Duralumin – 16 Marks Answer

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1. Introduction

- **Duralumin** is a **lightweight and strong alloy of aluminum**.
- It is made by mixing **aluminum (90–95%)** with **copper, manganese, and magnesium**.
- It was **developed in Germany** and is used widely in **aerospace and transportation**.

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2. Properties / Characteristics

- **Lightweight** – much lighter than steel.
- **High strength-to-weight ratio** – good for aircraft.
- **Corrosion-resistant** (but needs coating in marine use).
- **Good machinability** – easy to cut and shape.
- **Non-magnetic and conductive**.
- **Hardens with age** – known as **age-hardening** or **precipitation hardening**.

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3. Composition

Element	Approximate %
Aluminum (Al)	90–95%
Copper (Cu)	3–5%
Manganese (Mn)	~0.5%
Magnesium (Mg)	~0.5%

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4. Synthesis / Preparation

- Made by **melting aluminum** and mixing copper, magnesium, and manganese in required ratios.
- The alloy is **cast into blocks** and then **heat-treated** to improve strength.
- **Aging process** increases its hardness (natural or artificial aging).

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5. Applications

- **Aircraft and aerospace industry** – structural parts like wings and fuselage.
- **Automobile parts** – for lightweight strength.
- **Bicycle frames**.
- **Building structures** – bridges, doors, windows.
- **High-speed trains and boats**.
- **Military equipment** – tanks, armor plates.

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6. Advantages

- **High strength but light** – perfect for aircraft and transport.
- **Better than pure aluminum** in terms of mechanical strength.
- **Good conductor** – suitable for electric components.
- **Easy to machine and shape**.

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7. Disadvantages

- **Less corrosion resistance** than pure aluminum.
- Needs **protective coating** or **anodizing** in moist or salty environments.
- **Not weldable** easily – can weaken at the joints.
- **Expensive** compared to mild steel or pure aluminum.

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9. Summary

- Duralumin is a **light, strong, and durable aluminum alloy**.
- Composed mainly of **Al, Cu, Mg, and Mn**.
- Used in **aircrafts, vehicles, and structural parts**.
- It has both **engineering importance** and **future potential**.
