Approved Innovative Course

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- *Course requirements must be met without modification*

Course: Blueprint Reading for Manufacturing Applications
PEIMS Code: N1303684
Abbreviation: TECHBR
Grade Level(s): 10-12
Number of Credits: 1.0

Course description:

Blueprint Reading for Manufacturing Applications is an introduction to reading and interpreting working drawings for fabrication processes and associated trades. Students will learn sketching techniques to create pictorial and multiple-view drawings. Students will interpret working drawings including dimensions, notes, symbols, sections and auxiliary views.

Essential knowledge and skills:

(a) General requirements. This course is recommended for students in Grades 10-12. Recommended Prerequisites: Algebra I, Geometry, and Principles of Construction. Students shall be awarded one credit for successful completion of this course.

(b) Introduction.

(1) Career and technical education instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.

(2) The Manufacturing Career Cluster focuses on planning, managing, and performing the processing of materials into intermediate or final products and related professional and technical support activities such as, production planning and control, maintenance, and manufacturing/process engineering.

(3) In Blueprint Reading for Manufacturing, students gain knowledge and skills in an introduction to reading and interpreting working drawings for fabrication processes and associated trades. Students will use sketching techniques to create pictorial and multiple-view drawings.

(4) Students are encouraged to participate in extended learning experiences such as career and technical student organizations and other leadership or extracurricular organizations.

(5) Statements that contain the word "including" reference content that must be mastered, while those containing the phrase "such as" are intended as possible illustrative examples.

(c) Knowledge and skills.

(1) The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to:

(A) describe the roles, responsibilities, and dynamics of teams as applied in the manufacturing industry;

(B) explain employers' work expectations;

(C) demonstrate knowledge of the concepts and skills related to health; and

(D) demonstrate safety in the workplace as specified by appropriate governmental regulations such as the Occupational Safety and Health Administration (OSHA).

(2) The student applies codes and standards in the manufacturing industry. The student is expected to:

(A) examine and explain construction codes and standards for commercial and industrial projects;

(B) examine and explain mechanical codes and standards that govern the installation, inspection and maintenance of mechanical systems; and

(C) examine and explain recognized electrical codes and standards that apply to the safe installation of electrical wiring and equipment.

(3) The student demonstrates an understanding of a blueprint and technical drafting terminology, tools, and symbols. The student is expected to:

(A) define design and manufacturing processes;

(B) outline the methods of drawing reproduction such as electrostatic and diazo processes;

(C) describe fractional, decimal, and metric dimensions;

(D) identify drafting symbols and standard line types;
(E) describe projection methods, such as isometric, oblique, orthographic and perspective, used in engineering drawings;
(F) select various modes of viewing drawings using CADD software and explain the purpose of each view;
(G) identify threads, fasteners, and springs used in the manufacturing process;
(H) explain geometric dimension and tolerance;
(I) differentiate the various components of an assembly drawing; and
(J) identify and describe the different welding symbols and their meanings.

(4) The student interprets blueprint and schematics in order to plan, execute, and troubleshoot projects related to manufacturing processes. The student is expected to:
(A) read and interpret scales and other measuring instruments used in the mechanical drawing industry;
(B) read and interpret multi-view drawings;
(C) read and interpret section views;
(D) read and interpret auxiliary views;
(E) read and interpret types of dimensions;
(F) read and interpret pictorial drawings; and
(G) read, interpret, and paraphrase supplemental drawing information and drawing detail notes.

(5) The student interprets mechanical drawings in order to plan, execute, and troubleshoot projects related to manufacturing processes. The student is expected to:
(A) read, interpret, and explain removable fastener drawings;
(B) read, interpret, and explain welding drawings;
(C) read, interpret, and explain geometric tolerances;
(D) read, interpret, and explain cam drawings;
(E) read, interpret, and explain gear drawings;
(F) read, interpret, and explain assembly drawings and sub-assembly drawings;
(G) read, interpret, and explain detail drawings;
(H) read, interpret, and explain surface developments;
(I) read, interpret, and explain bearing drawings;
(J) read, interpret, and explain spring drawings;
(K) read, interpret, and explain casting drawings;
(L) read, interpret, and explain forging drawings;
(M) read, interpret, and explain tool drawings;
(N) read, interpret, and explain stamping drawings;
(O) read, interpret, and explain numerical control drawings; and

(P) read, interpret, and explain computer aided drawings.

(6) The student interprets architectural drawings in order to plan, execute, and troubleshoot projects related to manufacturing processes. The student is expected to:

(A) read, interpret, and explain plot plans;
(B) read, interpret, and explain foundation plan drawings;
(C) read, interpret, and explain floor plan drawings;
(D) read, interpret, and explain elevation drawings;
(E) read, interpret, and explain section views and details;
(F) read, interpret, and explain construction schedules;
(G) read, interpret, and explain stair details;
(H) read, interpret, and explain fireplace details;
(I) read, interpret, and explain truss drawings;
(J) read, interpret, and explain roof-framing plans;
(K) read, interpret, and explain electrical plans and schematics;
(L) read, interpret, and explain plumbing drawings;
(M) read, interpret, and explain heating/cooling plans;
(N) read, interpret, and explain landscape layout drawings; and
(O) read, interpret, and explain architectural and construction drawing specifications.

