***Appendix***

Few MATLAB codes are given at the end of the book for the benefit of readers to understand the process of SHM development using Genetic Fuzzy System.

1. **Code for calculating Effective Young’s modulus for given matrix cracking:** Matrix cracking effects are embedded in composite layups of cross-ply composite. This code is based on the theory given in Section 4.1.1. Material properties are given in code only. For given matrix cracking the code gives effective Young’s modulus which will be used in subsequent code for calculating variation in natural frequencies for given matrix cracking. File name: **matrix\_cracking\_code.m**
2. **Code for calculating change in frequencies at different crack densities:** The code calculates change in first eight modes of frequencies due to matrix cracking at 10 different locations. This code is based on the theory discussed in Section 4.1.2, Section 3.1 and Section 4.2. For this code input file is “model2.inp” and output is stored in “model2.out”. Inputs given in the input files can be understood by the comments given in the code. The inputs are in the sequence of Number of nodes, Number of Elements, Number of material properties, coordinates of the nodes, connectivity, For each element Material index, moment of inertia, cross-sectional area, Mass Density of beam material. Effective material properties obtained from previous code for different crack densities are given in “mat1”.

File name: **frequency\_calculation\_code.m**

Input file: **model2.inp**

Output file: **model2.out**

1. **Code for training the Genetic Fuzzy System:** The first eight modes of frequencies for three damage levels at ten different locations will be the input to this code. These numerical values are considered as midpoints of Gaussian membership functions and the code will obtain the values of standard deviations of membership function for maximization of Success Rate of each rule for noisy data of that rule. This code is based on the theory discussed in **Section 4.3.1** and **Section 2.3.**

Code File name: **Training code for GFS.m**

Input file: rul309.dat

Output file: tune.dat

1. **Code for Testing the Genetic Fuzzy System:**  This code uses the frequencies developed from the code in point 2 and standard deviations obtained in previous code to obtain success rate of each rule for various noise levels. This code is based on the theory discussed in **Section 4.3.2 and Section 2.3.**

Code File name: **Testing\_code\_for\_GFS.m**

Input file: rul309.dat and tune.dat

Output file: f09\_15.dat