
ME361A – Manufacturing Science & Technology

Introduction

Lecture schedule: M, F: 8-9 am T: 9-10 am, L5

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Topics

- Brief introduction to Manufacturing Technology
- Casting
- Joining
- Non-conventional Manufacturing (e.g., Additive Manufacturing)
- Machining
- Forming
- Metrology

Suggested Readings

- Ghosh, A., Mallik, A.K., Manufacturing Science (2nd edition), EastWest Press, 2010.
- Groover, M.P, Fundamentals of Modern Manufacturing (2 nd edition), John Wiley.
- Kalpakjian, S., Schmid, S.C., Manufacturing Engineering and Technology, Pearson Education
- Galyer, J.F.W., Shotbolt, C.R., Metrology for Engineers, ELBS Class notes
- Science and Engineering of Casting Solidification, D M Stefanescu, 2nd ed.
- Principles of Metal Casting, R W Heine, C R Loper and Rosenthal, Tata McGraw Hill, New Delhi.

Grading

Theory:

Quiz 1 – 5%, Mid sem – 35%

Quiz 2 – 5%, End sem – 35%

Lab:

Lab report – 5%, Lab quiz – 10%, Feedback of supervisorial support – 5%

MAKE-UP for End-sem can be considered as per DOAA directives, and when the student has authorized leave during the end-sem exam period.

PAST INCIDENCES SHOWED THAT A STUDENT SEEKING A MAKE-UP IS USUALLY AT DISADVANTAGE.

No Make-up for Mid sem and any Quizzes (including Lab quiz)

To pass the course consolidated 40% score is required

ACADEMIC DISHONESTY

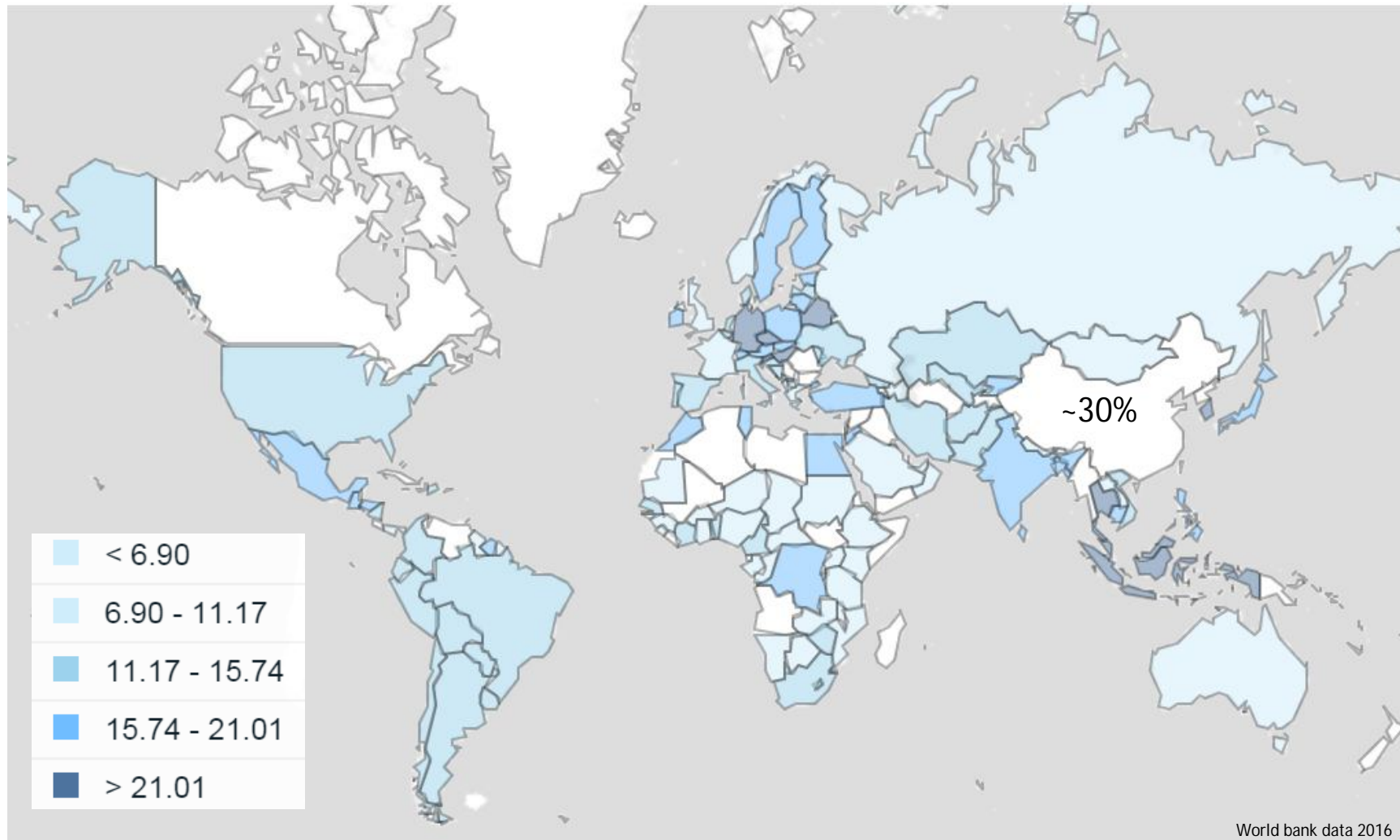
For cheating during the exam : Zero tolerance → "F" GRADE

