

**KANDULA SRINIVASA REDDY MEMORIAL COLLEGE OF  
ENGINEERING (AUTONOMOUS)**

Kadapa-516003. AP

(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC)  
(An ISO 9001-2008 Certified Institution)

**DEPARTMENT OF MECHANICAL ENGINEERING**



Certification Course on

**“COMPUTER AIDED ANALYSIS AND SIMULATION”**

Resource Person : Sri U. Pradeep Kumar, Assistant Professor, Dept. of ME, KSRMCE

Course Coordinators: D. Merwin Rajesh, Assistant Professor, Dept. of ME, KSRMCE

Date: 19/07/2019 to 06/08/2019



# K.S.R.M. COLLEGE OF ENGINEERING

(UGC-AUTONOMOUS)

Kadapa, Andhra Pradesh, India- 516 003

Approved by AICTE, New Delhi & Affiliated to JNTUA, Ananthapuramu.

An ISO 14001:2004 & 9001: 2015 Certified Institution

Lr./KSRMCE/ME/2019-20/

Date: 17-07-2019

To  
The Principal,  
KSRMCE,  
Kadapa.

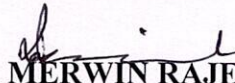
**Sub:** Permission to Conduct Certificate Course on “**Computer Aided Analysis and Simulation**” from 19-07-2019 to 06-08-2019 – Reg.

Respected Sir,

The Department of Mechanical Engineering is planning to offer a certification course on “**Computer Aided Analysis and Simulation**” to B. Tech. students. The course will be conducted from 19-07-2019 to 06-08-2019. In this regard, we are requesting you to grant permission to conduct certificate course.

Thanking you

Yours faithfully

  
(D. MERWIN RAJESH),  
(Asst. Professor)

*Forwarded to Principal Sir  
17/07/2019*

*Permitted  
V. S. S. Murthy  
17/07/2019*



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Lr./KSRMCE/ME/2019-20/

Date: 17-07-2019

## CIRCULAR

The Department of Mechanical Engineering is offering a certification course on “**Computer Aided Analysis and Simulation**” from 19-07-2019 to 06-08-2019 to B.Tech students. In this regard, interested students are required to register for the Certification Course.

Course Coordinator

**D. Merwin Rajesh,**  
Department of Mechanical Engineering

HoD

Professor & head  
Department of Mechanical Engineering  
K.S.R.M. College of Engineering  
KADAPA - 516 003.

Copy to:  
IQAC - KSRMCE



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## DEPARTMENT OF MECHANICAL ENGINEERING

### Certification Course on COMPUTER AIDED ANALYSIS AND SIMULATION

#### LIST OF PARTICIPANTS

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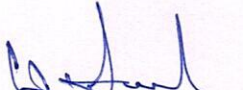
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COORDINATOR

  
HoD

Professor & head  
Department of Mechanical Engineering  
K.S.R.M. College of Engineering  
KADAPA - 516 003.

## **SYLLABUS**

### **COMPUTER AIDED ANALYSIS AND SIMULATION**

#### **Chapter-1**

##### **INTRODUCTION TO FEA AND ANSYS:**

Introduction to FEA, Key Assumptions in FEA, Types of Analysis, Important terms and Definitions, Setting the Analysis Preferences, Units in ANSYS, Exiting ANSYS, Self-and Evaluation Test

#### **Chapter-2**

##### **BASIC SOLID MODELING:**

Solid modeling in ANSYS, Solid modeling methods, Considerations before creating a model for analysis, creating geometric entities, creating and modifying work planes and coordinate systems in ANSYS.

#### **Chapter-3**

##### **ADVANCED SOLID MODELING:**

Advanced Solid Modeling, Creating complex solid models by performing Boolean operations, modifying the solid model, Deleting solid model entities, importing solid models, importing the IGES file, importing models from Pro/ENGINEER and importing the model from unigraphics.

#### **Chapter-4**

##### **FINITE ELEMENT MODELING:**

An overview of the Finite element modeling, element attributes, real constants, material properties, multiple attributes, assigning multiple attributes before meshing, assigning default attributes before meshing, modifying attributes after meshing, verifying assigned attributes and element attributes table.

##### **THERMAL ANALYSIS:**

Thermal analysis, important terms used in thermal analysis, types of thermal analysis and performing steady-state thermal analysis.

