A study has been made to determine the critical time parameters of truncated conical shells with functionally graded coatings (FGCs) and subjected to a time dependent axial load in the large deformation. The method of solution utilizes Superposition principle and Galerkin procedure. Donnell–Karman type non-linear differential equations for the truncated conical shell with FGCs are derived and reduced to ordinary differential equation with the time dependent coefficient. The Runge–Kutta method and modified Budiansky–Roth criterion are then used to solve this non-linear differential equation with the time dependent coefficient. Finally, effects of compositional profiles of coatings, variation of truncated conical shell parameters and loading speed on the dimensionless linear and non-linear critical time parameters have been studied. Comparing the results of this study with those in the literature validates the present analysis.