Abstract: A numerical simulation over a domain consisting of multiple materials usually results in discontinuous data functions of the governing partial differential equations (PDEs), and this leads to a so-called interface problem for these PDEs. The solution to an interface problem often lacks regularity across the material interfaces. This deficiency of the global regularity requires traditional finite element (FE) methods to use fitted meshes in which each element essentially contains one of the materials; otherwise, the performance of a FE method cannot be guaranteed. Fitted meshes are unstructured in general unless material interfaces have trivial geometries. The immersed finite element (IFE) methods are non-traditional FE methods that can utilize interface-independent meshes to solve interface problems; hence, if desired, they can use structured/Cartesian meshes even if the material interface has non-trivial geometries. This talk focuses on an essential issue of IFE methods: the construction of IFE functions. After a brief introduction to IFE methods, we will discuss a few procedures for constructing IFE functions with features such as (1). they can handle non-homogeneous jump conditions; (2). they can use higher degree polynomials; (3). they can be extended to 3D interface problems; (4); they can deal with interface problems for modelling multiphysics. Some applications will be presented to demonstrate features of IFE methods.