## Chapter-5

### SOLUTION AND POSTPROCESSOR:

Solution, defining the new analysis type, restarting the analysis, setting solution controls, setting analysis options, solving the analysis problem and post processing the result.

### GENERATING THE REPORT OF ANALYSIS:

Starting the ANSYS report generator, capturing images, animations, tables and lists for the report, compiling the report and changing the default settings of the ANSYS report generator. Error estimation in solution, percentage error in energy norm, element energy error, and element stress deviations, maximum and minimum stress bounds.

### Learning References

1. <https://www.ansys.com/academic/terms-and-conditions>
2. <https://www.featuredcustomers.com/vendor/ansys/testimonials>
3. <https://www.featuredcustomers.com/vendor/ansys>
4. <http://research.me.udel.edu/~lwang/teaching/MEx81/ansys56manual.pdf>
5. <https://www.afs.enea.it/project/neptunius/docs/fluent/html/ug/node971.htm>
6. <https://www.afs.enea.it/project/neptunius/docs/fluent/html/ug/node332.htm>



Professor & Head  
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## SCHEDULE

### DEPARTMENT OF MECHANICAL ENGINEERING

#### Certification course on

#### “COMPUTER AIDED ANALYSIS AND SIMULATION”

Date	Timing	Resource Person	Topic to be covered
19-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Introduction to FEA, Key Assumptions in FEA
20-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Types of Analysis, Important terms and Definitions, Setting the Analysis Preferences
22-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Units in ANSYS, Exiting ANSYS, Self-and Evaluation Test
23-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Solid modeling in ANSYS, Solid modeling methods
24-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Considerations before creating a model for analysis, creating geometric entities, creating and modifying work planes
25-07-2019	4 PM to 6 PM	U. Pradeep Kumar	coordinate systems in ANSYS
26-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Advanced Solid Modeling, Creating complex solid models by performing Boolean operations,
29-07-2019	4 PM to 6 PM	U. Pradeep Kumar	modifying the solid model, Deleting solid model entities, importing solid models, importing the IGES file
30-07-2019	4 PM to 6 PM	U. Pradeep Kumar	importing models from Pro/ENGINEER and importing the model from unigraphics
31-07-2019	4 PM to 6 PM	U. Pradeep Kumar	Finite element modeling, element attributes, real constants, material properties, multiple attributes, assigning multiple attributes before meshing, assigning default attributes before meshing,
01-08-2019	4 PM to 6 PM	U. Pradeep Kumar	modifying attributes after meshing, verifying assigned attributes and element attributes table.
02-08-2019	4 PM to 6 PM	U. Pradeep Kumar	Thermal analysis, important terms used in thermal analysis, types of thermal analysis and performing steady-state thermal analysis
03-08-2019	4 PM to 6 PM	U. Pradeep Kumar	Solution, defining the new analysis type,





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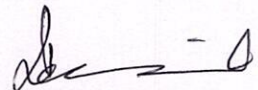
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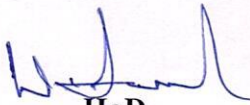
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			restarting the analysis, setting solution controls, setting analysis options, solving the analysis problem and post processing the result
05-08-2019	4 PM to 6 PM	U. Pradeep Kumar	Starting the ANSYS report generator, capturing images, animations, tables and lists for the report, compiling the report and changing the default settings of the ANSYS report generator
06-08-2019	4 PM to 6 PM	U. Pradeep Kumar	Error estimation in solution, percentage error in energy norm, element energy error, and element stress deviations, maximum and minimum stress bounds

  
Course Coordinator

  
HoD

Professor & head  
Department of Mechanical Engineering  
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Report of  
Value Added Course on “COMPUTER AIDED ANALYSIS AND SIMULATION”  
From 19<sup>th</sup> July 2019 to 06<sup>th</sup> August 2019

Target Group	:	B.Tech Students
Details of Participants	:	70 Students
Co-coordinator(s)	:	Sri D.Merwin Rajesh
Resource Person	:	Sri U.Pradeep Kumar
Organizing Department	:	Mechanical Engineering
Venue	:	Seminar Hall, Mechanical Department

**Description:**

The Department of Mechanical Engineering conducted a certification course on “COMPUTER AIDED ANALYSIS AND SIMULATION” 19<sup>th</sup> July 2019 to 06<sup>th</sup> August 2019. The course duration was 30 hours. The course Resource Persons are Sri U.Pradeep Kumar, Assistant Professor and Sri D.Merwin Rajesh, Assistant Professor Department Mechanical Engineering, KSRMCE.

