**CAD/CAM/CAE (MIEG 6431)**

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| **Addis Ababa Institute of Technology, Addis Ababa University**  **School of Mechanical & Industrial Engineering**  **Manufacturing Engineering Chair**  **MS.c in Manufacturing Engineering program** | |
| **Course Number** | MIEG 6431 |
| **Course Title** | CAD/CAM/CAE |
| **Degree Program** | MS.c in Mechanical Engineering (Manufacturing Engineering) |
| **Instructor** | Desalegn Wogaso (Ph.D) |
| **Credit Hours:** | 3 ( **Contact hrs**: 2 lecture hrs + 3 tutorial hrs) |
| **ESTC** | 7 |
| **Learning Outcomes** | On successful completion of this module students would be able to:   * Create the different wireframe primitives using parametric representations * Create surface primitives using parametric modeling * Create the different solid primitives using the different representation schemes * Apply geometric transformations on the created wireframe, surface and solid models * Apply the concepts of machining for the purpose of selection of appropriate machining centers, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment * Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications. * Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools. * Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology. |
| **Course Content** | 1. **INTRODUCTION**: Definition and scope of CAD/CAM, Introduction to design process and role of computers in the design process. 2. **TRANSFORMATIONS**: 2D and 3D transformations. 3. **CURVES AND SURFACES**: Analytical, Synthetic curves with advantages, Disadvantages, Comparison with parametric curves, Geometric modeling curves and surfaces, Representation, Wire frame models, Parametric representations, Parametric curves and surfaces, Manipulations of curves and surfaces, DDA, Bresenham’s /Mid-point line, circle, ellipse algorithms. 4. **SOLID MODELING**: Solid models, Fundamentals of solid modeling, Different solid representation schemes, Half -spaces, Boundary representation (B-rep), Constructive solid geometry (CSG), Sweep representation, Analytic solid modeling, Perspective, Parallel projection, Hidden line removal algorithms. 5. **CAD/CAM DATA EXCHANGE FORMATS**: Types of file formats & their exchange, Graphics standards. 6. **NEED OF NC TECHNOLOGY, FUNDAMENTAL CONCEPTS IN NUMERIC CONTROL:** Structure and functions of NC System, advantages of NC technology over conventional manufacturing. 7. **NC MACHINE TOOLS**: Types, Definition and designation of control axes, Special constructional and design characteristics of NC machine tools, Standard tooling used for NC turning and milling centers. 8. **NC PART PROGRAMMING**: Work holding and tool setting procedure for NC turning and milling centers, Tool zero presetting, Block formats and introduction to ISO based G & M codes for NC part programming, Concepts of tool length and radius compensation, Standard canned cycles used in CNC turning and milling centers, Introduction to automatic NC part program generation from CAD models using standard CAD/CAM software for machining of surfaces, moulds and dies etc. 9. **COMPUTER NUMERICAL CONTROL OF MACHINE TOOLS:** Types and functions of computer numeric control (CNC), Types and functions of direct numeric control (DNC), Need of adaptive control types, functions and types of adaptive control, its uses & benefits, Advantages of combined CNC/DNC systems. 10. **SYSTEM DEVICES**: Drives, Feedback devices, Interpolator systems, Control loop circuit elements in point to point (PTP) and contouring system, Interpolation schemes for linear and circular interpolations. |
| **Pre-requisites** | None |
| **Semester** | I |
| **Status of Course** | Core |
| **Method of Delivery** | Lectures supported by tutorials, Assignments, Laboratory exercises, Project & Final Examination |
| **Assessment Strategy** | Assignments, Laboratory exercises, Project = 50% and Final Exam = 50% |
| **Module Requirements** | * Minimum of 75% attendance during lecture hours * 100% attendance during practical laboratory sessions, except for some unprecedented mishaps * All exercises and project works must be submitted by the specified dead line date |
| **Text Books** | 1. Zeid, I., CAD/CAM, McGraw Hill (2008) 2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill (1989). 3. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008). 4. Rooney, J. and Steadman, P., Principles of Computer Aided Design, prentice Hall (1988). 5. Rooney, J. and Steadman, P., Computer Aided Design, Pitman/Open University (1987). 6. Mallineuse, G., Computational Concepts and Methods, Kogan Page Ltd. (1986). 7. Manuals & Tutorials on CAD/CAE packages like Pro/Engineer, Pro/Mechanica, ANSYS, etc latest available in the lab. 8. Kelley David S., Pro/ENGINEER Wildfire 5.0 Instructor, Tata McGraw Hill (2011). 9. Shih Randy H., Introduction to Finite Element Analysis Using Creo Simulate 1.0, SDC Publications, USA (2011, ISBN: 978-1-58503-670-7, ISBN (Book + Software on Disk): 978-1-58503-731-5 10. Toogood Roger Ph.D., P. Eng., Zecher Jack P.E., Creo Parametric 1.0 Tutorial and MultiMedia DVD, SDC Publications, USA (2012), ISBN: 978-1-58503-692-9, ISBN (Book + Software on Disk): 978-1-58503-730-8 11. Shih Randy H., Parametric Modeling with Creo Parametric 1.0-An Introduction to Creo Parametric 1.0, SDC Publications, USA (2011) ISBN: 978-1-58503-661-5, ISBN (Book + Software on Disk): 978-1-58503-729-2 |