

**Industrial Driven Elective****Sub Code : MMD2101****Hrs/Week : 02****SEE Hrs : 03****Total: 26 hrs****CIE : 50% Marks****SEE : 50% Marks****Max. : 100 Marks****Course outcomes:****Upon the successful completion of this course, students will be able to:**

1. Select suitable sensor and actuator; and develop the plan for experimental testing of structural vibrations
2. Understand the importance of digital signal processing of measurements, and its impact on quality of measured data
3. Construct mathematical models to describe the structure based on experimental modal analysis and appreciate the role of modal analysis in system identification, model updating, and condition monitoring

**Module 1:****Theoretical basis for modal analysis:**

Overview of modal analysis, Vibrations of single and multiple degree of freedom (SDOF, MDOF) systems, Frequency response functions (FRFs) for SDOF/MDOF systems. Types of FRFs, Orthogonality of modes and their application in modal analysis, Theory of undamped, proportionally damped, and non-proportionally damped SDOF/MDOF systems, Analyses for complex modes and sensitivity analysis of modal models **8 hrs**

**Module 2:****FRF measurement considerations:**

Introduction to test planning, Excitation of structures (electromagnetic and electro-hydraulic shakers, hammers, etc.), Transducers and amplifiers for measurements (force transducer, accelerometers, laser vibrometers, signal conditioners, amplifiers, Actuator/sensor placement considerations, Revision of Fourier analysis and Fourier transforms, Discussions on aliasing, leakage, windowing, filtering and averaging, Role of excitations signals in structural testing **9 hrs**

**Module 3:****Modal parameter extraction and derivation of mathematical models:**

Preliminary checks of FRF data (spectrum, coherence, asymptotic behavior, assessment using singular value decomposition (SVD), Mode indicator functions, SDOF modal analysis methods (peak-picking, circle-fit), Treatment of residuals, MDOF modal analysis in the frequency domain (least square methods, rational fraction polynomial methods), Extraction of natural frequencies, damping ratios and shapes. Discussion on modal models, response models and spatial models, Applications: Comparison of and Correlation of Experiment and Prediction **9 hrs**

**Text Book:**

1. Modal testing: theory, practice and application by D. J. Ewins;

**Reference Book:**

1. Theoretical and experimental modal analysis by N. Maia and J. Silva

**Assessment Methods:****CIE Assessment Methods:**

- CIE Pattern will be 20+20+10
- Test 1 and Test 2 is for 20 marks each and is descriptive.
- Test 3 which is for 10 marks could be Test / Assignment / Quiz / Modeling.