The main objective of this course is COMPUTER AIDED ANALYSIS AND SIMULATION is mainly using Ansys Software.

It provides an Analysis and simulation software ANSYS for the students Familiar in Analysis and simulation. Computing has completely changed the world in the past decade and its power is continually increasing.

CAD software is frequently used by different types of engineers and designers. CAD software can be used to create two-dimensional (2-D) drawings or three-dimensional (3-D) models. CAD allows experts to create more accurate design representations. CAD replaced manual design drafting, allowing design development alteration and optimization.

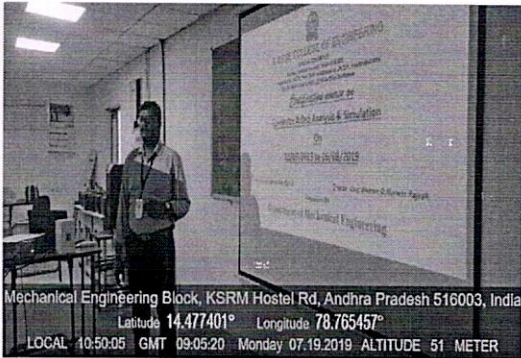
CAM is Computer-aided manufacturing reduces the dependency on manual labour for any production process. A technological approach helps control machines, other equipment and software with ease. It reduces set-up time, minimises training, improves cost-efficiency and reduces errors in production operations.

CAE is the use of computer software to simulate performance in order to improve product designs or assist in the resolution of engineering problems for a wide range of industries. CAE involves computers to perform much of the iteration of synthesis and analysis in the design procedure. Digital prototyping refers to a computer-generated realistic prototype model near or at the final state of the product.

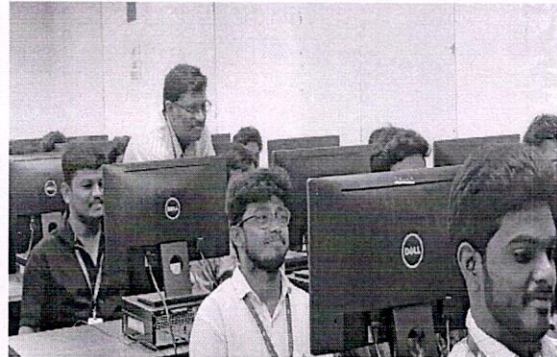
On final Day last session Value added course is Ended with oath of thanks and certificate distribution by coordinator & HOD to the Participants. Feedback from participants are collected.

### Photos

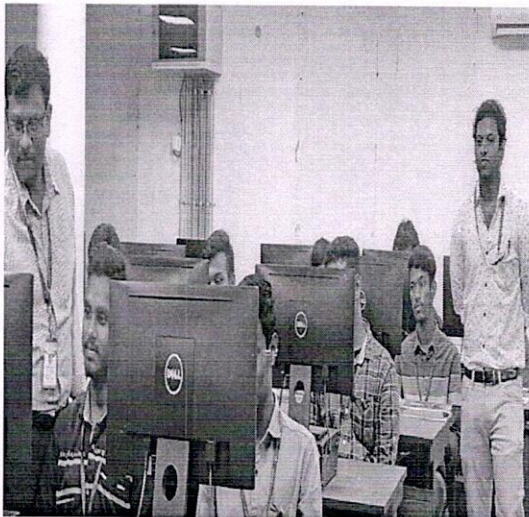
The pictures taken during the course are given below:



Inaguration of Programme




Students Particing during to the course

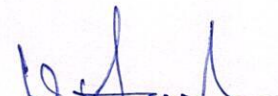


Students Practicing and clarifying their doubts



Certificate distribution to the students

  
Coordinators

  
HoD

Professor & head  
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*Certification Course on*

