1. Cross Product: \( C = A \times B \)
   a. Magnitude of \( A = |A| = AB\sin \theta \)
      Direction is perpendicular to the plane containing \( A \) and \( B \)
   b. \( A \times B = \begin{vmatrix} i & j & k \\ A_x & A_y & A_z \\ B_x & B_y & B_z \end{vmatrix} \)
   c. Unit vector cross products
      \[
      \begin{align*}
      i \times i &= 0 \\
      i \times j &= k \\
      i \times k &= -j \\
      j \times i &= -k \\
      j \times j &= 0 \\
      j \times k &= i \\
      k \times i &= j \\
      k \times j &= -i \\
      k \times k &= 0 
      \end{align*}
      \]

2. Moments
   a. 2-dimensional
      \[ M_o = dF \]
      \((d) \) is the perpendicular distance between the line of action of the force \( F \) and the point \( O \)
   b. 3-dimensional
      \[ M_o = \mathbf{r} \times \mathbf{F} = \begin{vmatrix} i & j & k \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix} \]
   c. Transmissibility of a force (acts like a sliding vector)
   d. Principle of moments
   e. Moment about a specified axis (mixed triple product)
\[ \mathbf{M}_A = \mathbf{u}_A \cdot (\mathbf{r} \times \mathbf{F}) = \begin{vmatrix} u_{ax} & u_{ay} & u_{az} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix} \]

f. Couple moments

\[ \mathbf{M}_O = \mathbf{r} \times \mathbf{F} \quad \text{where } \mathbf{r} \text{ is a position vector from anywhere along the line of action of } -\mathbf{F} \text{ to } \mathbf{F} \]

g. Resultant of a force and couple system
   i. Movement of \( \mathbf{F} \) to point \( O \) along its line of action
   ii. Movement of \( \mathbf{F} \) to point \( O \) off its line of action

h. Reduction of a force and couple system to a single equivalent force
   i. Concurrent, coplanar, or parallel

i. Reduction to a force and a moment (wrench)

j. Reduction of a simple distributed loading

3. Equilibrium of a Rigid Body

\[ \sum \mathbf{F} = 0 \quad \sum \mathbf{M} = 0 \]

a. Free body diagrams (FBD’s)

b. 2-force members

c. Equations of Equilibrium
   i. Two-dimensional

\[ \sum F_x = 0 \quad \sum F_y = 0 \quad \sum M_O = 0 \quad F = ks \]

ii. Three-dimensional

\[ \sum F_x = 0 \quad \sum F_y = 0 \quad \sum F_z = 0 \quad \sum M_O = 0 \quad F = ks \]