

**UNIVERSITY OF ENGINEERING AND TECHNOLOGY, TAXILA**  
**DEPARTMENT OF CIVIL ENGINEERING**

**Course Title : CE-411 Computer Aided Analysis and Design of Structures**

**Pre-requisite(s) : Design of Reinforced Concrete and Steel Structures**

**Credit Hours : 1**

**Contact Hours : 3**

**Text Book(s) :**

- 1. ETABS Manual**
- 2. SAP Manual**
- 3. SAFE Manual**
- 4. STAAD PROV Manual**

**Reference Book(s):** **1. The Finite Element Method A Practical Course by G.R.LIU and S.S.QUEK**

**Catalog Data:**

Introduction to finite element analysis, modeling of plane frame, modeling of floor structures subjected to area loads, modeling of portal frame, steel structures with concrete footing, Modeling of load dependent structures where structural condition changes for different load cases, Application of support displacement load on spaced frame structure, Modeling of pre-stress loading in a plane frame structure, Modeling of structures with offset connection, Concrete analysis and design of space frame structures, Analysis and design of space frame with floor, Flat plates and shear wall using finite elements, Analysis and design of water retaining structures, Dynamic analysis (Response spectrum and time history), Analysis of space frame for seismic loads, Analysis of space frame for wind, Modeling of space frame using mesh generation command, Modeling of space structures subjected to moving loads, Analysis and design of space frame structures sitting on all types of foundations, Modeling of domed cylindrical structures, Analysis of bridge with moving loads, Frame shear wall interaction, Barrel vaulted structures, Beam and slabs on elastic foundations, Wall resisting hydrostatic pressures.

**Course Objectives:**

- To use industry standard softwares in a proficient manner in addition to knowing the theoretical concepts of structural analysis and design
- To understand the finite element modeling, specification of loads and boundary conditions, performing analysis and interpretation of results for final analysis and design using commercial softwares.

## **Course Learning Outcomes:**

At the end of this course, the student will be able

**CLO 1:** To use industry standard commercial softwares in professional design state of affairs.

**CLO 2:** To use modern tools in order to meet the demands of latest technology in the field of structural engineering.

**CLO 3:** To gain confidence for analysis and design of real 3D structures using the latest commercial softwares

**CLO 4:** To understand the finite element modeling, specification of loads and boundary conditions, performing analysis and interpretation of results for analysis and design of structures using commercial softwares

## **Course Contents:**

1. Introduction to Finite Element Analysis
2. Modeling of plane frame,
3. Modeling of floor structures subjected to area loads,
4. Modeling of portal frame, steel structures with concrete footing,
5. Modeling of load dependent structures where structural condition changes for different load cases,
6. Application of support displacement load on spaced frame structure,
7. Modeling of pre-stress loading in a plane frame structure,
8. Modeling of structures with offset connection,
9. Concrete analysis and design of space frame structures,
10. Analysis and design of space frame with floor,
11. Flat slabs and shear wall using finite elements,
12. Analysis and design of water retaining structures,
13. Dynamic analysis (Response spectrum and time history),
14. Analysis of space frame for seismic loads,
15. Analysis of space frame for wind,
16. Modeling of space frame using mesh generation command,
17. Modeling of space structures subjected to moving loads,
18. Analysis and design of space frame structures sitting on all types of foundations,
19. Modeling of domed cylindrical structures,
20. Analysis of bridge with moving loads,
21. Frame shear wall interaction,
22. Barrel vaulted structures,
23. Beam and slabs on elastic foundations,
24. Wall resisting hydrostatic pressures.

## Grading Policy:

Sr. No.	Grading	% of Total Marks
1	Assignments	20-25
2	Quizzes	15-20
3	Midterm Exam	20
4	Final Exam	40-45
	<b>Total</b>	<b>100</b>

## Student Learning Outcomes:

Students who pass the course will be able to design miscellaneous and complex structural elements manually and using commercial industry softwares. Furthermore, they will have basic understanding of commercial industry software used in the field of structural engineering.

## Course Professional Outcome/Industrial Usage:

Students appreciate the need for becoming good structural engineers capable to design miscellaneous and complex structural elements manually and using softwares and for basic understanding of commercial industry software used in the field of structural engineering.