(7) The student interprets structural drawings in order to plan, execute, and troubleshoot projects related to manufacturing processes. The student is expected to:

(A) read, interpret, and explain structural steel erection plans;
(B) read, interpret, and explain structural steel design drawings;
(C) read, interpret, and explain concrete engineering drawings; and
(D) read, interpret, and explain site placement drawings.

(8) The student interprets electrical drawings in order to plan, execute, and troubleshoot projects related to manufacturing processes. The student is expected to:

(A) read, interpret, and explain schematic drawings;
(B) read, interpret, and explain printed circuit board drawings;
(C) read, interpret, and explain package drawings;
(D) read, interpret, and explain electrical junction connection drawings;
(E) read and interpret interconnection drawings;
(F) read, interpret, and explain wiring lists;
(G) read, interpret, and explain cable drawings;
(H) read, interpret, and explain harness drawings;
(I) read, interpret, and explain component drawings;
(J) read, interpret, and explain programmable logic diagrams; and
(K) read, interpret, and explain block diagrams.

(9) The student interprets pneumatic/hydraulic drawings in order to plan, execute, and troubleshoot projects. related to manufacturing processes. The student is expected to:

(A) read, interpret, and explain pictorial diagrams;
(B) read, interpret, and explain cutaway diagrams;
(C) read, interpret, and explain graphical diagrams; and
(D) read, interpret, and explain combination diagrams.

(10) The student identifies elements of assembly drawings as defined by industry. The student is expected to:

(A) identify and interpret elements of the title block;
(B) define terms relate to the geometry of industrial drawings;
(C) differentiate and describe orientation relationships found within 2D and 3D geometry;
(D) identify and describe 2D and 3D geometric objects; and
(E) describe and confirm the three dimensions of an object.

(11) The student creates hand sketches applying proper techniques. The student is expected to:

(A) demonstrate proper sketching techniques to produce technical drawings;
(B) display proper lettering techniques;
(C) apply knowledge of geometric constructions to draw shapes, angles, and lines accurately;
(D) illustrate a series of multi-view projections;
(E) apply freehand techniques to create accurate sketches; and
(F) delineate sectional and auxiliary views.

(12) The student applies drafting principles to create sketch pictorials and construct multi-view drawings. The student is expected to:

(A) produce normal, inclined, and oblique surfaces in pictorial sketch drawings;
(B) document accepted drawing conventions for machine processing;
(C) produce multi-view sketch drawings;
(D) produce pictorial sketch drawings;
(E) construct first and third angle projections;
(F) apply knowledge of conventional dimensioning techniques to accurately produce construction drawings;

(G) recognize and describe aligned and unidirectional dimensioning systems; and
(H) draw geometric dimensioning and tolerance symbols.

(13) The student will demonstrate knowledge of tolerances. The student is expected to:
(A) define and explain terms related to tolerance;
(B) illustrate and explain how tolerances are expressed in drawings; and
(C) calculate tolerances for mating parts based on maximum material conditions and allowance.

(14) The student analyzes blueprints to obtain information. The student is expected to:
(A) interpret working drawings including all dimensions, notes, symbols, sections and auxiliary views;
(B) identify and describe surface finishes;
(C) calculate area of objects;
(D) identify title block data and detail data;
(E) interpret section views; and
(F) perform job setup and layouts based on blueprints.
(G) read and interpret traverse drawings;
(H) read and interpret plat drawings;
(I) read and interpret street layout drawings;
(J) read and interpret map drawings; and
(K) read and interpret topographic drawings.

(15) The student demonstrates knowledge of revision information related to drawings. The student is expected to:
(A) describe and illustrate standard drawing practices for drawing revisions;
(B) identify and explain revision information on an industrial print; and
(C) revise and publish drawings using proper industry techniques.

(16) The student will estimate materials and costs of a project based on information gathered from blueprints and schematics. The student is expected to:
(A) calculate and compile manufacturing material take-offs;
(B) calculate and compile construction take-offs;
(C) calculate and compile mechanical equipment take-offs;
(D) calculate and compile electrical/electronic take-offs;
(E) calculate and compile labor costs;

(F) calculate and compile equipment costs;
(G) calculate and compile overhead costs; and
(H) project total costs of construction projects.

Description of specific student needs this course is designed to meet:

This course can be used as an in-depth course in a coherent sequence of courses in the manufacturing cluster, which can prepare students to enter the job market with a work-ready skill upon completion of high school. National and State Workforce data projects high growth for machinists, CNC programmers, electro-mechanical technicians and engineering technicians over the next decade.

Major resources and materials:

McCreight, K. (2013). *The technology of manufacturing: Blueprint reading for the machinist training.* Cleveland, OH: National Tooling & Machining Association.
Micrometers, calipers, height gages, indicators and various transfer gages.

Recommended course activities:

Produce sketches for projects relating to the fabrication process
Utilize micrometers, calipers, height gages, indicators and various transfer gages
Interpret materials, processes and related information found on existing blueprints

Suggested methods for evaluating student outcomes:

Performance on assigned projects and teacher developed assessments will be used to determine the student's success. Students will be evaluated on skill competency, tests, daily grades and group/individual projects using rubrics.

Teacher qualifications:

Secondary Industrial Arts: Grades 6-12
Secondary Industrial Technology: Grades 6-12
Technology Education: Grades 6-12
Trade and Industrial Education:
Grades 6-12 with appropriate work approval as identified on the certificate

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Grades 8-12 with appropriate work approval as identified on the certificate
Vocational Trades and Industry with appropriate work approval as identified on the certificate

Additional information: