🏭🔩 Manufacturing and Production Engineering Roadmap (12 Weeks)

🗓️ Week 1: Introduction to Manufacturing Processes

- What is manufacturing? Classification of processes.
- Job, batch, and mass production systems.
- Role in mechanical industries and product life cycles.

🗓️ Week 2: Engineering Materials

- Classification: metals, polymers, ceramics, composites.
- Mechanical properties: hardness, strength, ductility, toughness.
- Material selection for manufacturing.

🗓️ Week 3: Casting Processes

- Sand casting, die casting, investment casting.
- Mold materials, pattern design, risers & runners.
- Defects in casting and their remedies.

🗓️ Week 4: Metal Forming Processes

- Rolling, forging, extrusion, drawing.
- Cold vs hot working.
- Force and power calculations, defects in formed parts.

🗓️ Week 5: Machining and Tooling

- Lathe, milling, drilling, grinding operations.
- Cutting tool materials, tool life, wear.
- Machining parameters: speed, feed, depth of cut.

🗓️ Week 6: Welding and Joining Techniques

- Arc welding, MIG/TIG welding, resistance welding.

- Soldering, brazing, adhesive bonding.
- Weld defects, inspection, and testing.

📅 Week 7: Advanced Manufacturing Technologies

- CNC machines and programming.
- EDM, ECM, Laser cutting, Waterjet machining.
- Micro and nano-manufacturing concepts.

📅 Week 8: Metrology and Quality Control

- Measurement tools: calipers, micrometers, CMM.
- Surface roughness, tolerance, fits, GD&T.
- Statistical quality control (SQC), Six Sigma basics.

📅 Week 9: Production Planning and Control

- Inventory control, routing, scheduling, dispatching.
- Gantt charts, CPM & PERT.
- Lean manufacturing, Kanban, 5S methodology.

📅 Week 10: Computer Integrated Manufacturing (CIM)

- Automation and robotics in production.
- CAD/CAM integration.
- Flexible manufacturing systems (FMS), AGVs.

📅 Week 11: Additive Manufacturing (3D Printing)

- Basics of 3D printing technologies: FDM, SLA, SLS.
- Materials used and applications.
- Design for additive manufacturing (DfAM).

📅 Week 12: Capstone Project / Industry Use Case

- Product design to production process planning.
- Case studies from automotive, aerospace, or electronics.
- Industry 4.0 concepts (smart factories, IoT in manufacturing).

🛠️ Tools & Software:

- AutoCAD, SolidWorks, MasterCAM, ANSYS
- MATLAB (for process simulation)
- ERP tools like SAP (for PPC)