**"COMPUTER AIDED ANALYSIS AND SIMULATION"**

***19/07/2019 to 06/08/2019***

**ORGANIZED BY**

**DEPARTMENT OF MECHANICAL ENGINEERING**







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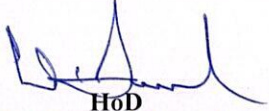
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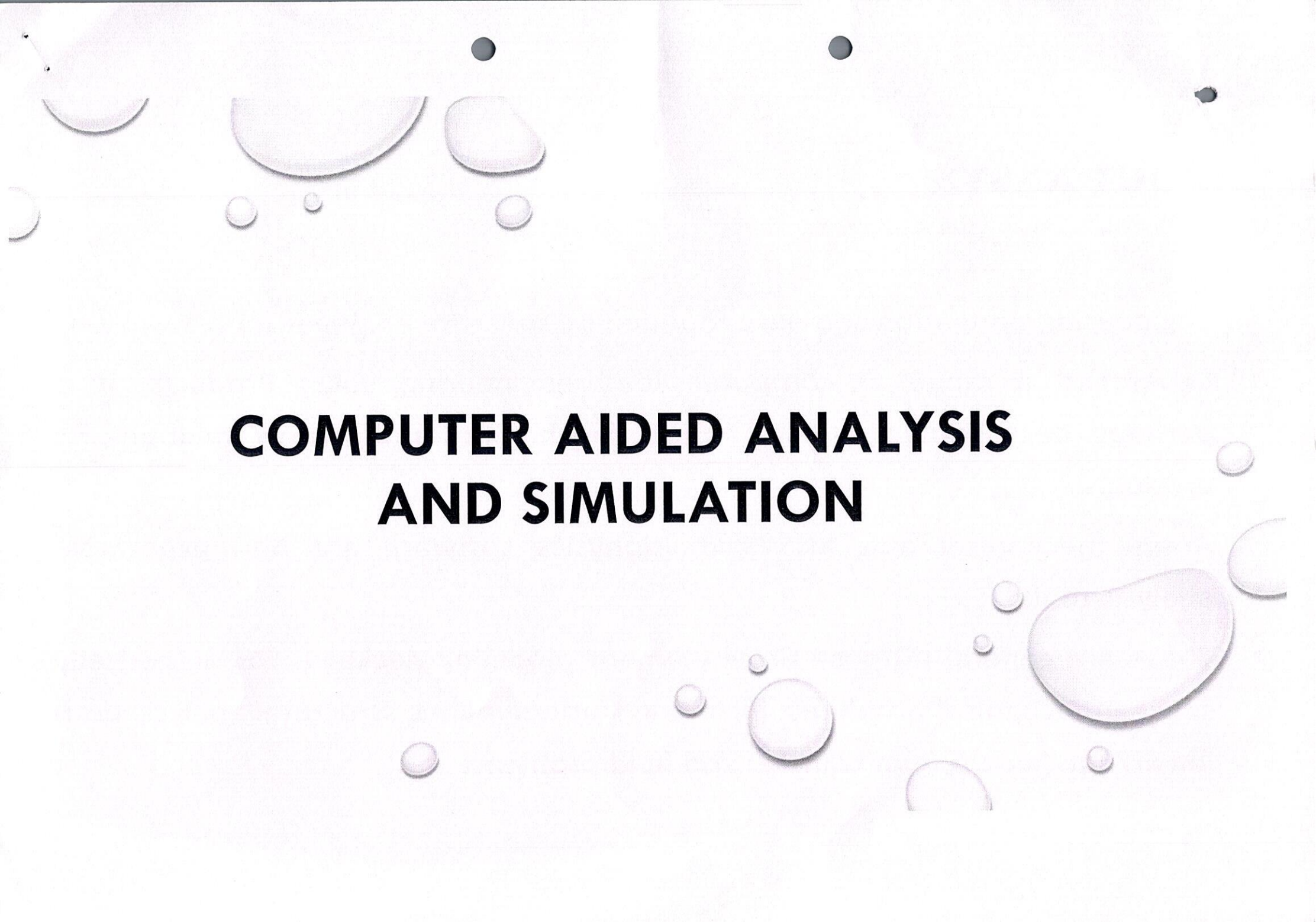
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58	179Y5A0324	MANDLA VIJAYA KUMAR	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
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61	179Y5A0327	MUTHUKURU SATISH KUMAR	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P
62	179Y5A0328	NADENDLA KULLAYAPPA	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P
63	179Y5A0329	NAGELLA VISWANATHA REDDY	P	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P
64	179Y5A0330	NAKKALA MADHUSUDHAN	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	A
65	179Y5A0331	NEMBI DURGA PRASAD	P	P	P	P	P	P	P	P	P	P	A	P	P	P	P	P	P
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67	179Y5A0334	PATNAM SUBAN BASHA	P	P	P	P	P	P	P	A	P	P	P	P	P	P	P	P	P
68	179Y5A0336	SANAGALA SREENIVASULU	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
69	179Y5A0337	SANGPATNAM LINGAMURTHI	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P	P	P
70	179Y5A0338	SANGATI LAKSHMI REDDY	P	P	P	P	A	P	P	P	P	P	P	P	P	P	P	P	P

