

Introduction to Thermal & Chemical Processing of Materials



ME 323: Manufacturing Processes II
Instructor: Ramesh Singh; Notes: Profs.
Singh/Melkote/Colton

Outline

- Contact details
- Course objectives
- Introductory remarks
- Grading policy
- Intro to manufacturing



Contact Details

- Prof. Ramesh Singh
- Room: Machine Tools Lab (Prof. Ramesh Singh)
 - E-mail:
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 - Tel: 7507
 - Off. Hrs.: Thursdays 3-5 p.m.
 - Also by appointment
 - Class website:

<https://www.me.iitb.ac.in/~ramesh/courses/ME323/me323.html>



Focus and Objectives of Course

- Learn the fundamentals of **solidification processing** (casting, welding, and additive manufacturing), **polymer and composite processing**, coatings, **powder processing**, and **non-conventional machining** (EDM, ECM, ECDM, EBM, laser machining, and FIB machining)
- Develop first order mathematical descriptions for select processes
- Understand the advantages and limitations of various processes in terms of quality productivity
- Apply this knowledge to manufacturing process selection, design and part quality
- Encourage teamwork and group activity via group assignments and Project.



Introductory Remarks

- See second page of syllabus
 - The course will be offered in interactive mode as recommended by TLA committee
 - Homework
 - Exams
 - Honor code (Integrity in assignments, quizzes and exams)



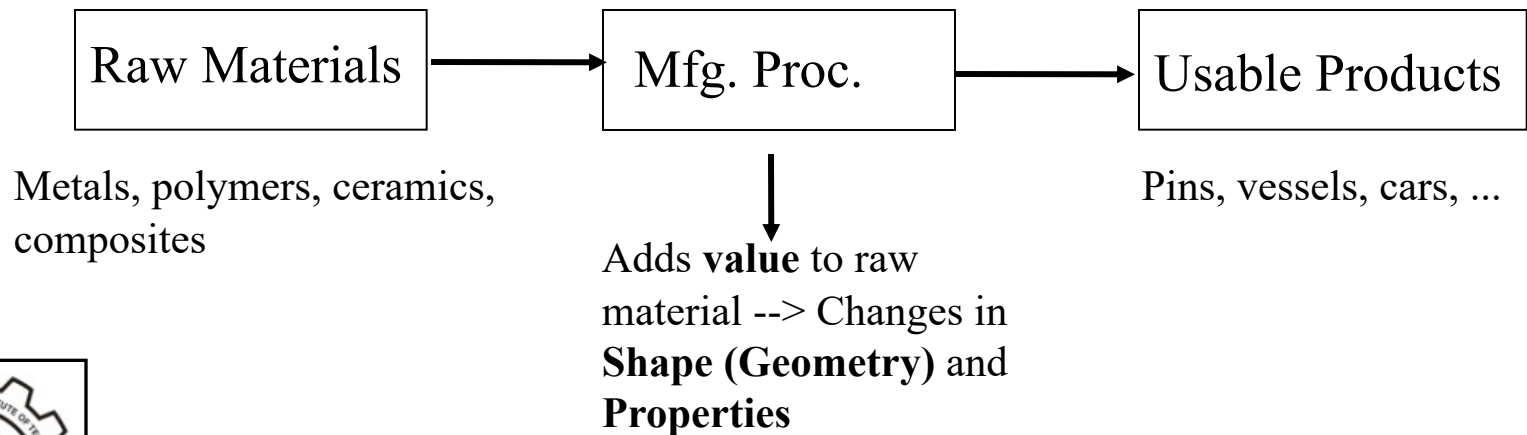
Grading Policy

- Attendance + Class participation (Mentimeter Quiz) 10%
- Assignments + Quizzes 20%
- Midterm 20%
- Project 20% (10% pre-midsem + 10% post midsem)
- End semester exam 30%
- Total 100%



Definition

- *What is Manufacturing?*
 - derived from the Latin word *manufactus*
 - *manus* = hand, *factus* = made
 - practical definition: *process of converting or processing raw materials into usable products.*



What is Materials Processing?

