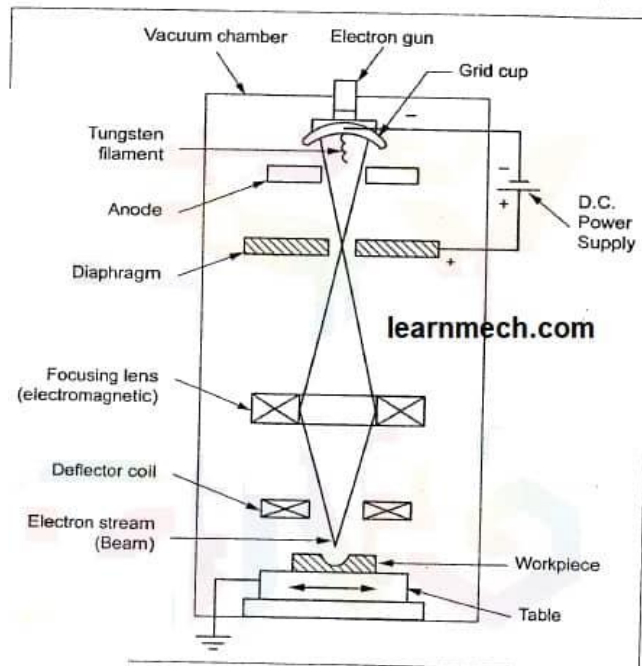
*(Any four explained.)*

OR

(d) Explain the working principle of Electron Beam Welding (EBW) with a neat diagram.

**Working Principle:**

- Electrons are emitted from a heated cathode.
- Accelerated using high voltage (30–175 kV).
- Focused into a narrow beam by electromagnetic lenses.
- Beam strikes the workpiece → kinetic energy converts to heat.
- Deep, narrow weld produced in vacuum.



*Arrangement of Electron Beam Machining*

-----End-----