  
COORDINATOR

  
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Professor & Head  
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The background of the slide is white and features several realistic water droplets and bubbles of various sizes. Some are in the top left, some in the top right, and a larger cluster is in the bottom right. There are also three small dark circular marks near the top edge, possibly representing punch holes or artifacts.

# **COMPUTER AIDED ANALYSIS AND SIMULATION**



## ABOUT ANSYS

- Engineering simulation software founded by software engineer John Swanson.
- Developed a range of computer-aided engineering (CAE) Products, it is perhaps best known for its ANSYS mechanical and ANSYS multiphysics products.
- Ansys mechanical and ANSYS multiphysics software are non exportable analysis tools.
- These are general purpose finite element modeling packages for numerically solving mechanical problems, including static/dynamic structural analysis both linear/non linear), heat transfer and fluid problems

## **About Analysis**

Process of analyzing a structure to the externally applied loads( Pressure, Force, Temperature)

# Basic Terminologies-Structural analysis

- Stress
- Strain
- Poisson ratio
- Hook's law
- Young's modulus
- Bending moment
- Shear force
- Stress strain curve for various materials
- Linear
- Nonlinear
- Isotropic vs. anisotropic vs. orthotropic

# GLOBAL & LOCAL AXES

## GLOBAL :

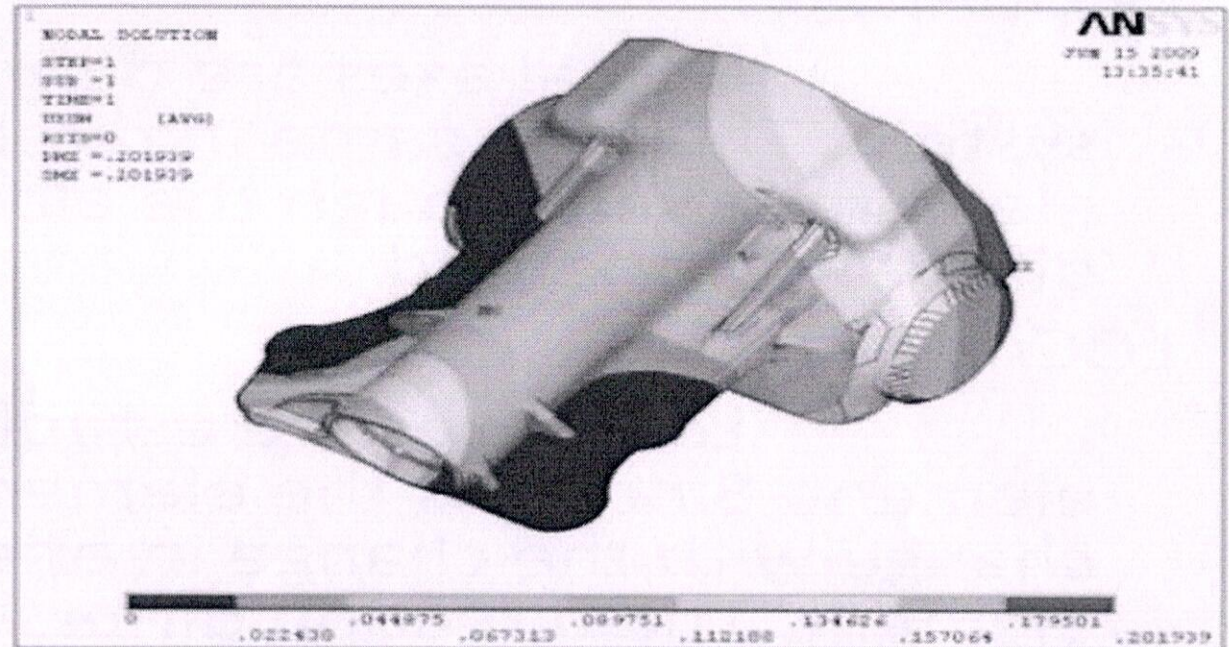
Global axes are defined for the entire system. They are same in direction for all the elements even though the elements are differently oriented