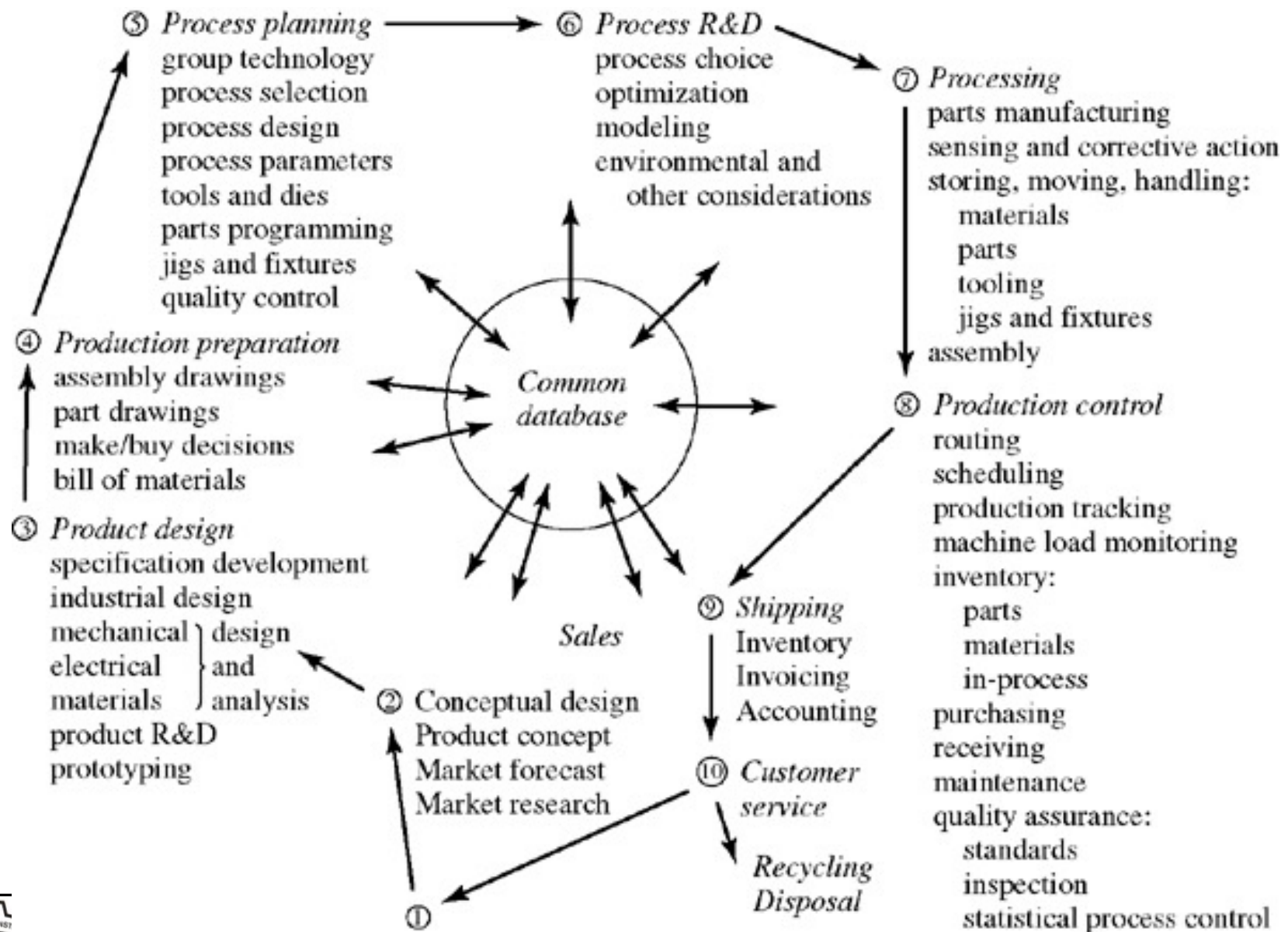
- Imparting changes in material :
 - Geometry
 - Material properties:
 - Strength
 - Hardness
 - Toughness
 - Etc.