Why manufacturing?

- Look around you
 - Everything is manufactured
- Manufacturing adds value
- Manufacturing has a multiplier effect
 - Every job added in the manufacturing sector has a multiplier effect

ME361 – is about introducing the fundamental science of manufacturing processes

Manufacturing, value added (% of GDP)



How are parts made?



Pressure cooker



Crankshaft



Impeller



Faucets

Car doors



How are parts made?



How are parts made – process identification?

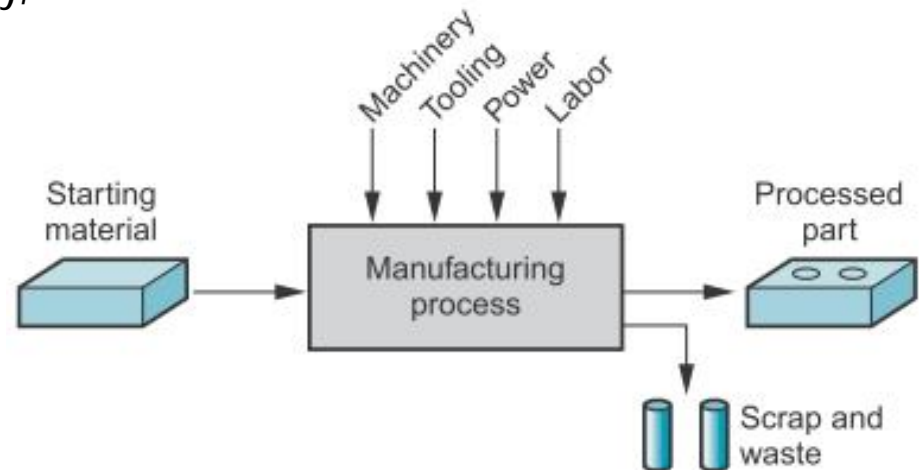
- What is the product?
 - Loads, environment, annual part volume
- What is the material?
 - Color, hardness, magnetic, surface
- Surface finish
 - Roughness, tool marks,...
- Shape?
 - Curvature, freeform, internal passages,...
- Size?
 - Thickness, aspect ratio,...

Manufacturing processes

- Bulk deformation processes
 - Casting, forging, rolling
- Joining processes
 - Welding
- Machining
 - Conventional – turning, boring, milling,...
 - Unconventional – waterjet, EDM, ECM,...
- Rapid prototyping

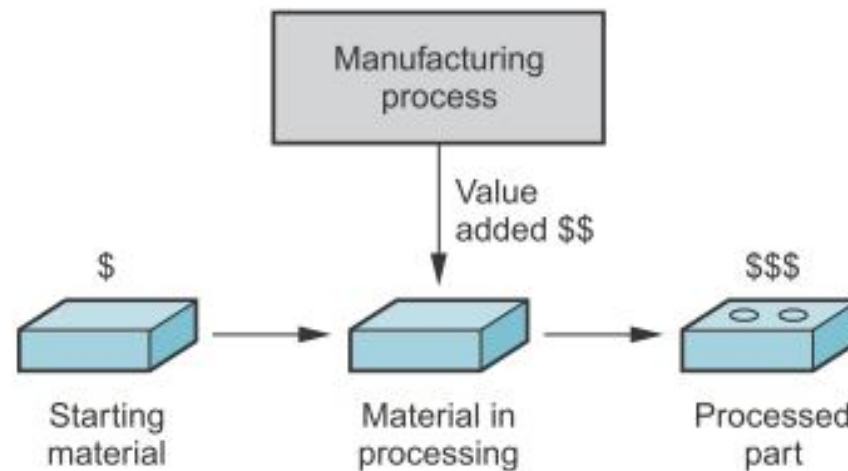
Manufacturing Defined - Technological Definition

