# MSE160 Notes

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# 1 Introduction

## 1.1 Types of Material

- There are three classes of material (though not all materials fall under these categories):
  - Metals
  - Ceramics
  - Polymers
- **Metals** (e.g. Fe, Cr, Cu, Zn, Al) are held together with *mellatic* bonds and is described by **bond theory**.
- **Ceramics** (e.g. poreclain, concrete) are held together with *ionic* bonds and are *brittle*. A lot of them are metal oxides.
- **Polymer** (Teflon®, Gore-tex®, polyethylene) *tend* to be from *covalent bonds*

> **Warning**: The word plastic actually describes a material property, and not a material type. There are plastics that are not polymers.

- Examples of materials that do not fall under this classification scheme include wood, skin, superconductors, and more.

## 1.2 Elastic Behaviour

- Hooke's law tells us that $F = -k\Delta x$, where $\Delta x$ is the displacement from equilibrium.
- **Engineering stress** is defined as $\sigma = \dfrac{F}{A_0}$ where $A_0$ is the *initial* (unloaded) cross-sectional area.

> **Warning**: Due to material properties, the cross sectional area of a spring can change as it elongates or compresses, so the engineering stress only refers to the initial cross sectyional area. The *true stress* refers to the force divided by the real area.

- **Engineering strain** is defined as $\varepsilon = \dfrac{\Delta \ell}{\ell_0}$ and the two are related via the **Young's Modulus**:

$$\sigma = E\varepsilon \tag{1}$$