|  |  |  |
| --- | --- | --- |
|  | **National Institute of Technology Meghalaya**An Institute of National Importance | **CURRICULUM** |
| Programme | **Master of Technology (Structural Engineering)** | Year of Regulation | **2018** |
| Department | **Civil Engineering** | Semester | **I** |
| Course Code | Course Name | Pre-requisite | Credit Structure | Marks Distribution |
| L | T | P | C | INT | MID | END | Total |
| **CE 555** | **Dynamic of Structures** | **NIL** | **3** | **0** | **0** | **3** | **50** | **50** | **100** | **200** |
| Course Objectives | Study the various types of dynamic loading and formulate the equations of motion. | Course Outcomes | CO1 | Know the fundamental theory of dynamic equation of motions and analysis methods for dynamic systems |
| To impart knowledge to model discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems. | CO2 | Able to develop the equations of motion for vibratory systems and solving them for the free and forced response |
| CO3 | Able to develop the skill to solve an Engineering problem under dynamic loading for industrial use. |
| CO4 | Interpret the dynamic analysis results for design of civil engineering structures. |
| Evaluate dynamic response using numerical methods | CO5 | Apply the structural dynamics theory to earthquake analysis, response, and design of structures |
| SYLLABUS |
| No. | Content | Hours | COs |
| I | **Introduction** Types of dynamic loads; Basic background of methods available and motivation for structural dynamics.  | 1 | CO1 |
| II | **Dynamics of Single Degree-of-Freedom Structures** Dynamic equation of equilibrium; Free vibration of single degree of freedom systems; Forced vibration: harmonic and periodic loadings; Dynamic response functions, force transmission and vibration isolation; SDOF response to arbitrary functions.  | 6 | CO2 |
| III | **Numerical Evaluation of Dynamic Response of SDOF Systems** Time domain analysis: finite difference methods; Frequency domain analysis: basic methodology.  | 3 | CO2, CO3 |
| IV | Earthquake Response of SDOF Systems Earthquake excitation, response history and construction of response spectra; Response spectrum characteristics, tripartite plot, and design spectrum.  | 3 | CO2, CO3, CO5 |
| V | **Multi Degree of Freedom Systems** Dynamic equations of equilibrium, static condensation; Symmetric plan and plan-asymmetric systems.  | 5 | CO2, CO3 |
| VI | Free Vibration Response of MDOF Systems Un damped systems: natural modes and their properties; Numerical solution for the eigen value problem; Solution of free vibration response for un damped systems; Free vibration analysis of systems with damping.  | 5 | CO2, CO3, CO5 |
| VII | Dynamic Analysis of Linear MDOF Systems Introduction, modal analysis; Response-history for earthquake excitations using modal analysis; Response spectrum analysis for peak responses; Concept of Caughey damping as a general type of proportional damping  | 5 | CO4, CO5 |
| VIII | Introduction to Dynamics of Continuous Systems Equations of motions for axial vibration of a beam; Equations of motion for flexural vibration of a beam; Free vibration analysis- boundary value problem, Natural frequencies, Mode shapes, Orthogonality conditions, Forced vibration analysis using modal superposition method.  | 5 | CO2, CO3 |
| IX | Introduction to a seismic analysis Seismic Analysis Methods; Nonlinear Time History Analysis (NLTHA) Method; Elastic Dynamic Analysis (EDA) Method using Multimodal Spectral Analysis. | 3 | CO5 |
| **Total Hours** | **36** |  |
| **Essential Readings** |
| 1. Chopra, A. K. “Dynamics of structures: Theory and applications to earthquake engineering”, PHI Ltd., 4th edition 2011.
 |
| 1. *Mario, Paz,* “Structural dynamics”, CBS Publishers, 1st edition 1991.
 |
| 1. *Clough R.W., &Penzien, J.* “Dynamics of Structures”, McGraw Hill international, 2nd edition 1993.
 |
| **Supplementary Readings** |
| 1. Siniu, E. &Scanlan, R.H. “Wind effects on structures: fundamentals and applications to design”, John Wiley and Sons., 1st edition 1996.
 |
| 1. *Meirovitch, L.* “Elements of Vibration Analysis”, McGraw-Hill, 2nd edition 1986.
 |
| 1. *Wilson, E. L.* “Static and Dynamic Analysis of Structures”, Computers and Structures, Inc., Berkeley, CA, 4th edition 2004.
 |