### MAPPING

CLO's PLO's	CLO 1	CLO 2	CLO 3	CLO 4
PLO-1 (Engineering Knowledge)			√	√
PLO-2 (Problem Analysis)	√	√	√	√
PLO-3 (Design/Development of Solutions)	√	√	√	√
PLO-4 (Investigation)				√
PLO-5 (Modern Tool Usage)	√	√	√	√
PLO-6 (The Engineer and Society)				
PLO-7 (Environment and Sustainability)				
PLO-8 (Ethics)				
PLO-9 (Individual and Team work)				
PLO-10				

(Communication)			
PLO-11 (Project Management)			
PLO-12 (Lifelong Learning)			

<b>CLOs Assessment Modules</b>	<b>CLO-1</b>	<b>CLO-2</b>	<b>CLO-3</b>	<b>CLO-4</b>
Assignments	√	√	√	√
Quizzes	√	√	√	√
Midterm Exam	√	√		√
Final Exam	√	√		√

### **LABORATORY TEMPLATE**

**Course Title : CE-411 Computer Aided Analysis and Design of Structures**

**Pre-requisite(s) : Design of Reinforced Concrete and Steel Structures**

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**Contact Hours : 3**

**Text Book(s) :**

1. ETABS Manual
2. SAP Manual
3. SAFE Manual
4. STAAD PROV Manual

**Reference Book(s):** 1. The Finite Element Method A Practical Course by  
G.R.LIU and S.S.QUEK

**Catalog Data:**

Introduction to ETABS, SAFE,SAP and STAAD PROV. Models; Analysis and Design in ETABS,SAFE,SAP and STAAD PROV.

### **Course Objectives:**

- To use industry standard softwares in a proficient manner in addition to knowing the theoretical concepts of structural analysis and design
- To understand the finite element modeling, specification of loads and boundary conditions, performing analysis and interpretation of results for final analysis and design using commercial softwares.

### **Course Learning Outcomes:**

At the end of this course, the student will be able

**CLO 1:** To use industry standard commercial softwares in professional design state of affairs.

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**CLO 4:** To understand the finite element modeling, specification of loads and boundary conditions, performing analysis and interpretation of results for analysis and design of structures using commercial softwares

### **Lab Practicals:**

#### **Sr. No.**

#### **Lab Practicals**

- 1 Introduction and tutorial learning of ETABS
- 2 Modeling of 2D planer RC frame using ETABS
- 3 Modeling of 3D Space RC frame using ETABS
- 4 Modeling of shell and frame elements using ETABS
- 5 Modeling of four storey RC frame structures for 100 ft x 100 ft plot using ETABS
- 6 Modeling of floors and gravity floor loads for the concrete and steel structures
- 7 Modeling and analysis of concrete and steel structure for gravity loads
- 8 Study and modeling of structure for combination of gravity loads according to ACI Code
- 9 Study and modeling of structure for combination of gravity and seismic loads according to UBC 97

- 10 Study and modeling of structure for combination of gravity and wind loads according to ASCE
- 11 Analysis and design of six storey building using static lateral force procedure method for seismic loading
- 12 Analysis and design of six storey building using response spectrum and time history for seismic loading
- 13 Introduction to SAFE
- 14 Transferring ETABS files to SFAE for analysis and design of floors slabs
- 15 Transferring ETABS files to SFAE for analysis and design of foundations
- 16 Introduction to SAP and Staad Pro
- 17 Analysis and design of water retaining structures
- 18 Analysis and design of bridges

### Grading Guidelines:

Sr. No.	Grading	% of Total Marks
1	Practice	40
2	Mid-Term Exam	20
3	Final Exam	40
	<b>Total</b>	<b>100</b>

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### MAPPING

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PLO-2 (Problem Analysis)	√	√	√	√

PLO-3 (Design/Development of Solutions)	√	√	√	√
PLO-4 (Investigation)				√
PLO-5 (Modern Tool Usage)	√	√	√	√
PLO-6 (The Engineer and Society)				
PLO-7 (Environment and Sustainability)				
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<b>CLOs Assessment Modules</b>	<b>CLO-1</b>	<b>CLO-2</b>	<b>CLO-3</b>	<b>CLO-4</b>
Assignments	√	√	√	√
Quizzes	√	√	√	√
Midterm Exam	√	√		√
Final Exam	√	√		√