Abstract

The present thesis deals with vibration and buckling analyses of sandwich plate and shell panels (cylindrical, spherical, and hyperboloid) with an auxetic honeycomb core. In this research, three types of facesheets, constant stiffness composite laminate (CSCL), variable stiffness composite laminate (VSCL), and functionally graded material (FGM) facesheets are considered. The variable stiffness is achieved by using linear varying and parabolic fiber facesheets. The material behavior is described with the help of constitutive relations. The artificial bee colony algorithm is used to optimize the fiber orientations *centre angle and edge angle* of the variable stiffness facesheet, gradation parameter *volume fraction coefficient* of the FGM facesheet, and the geometric parameters of the auxetic core (*viz., cell angle, vertical to inclined cell rib length ratio, thickness to inclined cell rib length ratio, and core thickness to laminate thickness ratio*). The analysis is carried out considering a higher-order shear deformation theory and employing a C_0 eight-noded isoparametric element with nine degrees of freedom per node. The material properties of the functionally graded material (FGM) facesheets are graded in the thickness direction according to a basic power law distribution in terms of the volume fractions of the constituents. The equivalent elastic parameters, thermal expansion coefficient and density of FGM facesheets are obtained using two micromechanical models, i.e., the rule of mixtures (RM) and Mori-Tanaka (MT) method. The equivalent elastic and thermal parameters of the auxetic core are obtained using the elastic and thermal properties of the material and the geometry parameters of the cell. The methodology is expanded to include nonlinear free vibration and post-buckling analyses. Geometrical nonlinearity is taken into consideration using the von Kármán type nonlinear strain-displacement equations. The nonlinear equations are solved iteratively using the displacement control technique. An in-house MATLAB code is built to solve linear and nonlinear equations for static, vibration and buckling analysis. Further, the analysis is extended to predict the critical buckling temperature of sandwich plate and shell panels using a machine learning approach. Two approaches-the Levenberg–Marquardt algorithm and the Bayesian regularization algorithm are used to train the neural network.