- Application of physical and chemical processes to alter the geometry, properties, and/or appearance of a given starting material to make parts or products
- Manufacturing also includes the joining of multiple parts to make assembled products
- Accomplished by a combination of machinery, tools, power, and manual labour
- Almost always carried out as a sequence of operations



Manufacturing Defined - Economic Definition

- Transformation of materials into items of greater value by means of one or more processing and/or assembly operations
- Manufacturing adds value to the material. Examples:
 - Converting iron ore to steel adds value
 - Transforming sand into glass adds value

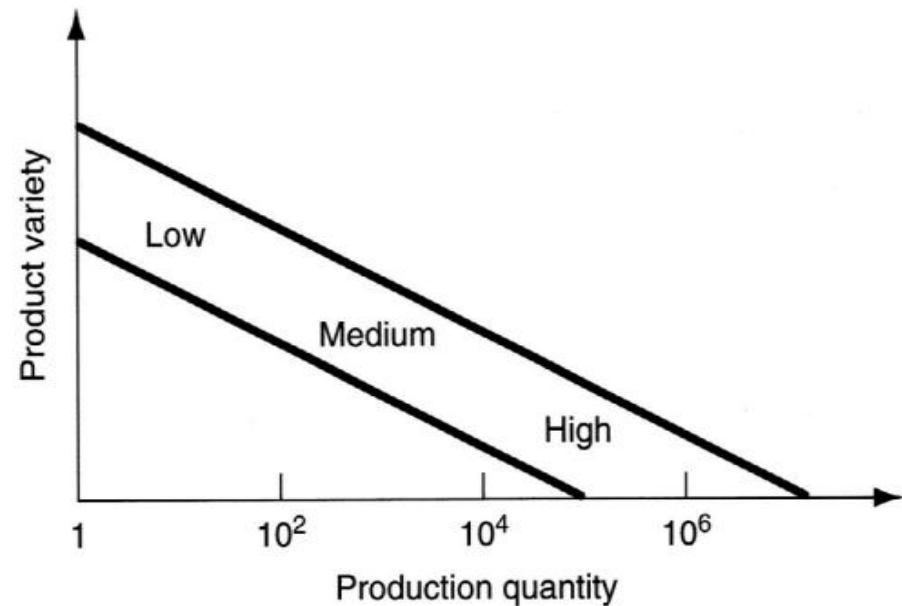


Product Creation Cycle

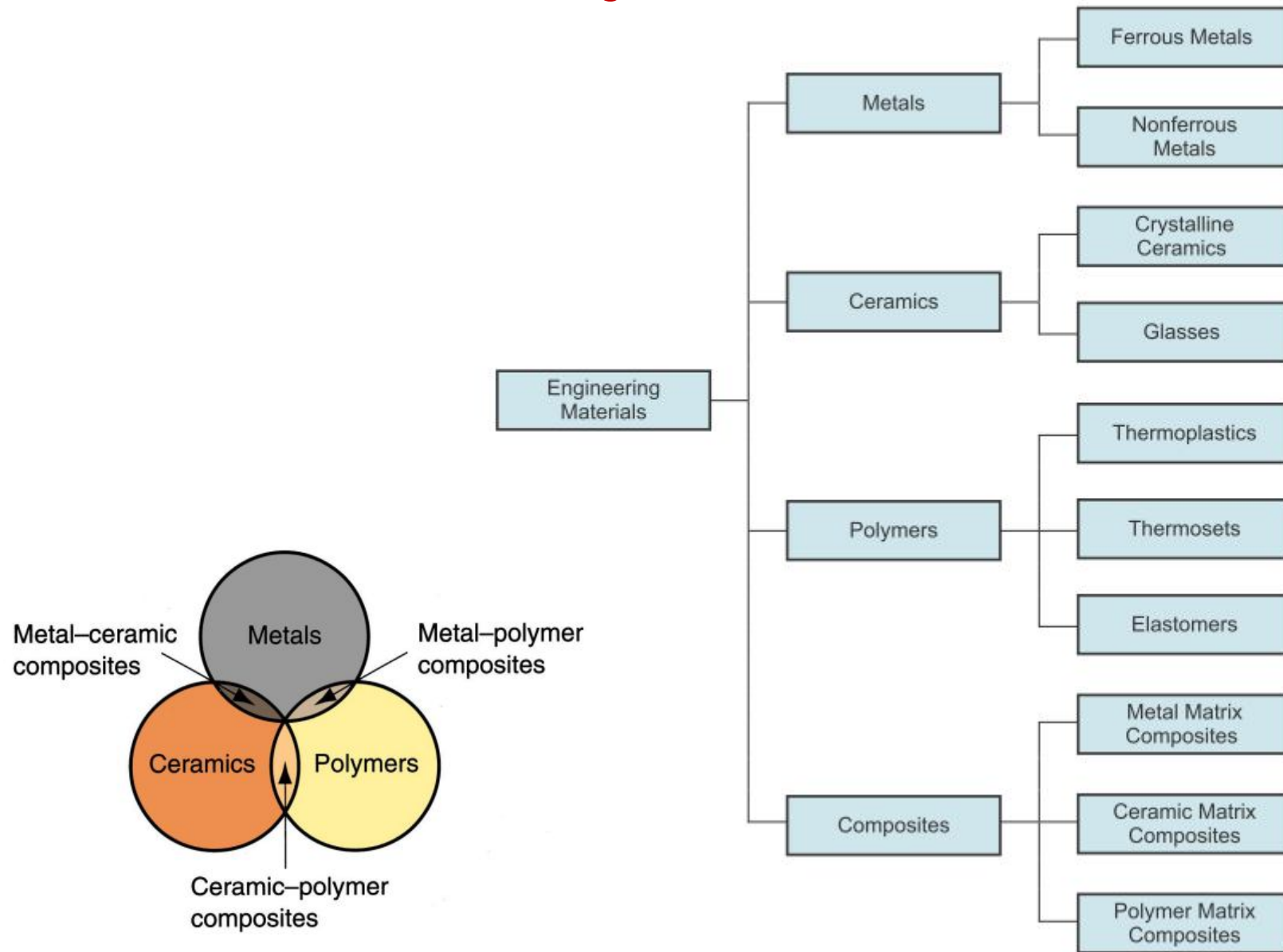


Production Quantity and Product Variety

- **Soft product variety** - small differences between products. Car models made on the same production line
- **Hard product variety** - products differ substantially. The difference between a car and a truck



Materials in Manufacturing



Materials

- **Ferrous metals:** carbon-, alloy-, stainless-, tool-and-die steels
- **Non-ferrous metals:** aluminum, magnesium, copper, nickel, titanium, superalloys, refractory metals, beryllium, zirconium, low-melting alloys, gold, silver, platinum, ...
- **Plastics:**
 - thermoplastics (acrylic, nylon, polyethylene, ABS,...)
 - thermosets (epoxies, Polyimides, Phenolics, ...)
 - elastomers (rubbers, silicones, polyurethanes, ...)
- Ceramics, Glasses, Graphite, Diamond, Cubic Boron Nitride
- **Composites:** reinforced plastics, metal-, ceramic matrix composites
- Nanomaterials, shape-memory alloys, superconductors, ...