Systems-Oriented Definition

- Manufacturing as a system or enterprise
 - “*A series of interrelated activities and operations involving design, materials selection, planning, production, quality assurance, management, and marketing of discrete consumer and durable goods*” (CAM-I)
 - a highly complex, interdependent activity that is dynamic in nature.





Design - Materials - Process Relationship

- Product design, materials selection, and materials processing are highly interrelated.
- For example:
 - weight reduction --> thin cross-sections --> mfg. problems
 - tight tolerance specs. --> specialized/high precision processes required --> increased cost
 - aluminum vs. steel beverage cans --> different metal forming needs.



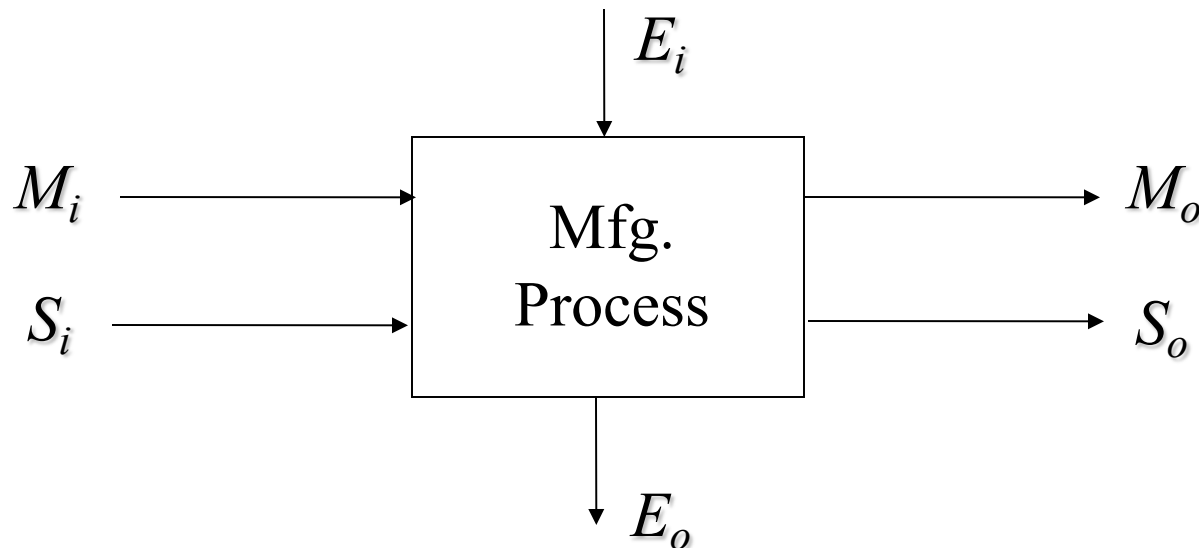
Coke Cans over the Years

0.66 oz. (18.8 g) in 60's, 0.48 oz (13.5 g) in 90's



Classification of Unit Manufacturing Processes

- Based on:
 - process type e.g., shaping vs. non-shaping
 - state of workpiece material e.g., solid or liquid
 - processing energy e.g., mechanical, electrical,...



Classification of Unit Manufacturing Processes

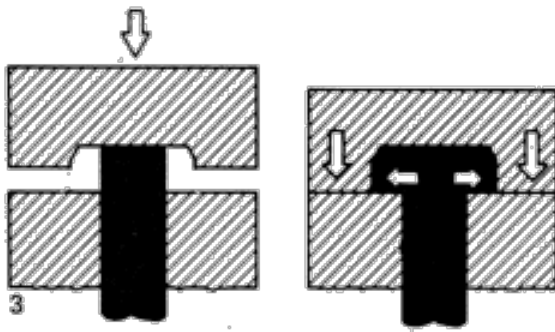
- Shaping process classification
 - Mass conserving, $dM \sim 0$
 - examples: casting, bulk forming, powder processing
 - Mass reducing, $dM < 0$
 - examples: conventional and unconventional machining
 - Mass adding, $dM > 0$
 - examples: joining processes

Further sub-classification is possible based on processing energy and workpiece state considerations





