

# COMPUTER AIDED ENGINEERING DESIGN (BFF2612)

## Introduction

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Design: Dr Nizar

# OVERVIEW

- Aims
  - Introduction of CAD/CAE/CAM
- Expected Outcomes
  - Students should be able to understand to the terms of CAD/CAE/CAM and it applications
- References
  1. Ibrahim Zeid, 2005. Mastering CAD/CAM, McGraw Hill
  2. Chris Mc Mohan, Jimmie Browne CAD CAM from principle to practice, Addison Wesley Publishing



# 4C

- **Computer Aided Design**
- **Computer Aided Engineering**
- **Computer Aided Manufacturing**
  
- **Computer Integrated Manufacturing**

- **CAD**
- **CAE**
- **CAM**
  
- **CIM**



**Engineering design + production function**



**Business philosophy**

# WHAT IS CAD?

## COMPUTER AIDED DESIGN

- Process that utilized computers to create, design and edit the models or drawings.
- Create geometric features for architectural structure, mechanical part, building layout or other electronic circuit,
- The information stored in computer database as the basis to produce engineering drawings.
- The CAD referred to 3D work in computer aided design, 2D computer aided drafting.



# ADVANTAGES OF 3D CAD

- Reduces the time and labour required to make engineering drawings.
- Eliminates drawing errors and mistakes caused by misreading the drawings.
- Gives an accurate geometric database that can be used to generate Numerical Control (NC), to design patterns, special tools, and fixtures needed to manufacture the part.
- The master model can be used to purchasing agents, cost estimators, inspectors, and production planners all directly viewed the CAD model to do their jobs.



# What is CAE?

## COMPUTER AIDED ENGINEERING

- To analyze CAD geometry, to simulate and to observe how the product will behave and find any errors earlier during the design cycle.
- Therefore, the design able to be refined and optimized and reducing overall product development time and cost.
- To analyze products that are already manufactured, but experiencing problems.



# What is CAE?

## COMPUTER AIDED ENGINEERING

- Finite element analysis (FEA) or Finite element model (FEM) function to analyze stress, strain, displacement, force, etc. of structure/part design.
- Kinematics: to analyze the movement of mechanism (displacement, force, velocity and acceleration).
- Dynamics: to analyze displacements, forces or vibration in complex mechanical systems such as vehicles.
- Rapid prototyping: to quickly transform CAD models into small physical models.



# COMPUTER-AIDED ENGINEERING (CAE)

## What if:

I change the *size*?

I change the *material*?

I change the *entire concept*?

ANALYSIS – SIMULATION – VALIDATION – OPTIMIZATION

The process of analysis involves simulating a product within an environment to predict an outcome.

## Example:

- In computer games, simulate other worlds and times.
- Print preview in word processors simulates how the printed page will look.



# What is CAM?

## COMPUTER AIDED MANUFACTURING

- Provide instructions to automated machines.  
Used to manufacture parts, assemblies, and circuits,
- The geometric data from CAD is used as a starting point.
- Generate Computer Numerical Control (CNC): to control a machine tool that grinds, cuts, mills, etc.



