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Course Outline for DSNT 66B

ELECTRO-MECHANICAL DESIGN

Effective: Fall

I. CATALOG DESCRIPTION:
DSNT 66B — ELECTRO-MECHANICAL DESIGN — 3.00 units

Continuation of mechanical design principles with the addition of electronic/electrical concepts. Part design with concentration on the flow and interaction between manufacturing and design, documentation, revision systems, Engineering change orders and requests, complex drawing and notation of entire systems. Also includes résumé, portfolio, and interview preparation, career opportunities, skills and attitudes necessary to succeed in industry.

1.50 Units Lecture 1.50 Units Lab

Prerequisite
DSNT 61 - Electronic Design
and

DSNT 66A - Mechanical Design Concepts

Grading Methods:
Letter Grade

Discipline:

	MIN
Lecture Hours:	27.00
Lab Hours:	81.00
Total Hours:	108.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

Before entering the course a student should be able to:

A. DSNT61
1. explain the need for drawing quality and demonstrate how the computer and traditional tools are used to attain a high standard of legibility;
2. describe the purpose and function of electronic and electrical components;
3. draw a block, flow, and/or single line diagram, illustrating preferred practices;
4. list the qualities of a good schematic and draw a schematic from an engineer's sketch;
5. understand how schematic layout is a reflection of circuit function;
6. correctly apply component symbology, reference designations, abbreviations, component values, and other appropriate electronic terminology to a drawing;
7. draw a logic diagram and interpret the logic symbols;
8. understand wiring methods and be able to make selection decisions based on quantity and complexity;
9. create a wiring list or other wiring documents, complete with annotation for the assembler;
10. draw a point-to-point, highway, and /or interconnection diagram;
11. draw a cable and/or harness assembly drawing with proper wire terminal identification method;
12. lay out a printed circuit board and create artwork masters;
13. create a drill drawing and a printed circuit board assembly drawing;
14. explain the process for etching printed circuit boards;
15. recognize the influence of CAD in the design process from development, through printed circuit board layout, to generation of service handbooks;
16. complete an integrated multi-drawing package from a schematic or sketch;
17. demonstrate an understanding of the job description for industrial electrical/electronic designers.

B. DSNT66A
1. visualize, sketch, and draw detail parts of assemblies using symbols and concepts;
2. recognize the significance of 2-D and 3-D CAD integration into design process, design intent and geometric problem-solving;
3. apply visualization by solids and surfaces to analyze and accurately display multiview drawings with complex limiting elements, hidden features, and intersecting cylinders and planes;
4. utilize technical mathematics to solve geometry problems related to the design;
5. apply descriptive geometry solutions to three-dimensional problems;
6. identify the basic conditions for plane representation and projection;
7. differentiate between precision and accuracy while acquiring knowledge of tolerancing;

8. become familiar with geometric controls and tolerancing rules, symbology, and modifiers;
9. develop an understanding of datums and datum systems;
10. apply knowledge of manufacturing practices, industrial materials, instrumentation, and fabrication specifications to the design of castings, forgings, sheet metal, weldments, and machined parts;
11. develop complex mechanical detail drawings with computer-aided design system.

IV. MEASURABLE OBJECTIVES:

Upon completion of this course, the student should be able to:

A. contribute to a team's progress in identifying and defining design parameters and considerations;
B. interpret the criteria for product and manufacturing engineering that results in design for manufacturability;
C. analyze and utilize the stages involved in the design process while recognizing their flexibility;
D. develop an understanding of critical-path scheduling and just-in-time production concepts;
E. utilize full gamut of information sources for designers including standards, technical reports, handbooks, references, patents, published papers, registers, tables, vendor catalogs, and specialized search engines and websites;
F. protect the sanctity of the design database, especially within CAD applications;
G. describe flow of design parts, manufacturing, implementation and documentation;
H. demonstrate familiarity with the process of automated and computer-aided manufacturing;
I. sketch and detail entire assembly with proper notations and form proper revisions;
J. realize that revisions are a necessary part of design process and their inevitability can be prepared for by developing a healthy mental recovery strategy;
K. demonstrate familiarity with the associative dimensioning capabilities of CAD;
L. demonstrate an understanding of the job description and the skills needed;
M. show awareness of the opportunities for Design Technology careers and advancement.

