

Abstract: In this work, we studied three selected problems in FRW spacetime. In the first part, we analysed the motion of a test particle in the homogeneous and isotropic universe. We presented a framework in which one can derive the uniformly accelerated trajectory and geodesic motion if a scale factor for a given spacetime is provided as a function of coordinate time. By applying the conformal time transformation, we were able to convert second order differential equations of motion in FRW spacetime to first order differential equations. From this, we managed to obtain a formalism to derive the uniformly accelerated trajectory of a test particle in spatially curved FRW spacetime. The second part of this work is devoted to dynamical cosmology. In particular, we analyse the cases of barotropic fluids and non-minimally coupled scalar field in spatially curved FRW spacetime. First, we set up the dynamical systems for an unspecified EoS of a barotropic fluid case and an unspecified positive potential for a non-minimal coupled scalar field case. For both of these systems, we determined well-defined dynamical variables valid for all curvatures. In the framework of these general setups we discovered several characteristic features of the systems, such as invariant subsets, symmetries, critical points and their physical interpretations. Finally, in the second part of both of these works, we provided some examples to illustrate how these general setups can be used.