## LOCAL :

Local axes are established in an element. Since it is the element level, they change with the change in orientation of the element. The direction differs from element to element

## Need for Analysis

- To reduce product development cycle time
- To reduce the cost of product
- Idle time reduction
- Better design and Alternate materials
- To reduce material wastage



# Types of Methods

- Mathematical approach
- Physical model
- Numerical method

# Introduction to FEM & FEA

- FEM-Finite element method
- FEA –Finite element analysis

# FEM

- Finite element method of structural analysis was created by academic and industrial researches during 1959's and 1960's
- Theoretical approach.
- Examples  
Euler's rule, LaGrange method,  
Newton Raphson method, Fourier series



# Nature of FEM

- Force method (Forces unknown)
  - Strain energy method
  - Consistent deformation method
  - Matrix flexibility method
  - Clayperons theorem of 3 moments
- Displacement method (Displacements unknown)
  - Kanis method
  - Slope deflection method
  - Matrix stiffness method
  - Moment distribution method
  - FEM

# FEA

FEA-

simulate loading conditions on design & determine design response to these conditions

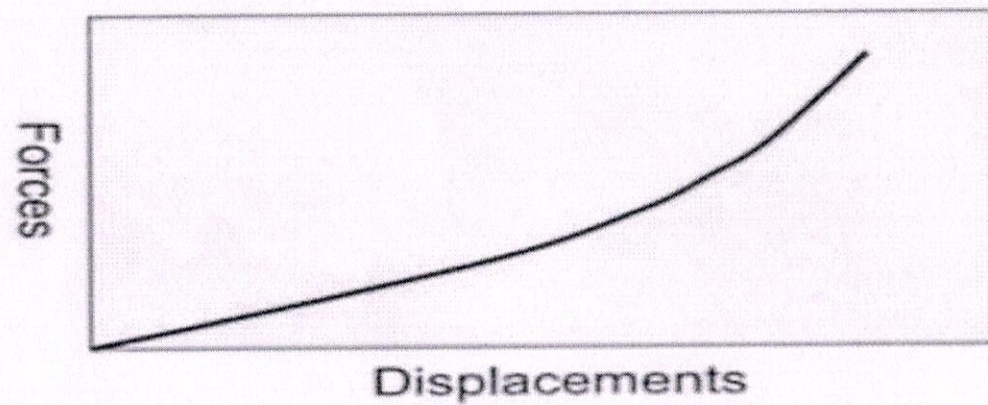
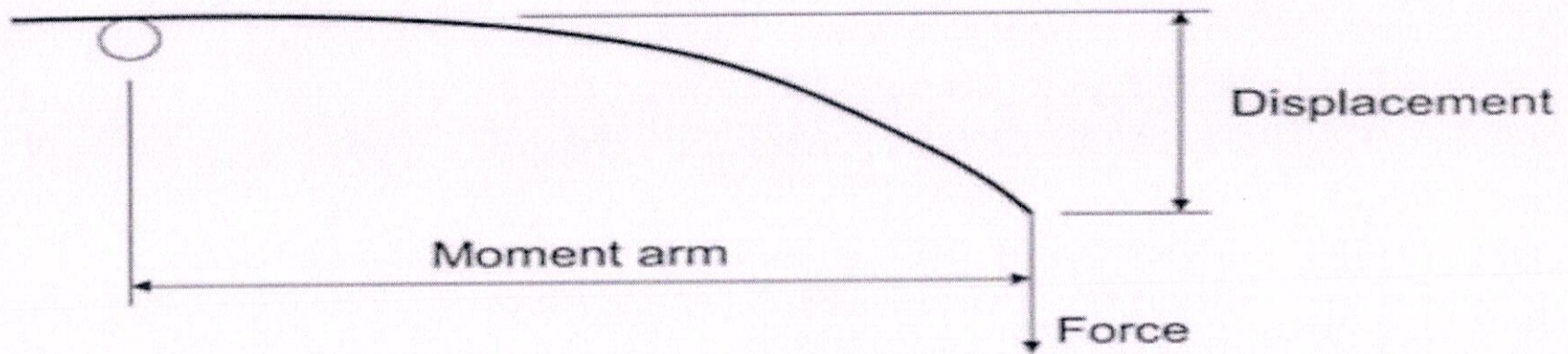
The design is modeled using discrete elements called elements

