| Physical Problem | Conservation Principle | State Variable, $u$ | Flux, $\sigma$ | Material Modulus, $k$ | Source, $f$ | Constitutive Equation, $\sigma = -ku'$ |
|---|---|---|---|---|---|---|
| Deformation of an elastic bar | Equilibrium of forces (conservation of linear momentum) | Displacement | Stress | Young's modulus of elasticity | Body forces | Hooke's law |
| Heat conduction in a rod | Conservation of energy | Temperature | Heat flux | Thermal conductivity | Heat sources | Fourier's law |
| Fluid flow | Conservation of linear momentum | Velocity | Shear stress | Viscosity | Body forces | Stokes' law |
| Electrostatics | Conservation of electric flux | Electric potential | Electric flux | Dialectric permittivity | Charge | Coulomb's law |
| Flow through porous media | Conservation of mass | Hydraulic head | Flow rate | Permeability | Fluid source | Darcy's law |

***FIGURE 2.1*** *Interpretation of physical variables and equations for various types of physical problems.*