

Abstract

This lecture presents a review of the latest advances in the mathematical models developed to describe the thermal behavior of macro and micro systems. Up to this time there are five known mathematical models proposed to describe the thermal behavior of these systems. Three of them are macro heat conduction models which are the Fourier diffusion model, the Maxwell wave model and the dual-phase-lag model. On the other hand there are two microscopic heat conduction models which are the parabolic and hyperbolic microscopic heat conduction models. This presentation investigates the fundamental physical differences among these five models and show different criteria that validate the use of each model within specified ranges of geometrical and operating conditions. These five models have been used to describe the thermal behavior of large number of systems subject to wide range of applications. Example of these applications are ultra fast heating processes, heating processes having very short duration, systems subject to fluctuating heating sources, micro-channel fluid flow problems, systems subject to moving heating sources, phase change problems, systems consist of porous domains, conjugated heat transfer problem, etc... Different analytical and numerical techniques have been adapted to solve the thermal models that describe the thermal behavior of these systems. Examples of these techniques are Laplace transformation, perturbation techniques, finite difference and element approaches, the trial solution methods, etc