IIT Mandi
Proposal for a New Course

Course number	**: CE522**
Name	**: Matrix Methods for Structural Analysis**
Credit	**: 3**
Distribution	**: *L-T-P-C* 3-0-0-3**
Intended for	**: UG Program (B. Tech 3rd/4th Year Students) and PG Program**
Prerequisite	**: CE404: Analysis of Structures/Equivalent**
Mutual Exclusion	**: -**

1. Preamble:

The basic structural analysis deals with understanding the response of a structural system subjected to external loads. With the advancements in digital computations, it becomes convenient if one can formulate the forces and displacements in structures in terms of matrix and/or vectors. Hence, it becomes essential to know how a structural system could be idealized systematically so that such computational advantages can be fully utilized. This course thus gives advanced exposure to the students on how matrix methods could be efficiently used in any type of structural systems to perform systematic analysis using computers. The course also encompasses assessments/projects and case studies which can equip the students to apply the formulation to any real structures.

2. Course Modules with quantitative lecture hours:

Module 1: Introduction to matrix analysis of structures, elements and structures, degrees of freedom, the principle of superposition, concepts of matrix algebra. **(3 Hours)**

Module 2: Matrix analysis of structures with axial elements: plane trusses and space trusses Flexibility method: Introduction to the approach, Deriving the flexibility matrix of truss. Analysis of determinate and indeterminate structures employing the flexibility matrix approach. **(5 Hours)**

Module 3: Matrix analysis of beams and grids: Flexibility method-Deriving the flexibility matrix beams and grids: Analysis of determinate and indeterminate structures employing the flexibility matrix approach. **(5 Hours)**

Module 4: Matrix analysis of plane and space frames: Flexibility method: Deriving the flexibility matrix of plane and space frames: Analysis of determinate and indeterminate structures employing the flexibility matrix approach. Analysis of prismatic and non-prismatic frames. **(5 Hours)**

Module 5: Matrix analysis of structures with axial elements: plane trusses and space trusses. Stiffness Method: Introduction to the approach, Deriving the stiffness matrix truss. Analysis of determinate and indeterminate structures employing the stiffness matrix approach. **(5 Hours)**

Module 6: Matrix analysis of beams and grids: Stiffness method: Derivation of stiffness matrix beams and grids: Analysis of determinate and indeterminate structures employing the stiffness matrix approach. **(5 Hours)**

Module 7: Matrix analysis of plane and space frames: Stiffness method: Derivation of the stiffness matrix plane and space frames: Analysis of determinate and indeterminate structures employing the stiffness matrix approach. Analysis of prismatic and non-prismatic frames. **(5 Hours)**

Module 8: Comparison between stiffness and flexibility methods, Analysis of truss, beams, and frame structures using direct stiffness approach; Computer application of direct stiffness method. **(5 Hours)**

Module 9: Beyond matrix methods: Introduction to finite element method, element types, basic formulation, and application to 1D problems. **(4 Hours)**

Laboratory/practical/tutorial Modules: -

3. Text books:

1. Weaver, W., and Gere, J. M., Matrix analysis framed structures. Springer science & business media, 2012.
2. Hibbeler, RC, Structural Analysis, Pearson Education, 9th edition, New Delhi, 2017.

4. References:

1. G. S. Pandit and S. P. Gupta, Structural Analysis: A Matrix Approach, Tata McGraw-Hill, 2008.
2. Martin, H. C., Introduction to Matrix Methods of Structural Analysis, McGraw-Hill, New York, 1996
3. Menon, D, Advanced Structural Analysis, Narosa Publishing House, 2015.

5. Similarity with the existing courses:
(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.		Course Code	Similarity Content	Approx. % of Content
1.	Analysis of Indeterminate Structures	CE506	Introduction to matrix methods for structural analysis.	21%

6. Justification of new course proposal if cumulative similarity content is >30%: