The aim of this paper is to investigate the vibration behavior of a functionally graded orthotropic toroidal shells segments (FGOTSSs), such as convex and concave shell segments, at large amplitudes. Material properties presumed to vary in thickness directions according to the exponential functions. The non-linear motion equations are conducted established on shear deformation theory in conjunction with Stein and McElman's assumption and von-Karman type of nonlinearity. The technique of superposition and the Galerkin approach was used to transform the nonlinear partial differential equations of FGOTSSs to the nonlinear ordinary differential. Then, utilizing the harmonic equilibrium method, nonlinear equations are solved to extract the expression for frequency amplitude relationships and the non-linear frequency to linear-frequency ratio of FGOTSSs. The results are compared to those found in the literature with the expressions, and the precise of numerical calculations are performed after testing the proposed formulation's reliability and accuracy. The homogeneous orthotropic and orthotropic FGM of the convex and concave shell segments are used for basic analyzes, and their vibrational behaviors with large amplitudes are examined in contrast to each other, with different examples revealing that heterogeneity has an effect.