The sum of response of all elements in the model gives the response of design

# Problem types in FEA

- Boundary value problem-static and steady state analysis
- Initial value problem-fluid flow
- Eigen value problem-Modal analysis, vibration and natural frequency
- Boundary initial value problem-forced vibration, transient and dynamic analysis

# Geometric Nonlinearity



# Advanced Solution Options

```
01  EQSLV, Lab, TOLER, MULT
02  SOLCONTROL, Key1, Key2
03  NEQIT, NEQIT
04  CNVTOL, Lab, VALUE, TOLER, NORM, MINREF
05  NROPT, Option,, Adptky
06  LNSRCH, Key
07  PRED, Sskey, --, Lskey
08  SSTIF, Key
09  PSTRES, Key
10  CUTCONTROL, Lab, VALUE, Option
11  TIMINT, Key, Lab
12  TINTP, GAMMA, ...
13  NCVN, KSTOP, DLIM, ITLIM, ETLIM, CPLIM
```

## ANSYS- TOPICS

Structural

- Static
- Dynamic

Thermal

- Steady state
- Transient state

CFD

- Laminar
- Turbulent

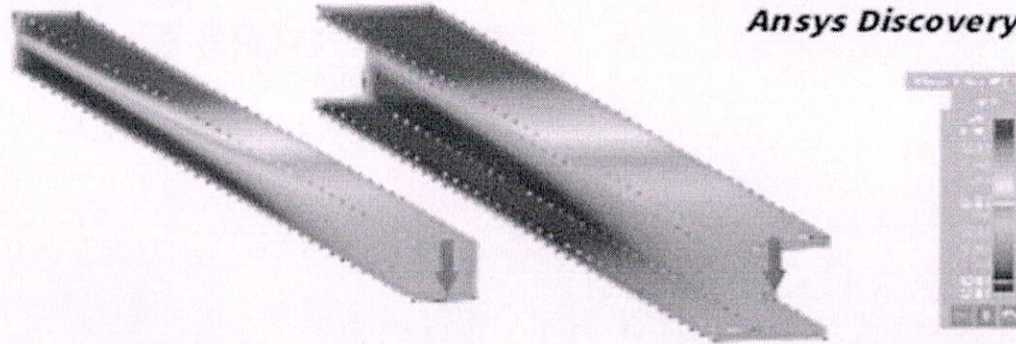
# Finite Element Simulations

- Can estimate the deflection caused by certain load
- Map the stress within the geometry caused by this load

Provided the necessary material properties are given

*Simulation of stress in beams (same area) for fixed material choice*

*Ansys Discovery Live*



**Opportunity: Using Granta EduPack to screen and select top material candidates in combination with Finite Element simulation to optimize geometry, engineers and designers can reduce the number of material candidates to consider in structural design.**

# Static analysis

- Analysis of a structure for various loads under static condition i.e. component under rest when loads are applied

## Examples

Holding devices-Clamp or fixture analysis

## Types

Linear analysis

Non linear analysis



# Dynamic analysis

- Analysis of a structure for various loads under Dynamic condition i.e. component is in motion when loads are applied or time varying loads

## Examples

Suspension systems of a vehicle

## Types

Linear analysis

Non linear analysis

# Structural analysis-Design consideration

- Change design
- Alternate material

# Thermal analysis

- To determine the temperature distribution occurring in the model

## Modes of heat transfer

Conduction

Convection

Radiation

# FEM

- Nodes
- Elements

## Types of elements

1D-Line element (Min 2 nodes)

2D-Plane element (Area-Min 4 node)

3D-Solid element (Volume-min 8 nodes)

# EXAMPLES FOR FINITE ELEMENT

ONE DIMENSIONAL ELEMENTS :

TRUSS ELEMENTS

BAR, BEAM ELEMENTS

TWO DIMENSIONAL ELEMENTS :

