

AUPE3007 COMPUTER AIDED DESIGN AND GRAPHICS (3-0-0)

Course Objectives:

1. To introduce the fundamentals of computer-aided design and its application in 2D and 3D modeling.
2. To familiarize students with computer-aided manufacturing processes including CNC and toolpath generation.
3. To integrate knowledge of CAD/CAM, product data exchange, and modern manufacturing technologies.
4. To explore additive manufacturing techniques used in rapid prototyping and production.

Module I: Computer Aided Design (CAD) (08 Hours)

Introduction to CAD systems – features and benefits. Types of CAD models: wireframe, surface, and solid modelling. 2D Sketching: Constraints, dimensioning, parametric design principles. 3D Modeling Techniques: Extrude, revolve, sweep, loft, shell, fillet, draft. Assembly modeling and kinematic simulations. CAD File Formats: Native formats (.sldprt, .ipt), exchange formats (.IGES, .STEP, .STL, .DXF). Import/export of geometry for simulation and manufacturing. Overview of CAD tools: AutoCAD, SolidWorks, CATIA, Fusion 360.

Module II: Computer Aided Manufacturing (CAM) (08 Hours)

Introduction to CAM: benefits and limitations. Types of CAM operations: turning, milling, drilling. Machining Setup: Stock definition, machine setup, fixture design. Tool library and tool selection criteria. Toolpath Generation: Roughing, finishing, facing, contouring, pocketing. Post-processing and NC code generation. CAM simulation and verification – collision checking and cycle time estimation. Overview of CAM tools: Mastercam, Fusion 360, Siemens NX CAM.

Module III: CAD/CAM Integration (07 Hours)

Introduction to CAD-CAM-CAE integration and digital thread. Product Lifecycle Management (PLM): data management, versioning, collaboration. Enterprise Resource Planning (ERP): role in CAM workflow. Interoperability of CAD/CAM systems.

Standard Data Exchange Formats:

IGES (Initial Graphics Exchange Specification). STEP (Standard for the Exchange of Product Data). DXF, STL – format structures and use cases.

Integration of CAE simulation results with design modifications.

Module IV: Computer Numerical Control (CNC) (08 Hours)

Introduction to CNC machines and axis nomenclature (X, Y, Z, A, B, C). Structure of a CNC system – controller, motors, drives, encoders.

CNC Part Programming:

G-Codes: linear interpolation (G01), rapid traverse (G00), canned cycles (G81, G83). M-Codes: spindle control, coolant, tool change.

Manual part program writing for turning and milling. Tool offset, datum setting, and work coordinate systems (G54–G59). Subprograms and macro programming. Introduction to DNC and real-time CNC control.

Module V: Additive Manufacturing (AM) (09 Hours)

Introduction to AM and classification of processes. Rapid Prototyping Systems: principles and process steps. Stereolithography (SLA): photopolymerization, layer curing, resolution. Selective Laser Sintering (SLS): powder bed fusion, sintering of polymers/metals. Fused Deposition Modeling (FDM): thermoplastic extrusion, material properties. Comparison of AM technologies based on materials, accuracy, and application. Design for Additive Manufacturing (DfAM) principles. Application of AM in automotive, biomedical, aerospace, and tooling. Hybrid manufacturing and future trends in digital fabrication.

Course Outcomes (COs):

Upon completion of this course, students will be able to:

CO1: Create and manipulate 2D sketches and 3D models using CAD software.

CO2: Generate machining toolpaths and simulate manufacturing operations using CAM tools.

CO3: Understand and implement data exchange formats and PLM tools in CAD/CAM integration.

CO4: Demonstrate knowledge of CNC programming and interpret G-code/M-code instructions.

CO5: Analyze additive manufacturing methods and their application in product development.

Text Books:

1. Ibrahim Zeid – Mastering CAD/CAM, Tata McGraw Hill
2. Mikell P. Groover – Automation, Production Systems, and Computer-Integrated Manufacturing, Pearson
3. Farid Amirouche – Computer Aided Design and Manufacturing, Pearson

Reference Books:

1. ChrisMcMahon, Jimmie Browne – CAD/CAM: Principles, Practice and Manufacturing Management, Pearson
2. Amitabha Bhattacharyya – New Technology of Computer Aided Design and Manufacturing, Khanna Publishers
3. Andreas Gebhardt – Understanding Additive Manufacturing, Hanser Publishers