Properties of Materials

Mechanical properties of materials

Strength, Toughness, Hardness, Ductility, Elasticity, Fatigue, Creep

Chemical properties

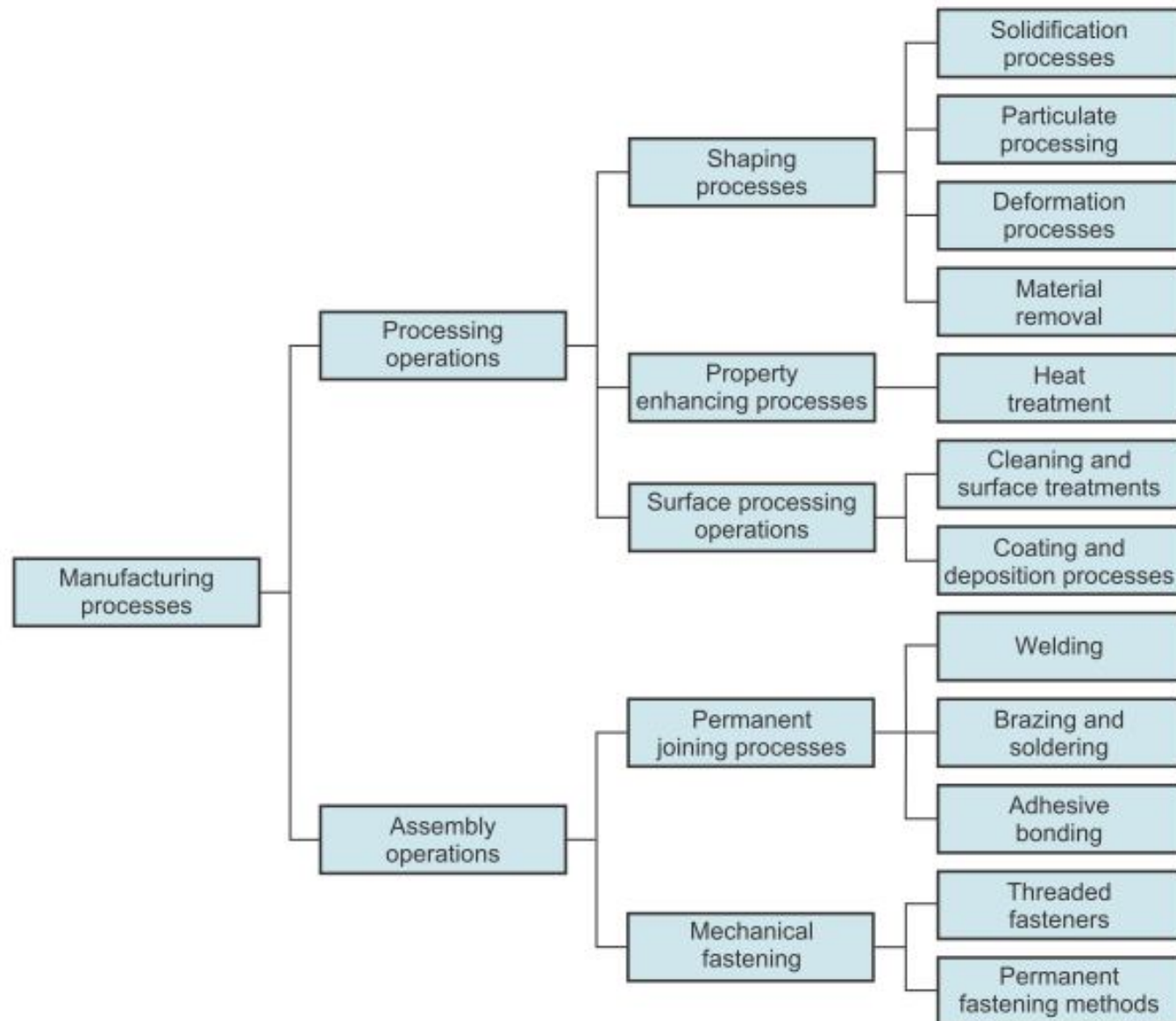
Oxidation, Corrosion, Flammability, Toxicity