TRIANGULAR ELEMENTS

RECTANGULAR ELEMENTS

THREE DIMENSIONAL ELEMENTS

TETRAHEDRAL ELEMENTS

HEXAHEDRAL ELEMENTS

# Meshing-Importance & drawbacks

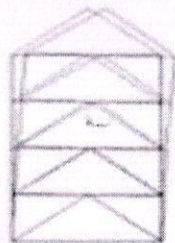
- Why should we mesh
- Element quality
- Problems associated with meshing

# FEM/ANSYS

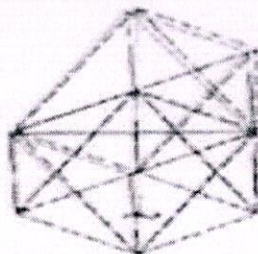
## Section I: Structural

By completing this section you will learn basic structural analysis using ANSYS.

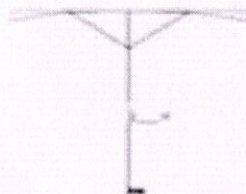
■ Truss Structure



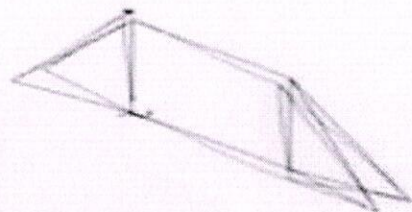
■ Truss Structure



■ Beam Structure



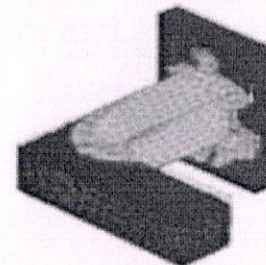
■ Beam Structure



■ 2D Bracket



■ 3D Solid





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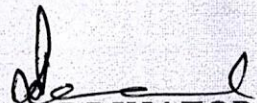
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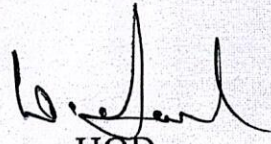
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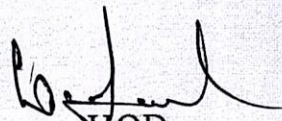
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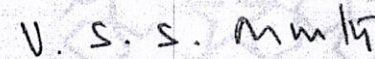
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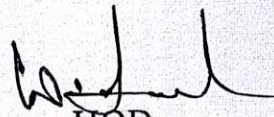
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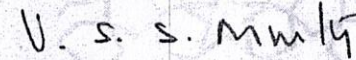
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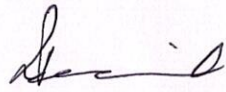
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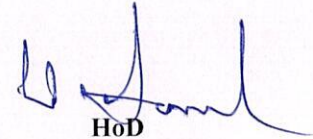
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54	179Y5A0319	KUMMARI MAHESH KUMAR	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
55	179Y5A0321	KURUVA SIVACHANDRUDU	Excellent	Excellent	Excellent	Satisfactory	Excellent	Excellent	
56	179Y5A0322	MADDU VARUN	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
57	179Y5A0323	MALLEM HARI PRANAY	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
58	179Y5A0324	MANDLA VIJAYA KUMAR	Excellent	Excellent	Excellent	Excellent	good	Excellent	
59	179Y5A0325	MANGALI NAGARAJU	good	Excellent	Excellent	Excellent	Excellent	Excellent	
60	179Y5A0326	M SIVA SANKAR YADAV	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
61	179Y5A0327	MUTHUKURU SATISH KUMAR	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
62	179Y5A0328	NADENDLA KULLAYAPPA	Excellent	Excellent	Excellent	Excellent	Excellent	good	
63	179Y5A0329	N VISWANATHA REDDY	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
64	179Y5A0330	NAKKALA MADHUSUDHAN	Excellent	Satisfactory	Excellent	Excellent	Excellent	Excellent	
65	179Y5A0331	NEMBI DURGA PRASAD	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
66	179Y5A0333	PATHAN ASIF KHAN	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
67	179Y5A0334	PATNAM SUBAN BASHA	Excellent	Excellent	Excellent	Satisfactory	Excellent	Excellent	
68	179Y5A0336	SANAGALA SREENIVASULU	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	
69	179Y5A0337	S LINGAMURTHI	Excellent	Excellent	Excellent	Satisfactory	Excellent	Excellent	
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