

MECHANICAL DRAFTING AND DESIGN II

Mechanical Drafting and Design II covers working drawings both in detailing and assembly. Topics include: fastening devices, thread symbols and nomenclature, surface texture symbols, classes of fits, and the use of parts lists, title blocks and revision blocks. This course will also focus on advanced CAD features, including fundamentals of three-dimensional modeling for design. An overview of modeling, graphical manipulation, part structuring, coordinate system, and developing strategies of modeling will also be included. Advanced CAD will enable the student to make the transition from 2D drafting to 3D modeling. Students will draw and calculate three dimensional problems. Theory and methods include graphic developments and the relationships between points, lines and planes, curved lines and surfaces, intersections, and development. Computer software and hardware experiences, as they relate to drafting and design, will be covered.

- DOE Code: 4838
- Recommended Grade Level: Grade 12
- Recommended Prerequisites: Mechanical Drafting and Design I
- Credits: 2-3 credits per semester, maximum of 6 credits
- Counts as a Directed Elective or Elective for the General, Core 40, Core 40 with Academic Honors and Core 40 with Technical Honors diplomas
- This course is aligned with postsecondary courses for Dual Credit
 - Ivy Tech
 - DESN 104 – Mechanical Graphics
 - DESN 220 – Advanced CAD
 - Vincennes University
 - DRAF 120 – Computers for Technology
 - DRAF 150 – Descriptive Geometry

Dual Credit

This course provides the opportunity for dual credit for students who meet postsecondary requirements for earning dual credit and successfully complete the dual credit requirements of this course.

Application of Content and Multiple Hour Offerings

Intensive laboratory applications are a component of this course and may be either school based or work based or a combination of the two. Work-based learning experiences should be in a closely related industry setting. Instructors shall have a standards-based training plan for students participating in work-based learning experiences. When a course is offered for multiple hours per semester, the amount of laboratory application or work-based learning needs to be increased proportionally.

Career and Technical Student Organizations (CTSOs)

Career and Technical Student Organizations are considered a powerful instructional tool when integrated into Career and Technical Education programs. They enhance the knowledge and skills students learn in a course by allowing a student to participate in a unique program of career and leadership development. Students should be encouraged to participate in SkillsUSA, the CTSO for this area.

Content Standards

Domain – History of Tool Technology

Core Standard 1 Students analyze the evolution of tool technology.

Standards

- MDII-1.1 Describe the evolution of machining
- MDII-1.2 Research ISO standards
- MDII-1.3 Identify casting processes
- MDII-1.4 Research robotics used in tool and die processes

Domain – Utilize the Design Process and Tools in Mechanical Drafting

Core Standard 2 Students analyze the design process used in mechanical drafting applications.

Standards

- MDII-2.1 Conceptualize sketches and diagrams that demonstrate problem solving of programmatic issues
- MDII-2.2 Utilize fundamentals of formal conceptual relationships, design methodology, and design process
- MDII-2.3 Develop basic spatial and compositional ideas introduced through the study of typology, diagrams, and process of conceptualization
- MDII-2.4 Demonstrate an ability to represent ideas in form and space, as a conceptual and cultural response to program, type, mechanical language and design methods
- MDII-2.5 Analyze forces and loads on a structure
- MDII-2.6 Identify line weights and how they relate to specific line types
- MDII-2.7 Apply industry standards in mechanical drafting

Domain – Mathematical Concepts Found in Mechanical Drafting

Core Standard 3 Students apply and adapt math concepts to design processes.

Standards

- MDII-3.1 Calculate distances, surface area, volumes, slope, and angles
- MDII-3.2 Understand and apply stress analysis to an object

Domain – Solving Spatial Problems Using Descriptive Geometry

Core Standard 4 Students analyze drawing concepts to solve spatial problems using descriptive geometry.

Standards

- MDII-4.1 Apply the rules of projection to solve for the other views given two views of lines, points, and/or surfaces
- MDII-4.2 Determine graphically the true length of lines
- MDII-4.3 Measure angles and distances to properly close polygons given the bearings and distances of all but one side of the polygon
- MDII-4.4 Draw successive auxiliary views of objects given two views
- MDII-4.5 Solve inclination problems
- MDII-4.6 Determine the edge view of a surface given other views
- MDII-4.7 Determine the point view of a line given other views
- MDII-4.8 Draw the true shape of a surface given other view
- MDII-4.9 Determine the visibility of two non intersecting objects