Physical properties

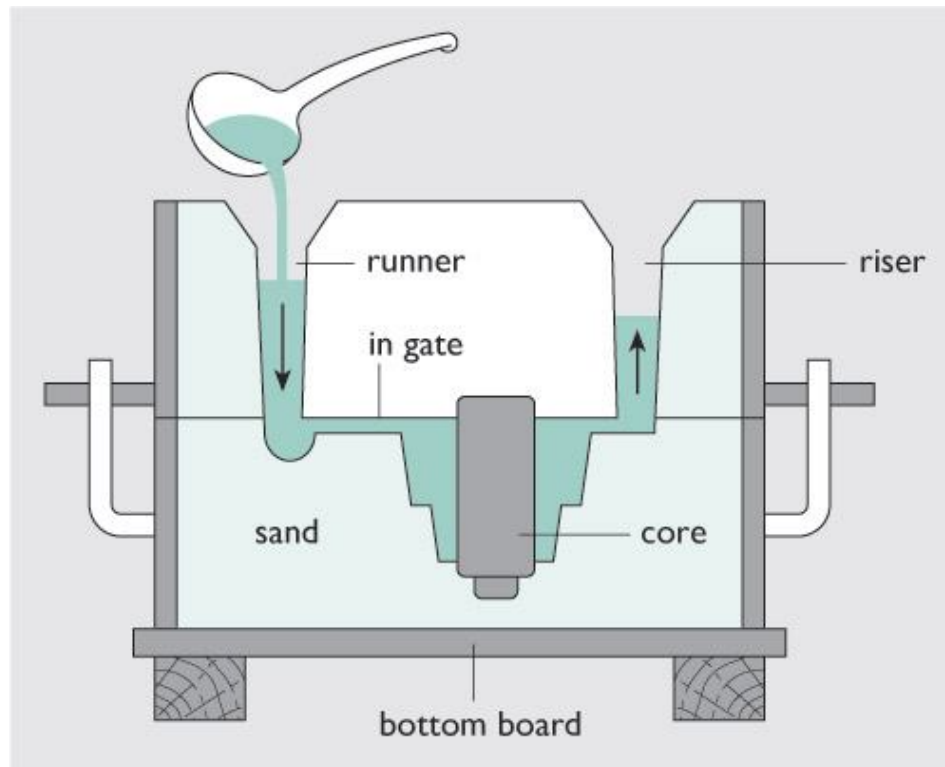
Density, Specific heat, Melting and boiling point, Thermal expansion, Thermal conductivity

Electrical and magnetic properties

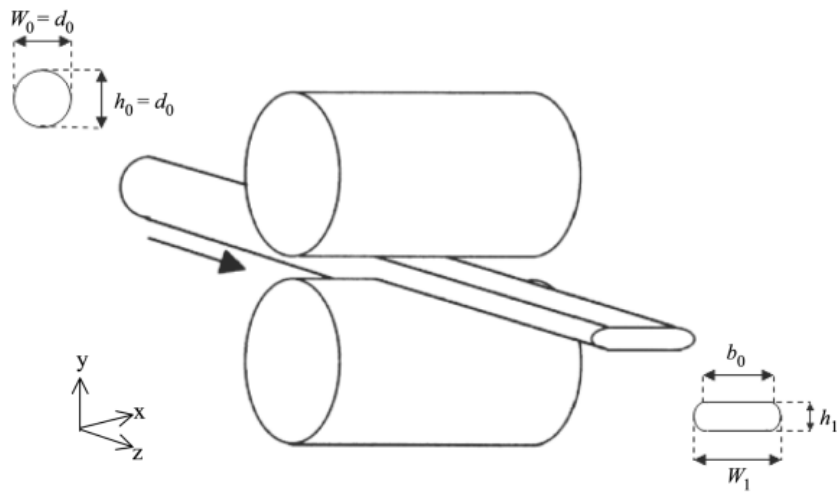
Classification of Manufacturing Processes