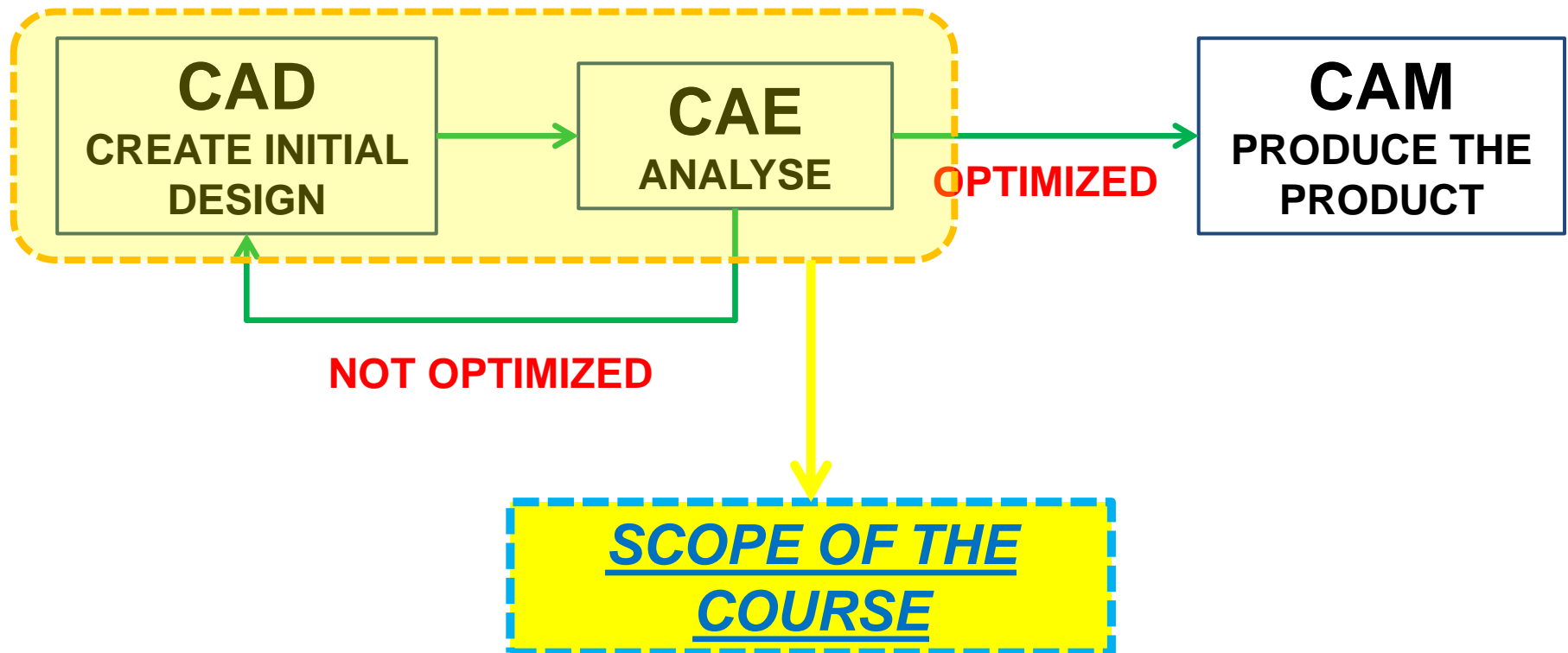
# What is CIM?

## Computer Integrated Manufacturing

- Process of using computer databases to run an entire factory more efficiently, such as in accounting, factory management, scheduling, and shipping.
- Overall data sharing, information flow and work.
- CIM applies in the areas as design, drafting, analysis, and testing:
  - Inventory control, engineering department, machine control, process planning, quality assurance;
  - Generate report, forecast, and plant management.



# CAD / CAE / CAM



# CAD-CAE-CAM SYSTEMS

- A CAD-CAE-CAM system is a complex application that requires both hardware and software.
- CAD-CAE-CAM software can run as a client/server or standalone application.
- CAD-CAE-CAM software utilizes a data structure to save the geometry and topology of geometric models.
- The data structure is a well-defined storage scheme that stores model data.
- A CAD database is the file that stores the model information where each file has a name and an extension.



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# CAD-CAE-CAM SYSTEMS

- New users are faced with two challenging problems:
  - ✓ Must understand the concepts of 3D modeling and viewing and how to control geometric construction.
  - ✓ Must learn the structure of the software Graphical User Interface (GUI) and where to find commands when needed.
- Learning and using one system should help accelerate learning and using other systems.
- CAD-CAE-CAM software is designed to run on all platforms and operating system.



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# Why is it important to study these subjects?

- ❖ CAD-CAE-CAM have been utilized in engineering practices:
  - Drafting
  - Design
  - Simulation
  - Analysis
  - Manufacturing
- ❖ CAD-CAE-CAM users become very inefficient in using the systems unless they understand the fundamental concepts on which these systems are built.

# So, what will be learned in this course?

This course will explain and apply the concepts and practices of geometric modeling in CAD/CAE system.



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# ADDITIONAL INFORMATION AND LECTURE NOTES

- <https://grabcad.com/library/category/aviation>
- <http://nptel.ac.in/courses/Webcourse-contents/IIT-Delhi/Computer%20Aided%20Design%20&%20Manufacturing/>
- <http://www.freecadweb.org/>





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