Casting ($dM \sim 0$)



Forging ($dM \sim 0$)



Cutting ($dM < 0$)



Welding ($dM > 0$)



Classification based on Energy

- Energy source
 - Thermal
 - examples: casting, welding, additive manufacturing, polymer processing, laser machining
 - Chemical
 - Chemical machining, electrochemical machining, electrochemical
 - Mechanical
 - Machining processes, deformation processing

Most of the manufacturing processes will involve thermal or mechanical energies



Summary

- Focus on:
 - Physical principles and analysis of process
 - Process Capabilities
- Teamwork will be encouraged
 - Homework
 - Term Paper



Robotic Restoration System



**Indian Institute of Technology
Bombay**



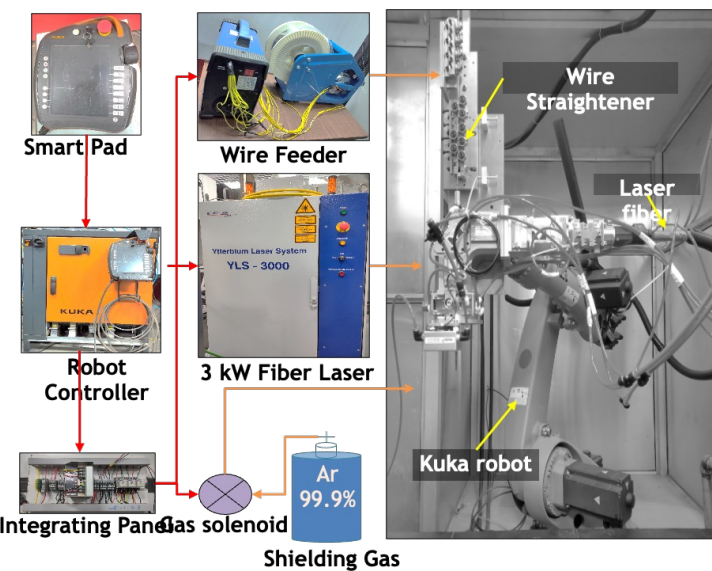
Laser Vent Cleaning



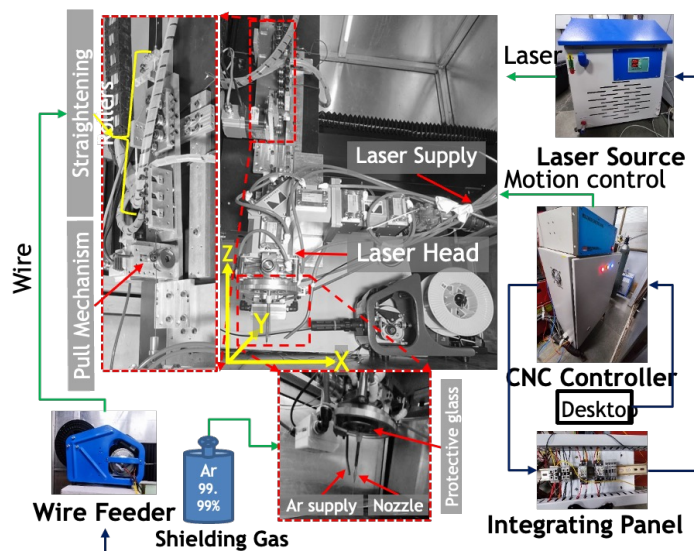
**Indian Institute of Technology Bombay
India**



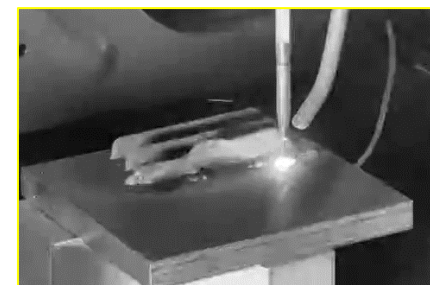
Development of Coaxial wire LDED Setups



Coaxial-WLDED-1.0: (With Robot Motion Control)



Coaxial- LDED-2.0: (With CNC Motion Control)



July 26, 2026