Casting Processes



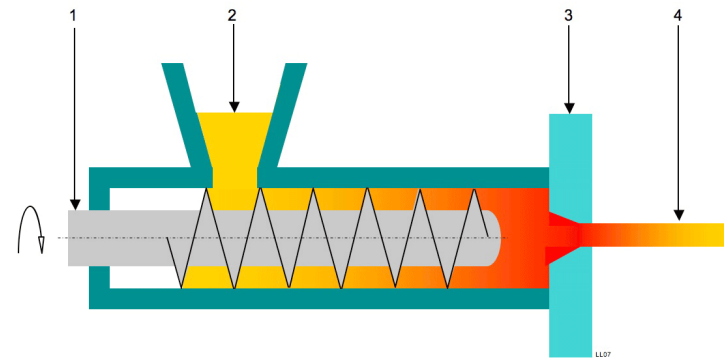
Forming Processes



Rolling

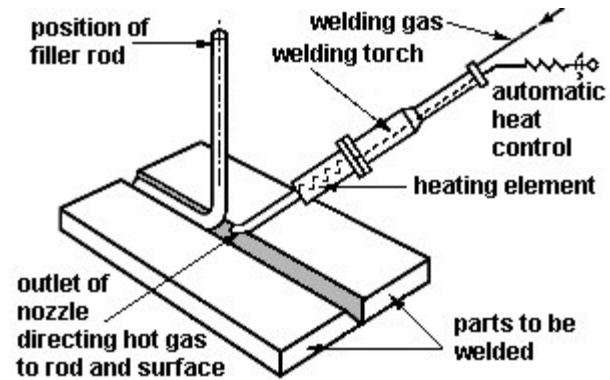


Forging



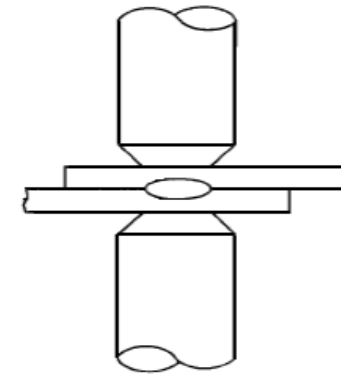
Extrusion

Joining processes

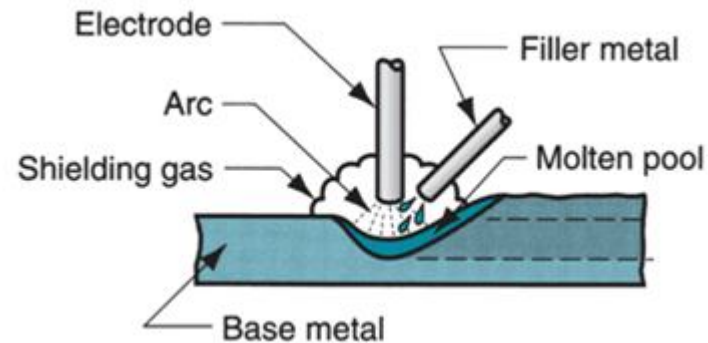


Schematic of hot gas welding showing correct position of torch and filler rod

Gas Welding

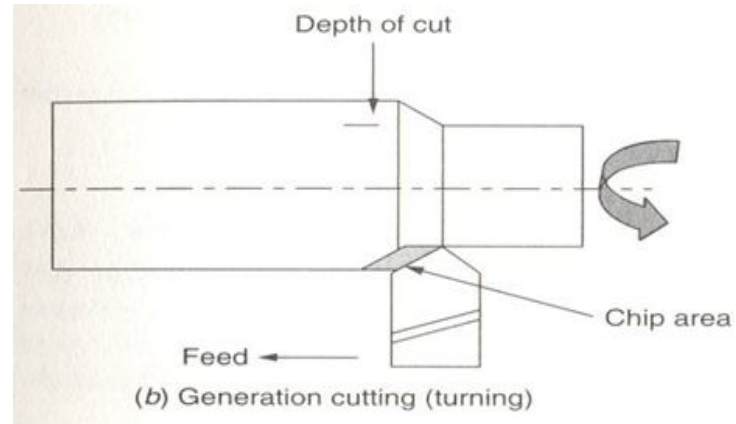


Resistance Welding

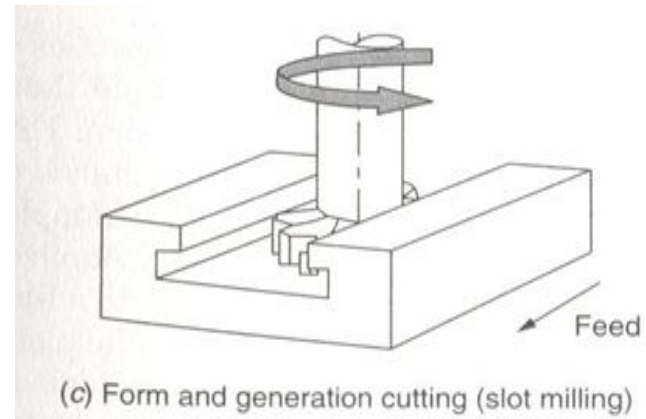


Arc Welding

Material Removal Processes



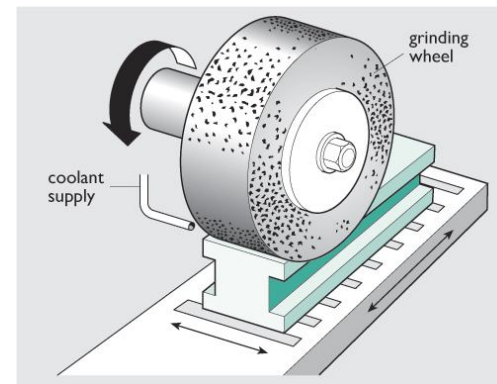
Turning



Milling



Drilling



Grinding