- MDII-4.10 Determine the shortest distance from a point to a plan given other views
- MDII-4.11 Find the shortest distance between two parallel planes given other views
- MDII-4.12 Determine the shortest distance between two lines given other views
- MDII-4.13 Determine the intersection of a line and a surface
- MDII-4.14 Find the intersection of two surfaces
- MDII-4.15 Determine the angle between two lines
- MDII-4.16 Determine the dihedral angle between two surfaces
- MDII-4.17 Find the resultant force of three concurrent coplanar forces
- MDII-4.18 Determine the resultant force of three concurrent non-planar forces
- MDII-4.19 Design flat pattern layouts of circular and cone shaped objects
- MDII-4.20 Develop flat pattern layouts of flat sided objects
- MDII-4.21 Determine the visibility of a line intersecting a surface
- MDII-4.22 Find the visibility of lines of an object

Domain – Mechanical Graphics

Core Standard 5 Students prove understanding of mechanical concepts that connect to industry standard drawings.

Standards

- MDII-5.1 Identify and draw various fastening devices
- MDII-5.2 Draw thread symbols and understand thread nomenclature
- MDII-5.3 Develop proper surface texture symbols
- MDII-5.4 Calculate classes of fits
- MDII-5.5 Develop a parts list
- MDII-5.6 Complete accurate title and revision blocks
- MDII-5.7 Research and utilize various standard blocks
- MDII-5.8 Develop detailed part and assembly drawings
- MDII-5.9 Determine tolerances on parts

Domain – Solving Advanced Design Challenges in Mechanical Drafting

Core Standard 6 Students create 3D CAD drawings to validate their knowledge of mechanical drafting.

Standards

- MDII-6.1 Understand the similarities and differences between 2D and 3D models
- MDII-6.2 Utilizing precision measuring tools to determine correct measurements
- MDII-6.3 Manage 3D space
- MDII-6.4 Create, modify, and use 3D wire frame, surface, and solid models
- MDII-6.5 Construct any surface or solid model
- MDII-6.6 Create production drawings of the 3D models
- MDII-6.7 Demonstrate an understanding of terminology

Domain – Careers in Mechanical Drafting

Core Standard 7 Students evaluate and explore mechanical careers and opportunities.

Standards

- MDII-7.1 Compare mechanical drafting careers

- MDII-7.2 Investigate mechanical drafting opportunities offered by a technical school or college
- MDII-7.3 Determine mechanical drafting occupation wages/salaries
- MDII-7.4 Explore mechanical drafting job outlook information
- MDII-7.5 Participates job shadowing of an mechanical job
- MDII-7.6 Research international mechanical drafting opportunities

Process Standards

Common Core Literacy Standards for Technical Subjects

Reading Standards for Literacy in Technical Subjects 11-12

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Key Ideas and Details

- 11-12.RT.1 Cite specific textual evidence to support analysis of technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
- 11-12.RT.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- 11-12.RT.3 Follow precisely a complex multistep procedure when performing technical tasks; analyze the specific results based on explanations in the text.

Craft and Structure

- 11-12.RT.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific context relevant to *grades 11-12 texts and topics*.
- 11-12.RT.5 Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
- 11-12.RT.6 Analyze the author’s purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.

Integration of Knowledge and Idea

- 11-12.RT.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- 11-12.RT.8 Evaluate the hypotheses, data, analysis, and conclusions in a technical subject, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- 11-12.RT.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Range of Reading and Level of Text Complexity

- 11-12.RT.10 By the end of grade 12, read and comprehend technical texts in the grades 11-CCR

text complexity band independently and proficiently.

Writing Standards for Literacy in Technical Subjects 11-12

The standards below begin at grade 11 and define what students should understand and be able to do by the end of grade 12. The CCR anchor standards and high school standards in literacy work in tandem to define college and career readiness expectations – the former providing broad standards, the latter providing additional specificity.

Text Types and Purposes

- 11-12.WT.1 Write arguments focused on *discipline-specific content*.
- 11-12.WT.2 Write informative/explanatory texts, including technical processes.
- 11-12.WT.3 Students will not write narratives in technical subjects. *Note: Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In technical, students must be able to write precise enough descriptions of the step-by-step procedures they use in their technical work that others can replicate them and (possibly) reach the same results.*

Production and Distribution of Writing

- 11-12.WT.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- 11-12.WT.5 Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
- 11-12.WT.6 Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

Research to Build and Present Knowledge

- 11-12.WT.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- 11-12.WT.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation
- 11-12.WT.9 Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing

- 11-12.WT.10 Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.