Year & Sem:	Course Code: CE4504	Course Name: **Advanced Structural Analysis**	No. of Credits: 4	L	T&PS	P
				2	2	0

Unit – I:_Review of Basic Structural Analysis:- ***structure*** (structural elements, joints and supports, stability, rigidity and static indeterminacy, kinematic indeterminacy);***loads*** (direct actions, indirect loading); ***response*** (equilibrium, compatibility, force-displacement relations); levels of analysis; analysis of ***staticallydeterminate structures*** (trusses, beams, frames);applications of ***principle of virtual work*** and displacement-based and force-based ***energy principles***; deriving stiffness and flexibility coefficients.***Force methods:*** Statically indeterminate structures (method of consistent deformations; theorem of least work). ***DisplacementMethods:*** Kinematically indeterminate structures (slope-deflection method; moment distribution method).

Unit - II:_BasicMatrix concepts:-Matrix; vector; basic matrix operations; rank; solution of linear simultaneous equations; eigenvalues and eigenvectors; Introduction; coordinate systems; displacement and force transformation matrices; Contra-gradient principle; element and structure stiffness matrices; Element and structure flexibility matrices; equivalent joint loads; stiffness and flexibility approaches.

Unit - III:Matrix analysis of structures with axial elements: ***Introduction-***Axial stiffness and flexibility; stiffness matrices for an axial element (two dof), plane truss element (four dof) and space truss element (six dof); ***One-dimensional axial structures-***Analysis by conventional stiffness method (two dof per element) and reduced element stiffness method (single dof); Analysis by flexibility method; ***Plane trusses-*** Analysis by conventional stiffness method (four dof per element) and reduced element stiffness method (single dof); Analysis by flexibility method; ***Space trusses-***Analysis by conventional stiffness method (six dof per element) and reduced element stiffness method (single dof).

Unit – IV:_Matrix analysis of beams and grids:-*Conventional stiffness method for beams-* Beam element stiffness (four dof); generation of stiffness matrix for continuous beam; dealing with internal hinges, hinged and guided-fixed end supports; accounting for shear deformations; ***Reduced stiffness method forbeams-***Beam element stiffness (two dof); dealing with moment releases, hinged and guided-fixed end supports; ***Flexibility methodfor fixed and continuous beams-***Force transformation matrix; element flexibility matrix; solution procedure (including support movements); ***Stiffness method for grids-***Introduction; torsional stiffness of grid element and advantage of torsion release; analysis by conventional stiffness method using grid element with six dof; analysis by reduced stiffness method (three dof per element);

Unit - V: Matrix analysis of plane and space frames: ***Conventional stiffness method for plane frames-***Element stiffness (six dof); generation of structure stiffness matrix and solution procedure; dealing with internal hinges and various end conditions; ***Reducedstiffness method for plane frames-***Element stiffness (three dof); ignoring axial deformations; dealing with moment releases, hinged and guided-fixed end supports; ***Flexibility method for plane frames-***Force transformation matrix; element flexibility matrix; solution procedure (including support movements); Ignoring axial deformations; ***Stiffness method for space frames-***Introduction; element stiffness matrix of space frame element with 12 dof and 6 dof; coordinate

transformations; analysis by reduced stiffness method (six dof per element);

.**Unit – VI: Analysis of elastic instability and second-order effects:** ***Effects of axial force on flexural stiffness-*** Review of buckling of ideal columns; flexural behavior and stiffness measures for beam-columns - braced and unbraced, under axial compression; ***Solution by slopedeflection method-*** Slope deflection equations for prismatic beam columns using stability functions; modifications for pinned and guided-fixed-end conditions; fixed-end moments in beam-columns; ***Solution by matrix method-***Stiffness matrix for prismatic beam-column element; estimation of critical elastic buckling loads; second-order analysis;

References/Text Books:

1. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. AsslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
4. Devdas Menon, "Structural Analysis", Narosa Publishing House, 2008.

Lecture Plan: Unit-I & -II syllabus for MID-I, Unit-III & -IV syllabus for MID-II and Unit-V & -VI syllabus for MID-III examinations.

Video Lectures (Web Links):
http://www.nptelvideos.in/2012/11/advanced-structural-analysis.html