ME 373 - MECHINE ELEMENT DESIGN I

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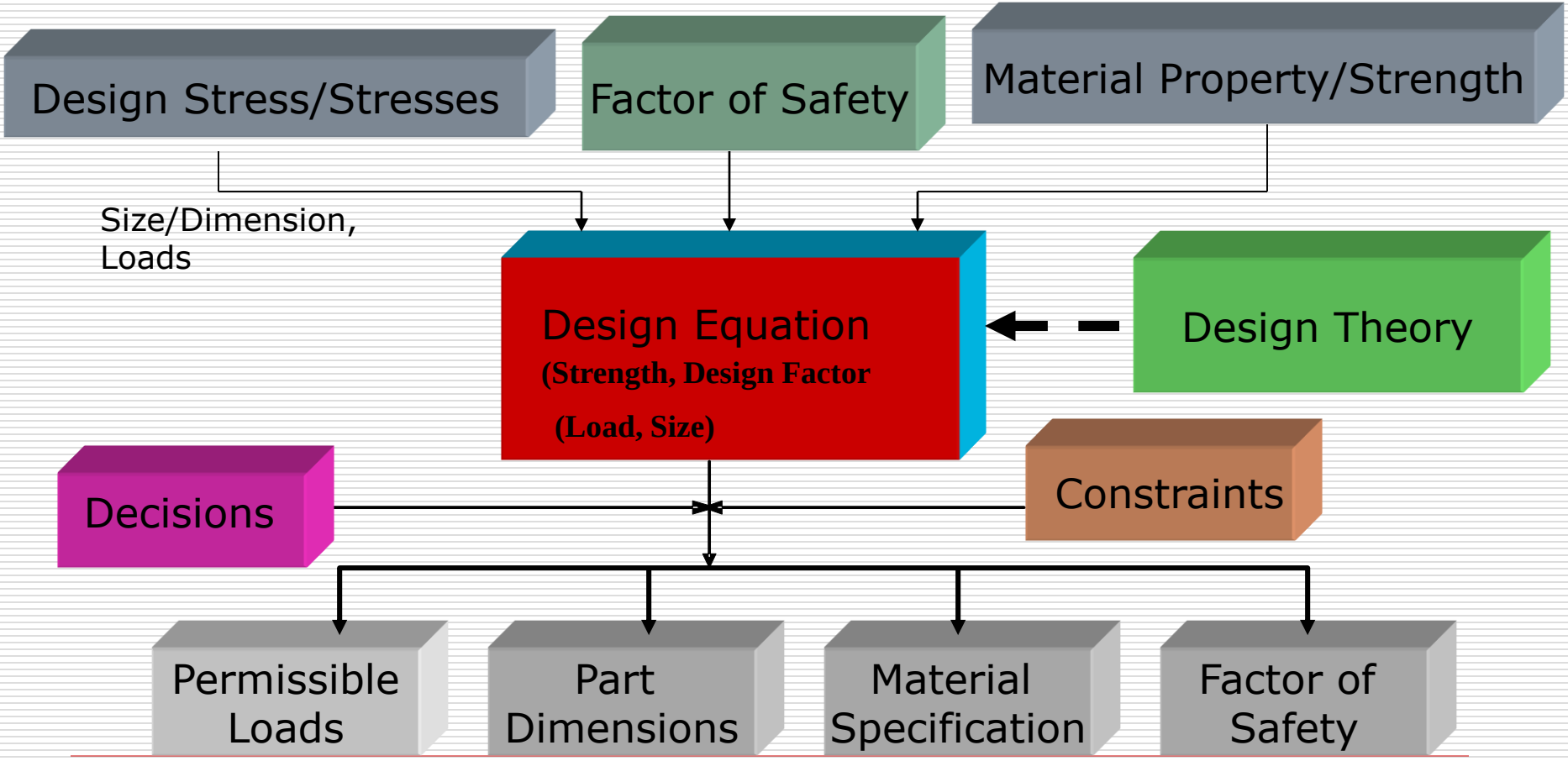
Course Outline

- Review - Theories of Failure of Parts Under Static Loading
- Review - Theories of Fatigue Failure.
- Torque Transmission Systems: Design of shaft, axle, keys.
- Selection of bearings
- Selection of springs
- Design of power screws
- Application - Group projects. Project topics include mechanical systems for domestic use.

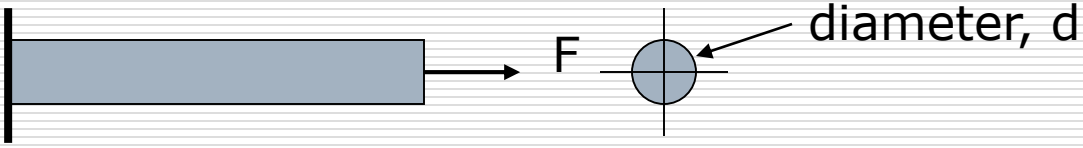
Units in Mechanical Design

Parameter	Design Units	
	US Customary	International SI
Part Size	Inch (in)	Millimeter (mm)
Force	Pound-force (Ibf)	Newton (N) Kilo-Newton (KN)
Moment and Torque	In-Ibf	N-mm
Stress, pressure	Ibf/in^2 (psi) Or K-Ibf/in^2 (Ksi)	N/mm^2 (MPa) KN/mm^2 (GPA)

Design Equation and Solution



A Hypothetical Design Equation



Stress, $\sigma = F/A = 4F/\Pi d^2$

Material Strength, $S = S_y$

F, d

Factor of safety, n

n

S_y

Design Equation:

$\mathbf{n = \pi d^2 S_y / 4F}$

Design Theory, $n = S/\sigma$

n=?

d=?

S_y=?

F=?

Guidelines - Factor of Safety

Stress Type	**Material Condition**	**Environmental Condition**	**Recommended Design factor of safety**
Very Certain	Ductile and Reliable Data	Well Controlled	1.25 to 1.5
Readily Determined	Ductile and Well Known	Reasonably Constant	1.5 to 2.0
Fairly Certain	Ductile and Common	Ordinary	2.0 to 2.5
Could Vary	Less Tried Ductile or Brittle	Average	2.5 to 3.0
Could Vary	Less Reliable Data	Average	3.0 to 4.0
Uncertain	Common	Uncertain	3.5 to 5.0

Guidelines- Selection of Carbon Steels

Carbon (%)	Typical Uses
0.05 – 0.10	Stampings, rivets, wire, cold drawn parts
0.10 – 0.20	Structural shapes, machine parts, carburized parts
0.20 – 0.30	Gears, shafts, levers, cold-forged parts, welded tubing, carburized parts
0.30 – 0.40	Shafts, gears, connecting rods, crane hooks
0.40 – 0.50	Gears, shafts, screws, forgings
0.50 – 0.70	Drawn-spring wire, lock washers, locomotive tires
0.70 – 0.90	Plowshares, shovels, leaf springs, hand tools
0.90 – 1.20	Springs, knives, drills, taps, milling cutters
1.20 – 1.40	Files, knives, razors, saws, wire-drawing dies.

Summary-Design Process