V. CONTENT:

A. Review of Design Process
    1. Design Considerations
        a. Function
        b. Constraints
        c. Materials
        d. Aesthetics
        e. Environmental effects and safety requirements
        f. Durability and Reliability
        g. Interchangeability and standardization
        h. Maintenance and service
        i. Costs
    2. Stages to Design Process
        a. Problem identification or recognition of a need
        b. Conceptualization of creative solutions
        c. Evaluation and refinement of preliminary ideas
        d. Analysis of proposed solutions
        e. Design choice and product or system decisions
        f. Development and implementation of design
        g. Production, manufacturing, and packaging
        h. Marketing, sales, and distribution
    3. Skills of a successful designer
        a. Possession of creative instincts
        b. Inquisitive mind
        c. Good communication skills - verbal, written, graphic
        d. Understand principles of design
        e. Ability to integrate and balance several ideas and solutions
        f. Ability to do self-evaluation
        g. Good concentration and visualization skills
        h. Ability to think and communicate in 3-D
        i. Good mathematical skills
B. Working drawings and assembly drawings
    1. Format and documentation
    2. Outline, sectioned, pictorial assemblies
    3. Working Assembly drawing
    4. Engineering change orders
    5. Drawing notes and specifications
    6. Reprographics
        a. Drawing storage
        b. Reproduction techniques
        c. Digital technologies
C. Tolerance studies
    1. Interchangeability
    2. Representations
    3. Fit types and determination
    4. Using the Machinery's Handbook
    5. Functional dimensioning
D. Quality control
    1. ISO 9000/9001 Standards
    2. Inspection tools
        a. Surface plate
        b. Height gages
        c. Calipers, Micrometers
        d. Precision spindle, centers, dial indicator
        e. Coordinate measuring machine
    3. Inspection processes
        a. Functional gaging
        b. Open gaging
        c. CMM gaging
E. Hydraulic system components
    1. O-Rings
        a. Types and Function
        b. Determining tolerancing
    2. Valves

F. Mechanisms: Gears, Cams, Bearings, and Linkages
    1. Gears
        a. Classifications
        b. Parallel, Intersecting, and Nonintersecting Shafting
        c. Gear Teeth geometry
        d. Gear and Pinion Ratios
        e. Spur gears-definition, formula, graphical representation
        f. Racks, Worm gears, Bevel gears
    2. Cams
        a. Cam and Follower types
        b. Displacement diagrams
        c. Motion types and diagrams
        d. Cam Profile
    3. Linkages
        a. Symbols, types, analysis
    4. Bearings
        a. Plain and Rolling contact Bearings
        b. Graphical Representations
G. Piping Drawings
    1. Pipe types and materials
    2. Pipe connections
    3. Pipe fittings
    4. Valves
    5. 3-D piping diagrams
H. Jigs and Fixtures
    1. Function
    2. Design Considerations
I. Automated Manufacturing Processes (CIM)
    1. Computer-aided manufacturing
    2. Numerical control
    3. Robotics
    4. Design for Manufacturability
J. Analysis of Job Qualifications and Résumé Preparation
K. Salary expectations, working conditions, future trends in Design Technology
L. Advancement opportunities and related fields
M. Job search, portfolio and interview preparedness

VI. METHODS OF INSTRUCTION:
A. **Lecture** -
B. **Demonstration** -
C. **Lab** - Independent laboratory project assignments
D. Practical examples
E. **Discussion** - Team discussion and problem solving
F. **Guest Lecturers** - Guest speakers with specific expertise
G. **Field Trips** - Field trips and site observation as needed
H. **Lab** - Collaborative laboratory project assignments

VII. TYPICAL ASSIGNMENTS:
A. Reading: 1. Read pgs. 632-662 on Design Process in preparation for creating a flow chart to organize the tasks and personnel assignments for your design project. 2. Read pgs. 1028-1043 on Gears and list the classification of gears. B. Homework: 1. Create a single-line drawing of the process flow diagram shown on page 1105 of textbook. 2. Design a drill jig to drill the four holes shown in the flanged adapter pictured below. Both ends of the part and the holes have been finished. Include a bill of material and call out all standard parts. B. Projects/Problem-solving: 1. From the following information, use the ANSI standards to create a detail drawing of a bevel gear: Diametral pitch = 4, Pressure angle = 20 degrees, Teeth = 36, Face width = 2", Shaft diameter = 1", keyway for #406 Woodruff key. 2. Wheel pullers are used to remove cams, pulleys, gears, wheels, and so on, which have been tightly mounted on a shaft. Design a wheel puller with three hook clamps that will fasten onto an outer edge of a part to be removed. Include a pressure screw that bears against the end of a shaft. In operation as the pressure screw is turned, the screw should push against the shaft, causing the legs to pull the part away from its shaft. Prepare a design layout, a set of detail drawings, a brief written statement explaining its function, and a working assembly drawing. Select suitable materials, manufacturing processes, and hardware.

VIII. EVALUATION:
A. **Methods**

B. **Frequency**

    1. Frequency:
        a. Weekly graded assignments
        b. One or more multi-drawing projects
        c. One collaborative, semester-long project
        d. One midterm and one final examination

IX. TYPICAL TEXTS:

1. Lamit, Gary *Technical Drawing and Design.*, West Publishing Company, 1994.
2. Jensen, Helsel, and Short *Engineering Drawing and Design.* 5th ed., Glencoe, McGraw-Hill, 1996.
3. Giesecke, Mitchell, Spencer, Hill, Dygdon, Novak *Technical Drawing.* 10th ed., Macmillan Publishing Company, 2000.
4. Bertoline, Wiebe, Miller, & Mohler *Technical Graphics Communication.* 2nd ed., McGraw-Hill, 1997.
5. Rowh, Mark *Opportunities in Drafting Careers.*, NTC Publishing Group, 1994.

X. OTHER MATERIALS REQUIRED OF STUDENTS:
A. Computer use certificate
B. Zip disk or several 3 ½" diskettes