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ABSTRACT

Designed for students interested in engineering fields pertaining to mechanical and electronic drafting, the course covers several types of drawings in the mechanical and electronic drafting field and many types of machine shop operations. The student will become familiar with stress, loading, safety factors, and manufacturing processes. The manufacturing processes that will be covered in this course are machining, casting, forging, extruding, stamping, welding, forming, and tube bending. Prior to entry into this course, the vocational student must master the skills indicated in Aeronautical Drafting--9257.02. Totaling 135 clock hours, the course consists of six instructional blocks: (1) materials, (2) manufacturing, (3) welding, (4) working drawing, (5) structural drafting, and (6) a Quinmester posttest. A bibliography lists basic and supplementary references, and a sample posttest concludes the document. (Author/MW)

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

Course Outline
DRAFTING 3 - 9257
(Materials and Manufacturing)
Department 45, 48 - Quin 9257.03

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

D A D E C O U N T Y P U B L I C S C H O O L S

1 4 5 0 N O R T H E A S T S E C O N D A V E N U E

M I A M I, F L O R I D A 33132

Course Outline

DRAFTING 3 - 9257
(Materials and Manufacturing)

Department 45, 48 - Quin 9257.03

county office of

VOCATIONAL AND ADULT EDUCATION

Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

April, 1973

Published by the School Board of Dade County

Course Description

9257	45 & 48	9257.03	Materials and Manufacturing
State Category Number	County Dept. Number	County Course Number	Course Title

This course will cover materials used in the fabrication procedures in industry. The student will become familiar with stress, loading, safety factors and manufacturing processes. The manufacturing processes that will be covered in this course are machining, casting, forging, extruding, stamping, welding, forming and tube bending.

Indicators of success: Prior to entry into this course, the vocational student will display master of the skills indicated in Aeronautical Drafting - 9257.02.

Clock Hours: 135

PREFACE

This quinmester course outline is designed for cooperative students who have expressed an interest in engineering fields that pertain to mechanical and electronic drafting. It is intented to cover more advanced subject matter than was described in Quinmester Course 9257.02.

This course covers several types of drawings in the mechanical and electronic drafting field and will also cover many types of machine shop operations. The course is considered advanced training as the student is introduced to various types of tools and equipment and is provided with an opportunity for instruction and laboratory experiences.

This course is taught in a two-hour block for 90 hours or a three-hour block for 135 hours. In each instance, the course consists of six instructional blocks; however, the three-hour session permits the student to cover each block in more detail and also provides additional opportunity to practice and increase his or her skills.

The course is concluded by a post-test.

An adjunct to the listed instructional methods is provided through the instructor's utilization of audiovisual equipment and materials.

The bibliography lists the basic reference, workbooks and supplementary references used by the teacher in presenting the material. These books are available to the student through the instructor.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee and the Occupational Curriculum Materials Service, and has been approved by the Los Angeles County Vocational Curriculum Committee.

TABLE OF CONTENTS
with Suggested Hourly Breakdown

GOALS

The student must be able to demonstrate:

1. The ability to develop and direct his or her activities along lines parallel to present day drafting practice.

2. Skills in the selection and handling of tools and equipment through organized practice sessions in the related field of fasteners of all types.

3. The skills needed to perform as a draftsman with assigned tasks that may require pictorial drafting. The student will become knowledgeable with drawings that require illustration in the industry.

4. The ability to advance his knowledge and skills in drafting to meet the requirements of the electrical and electronic industry.

5. The desire for advancement in his chosen vocation by introducing and keeping before him achievements of leading machine designers, engineers and [illegible], especially in the piping field.

6. The use of tools and equipment to perform a task in a predetermined length of time and to the satisfaction of a drafting checker.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - MATERIALS

The student must be able to:

1. Exhibit the ability to write parts lists or bills-of-material that call for the use of various metals used in the industry for which the student is being trained.
2. Prepare drawings that call for the use of nonmetallic materials in the field of engineering.
3. List specifications that are related to material properties having to do with the strength of materials.
4. Define terms that are common to material properties.
5. Draw drawings which include safety factors required in the industry.

BLOCK II - MANUFACTURING

The student must be able to:

1. Draw machine drawings that involve the process of machining operations.
2. Explain all the various types of operations that take place in a machine shop.
3. Demonstrate an understanding of heat treatment required for metals used in the drawings.
4. Explain the procedures followed for the inspection and testing of those metals.
5. Explain the theory of castings, all the various types and the reasons for using specific types.
6. Demonstrate an understanding of the various types of coring in casting and know the basic design considerations for casting metal.
7. Explain the procedures for the inspection and testing of castings.
8. Explain the procedures for the inspection and testing of forgings.
9. Explain the theory of forgings, all the various types and the reasons for using specific types.
10. Demonstrate an understanding of the various design considerations for forging metal.
11. Draw and sketch drawings that call for the use of extrusions and stamping parts.
12. State the various types of sheet metal forming.
13. Define the duties of a production engineer and discuss the reasons for quality control.

BLOCK III - WELDING

The student must be able to:

1. Prepare drawings that call for welding parts to make the required assembly.
2. Demonstrate an understanding of the various types of welding processes and their application.

3. Demonstrate understanding of the basic design considerations for [illegible]
4. Prepare welding symbols for parts that are brazed or soldered [illegible]
5. State the various types of materials used for brazing and soldering and know the various types of brazing and soldering that are performed in the industry today.

BLOCK IV - WORKING DRAWINGS

The student [illegible]

1. Perform [illegible] require the knowledge and skills necessary in the preparation of detailed working drawings.
2. Demonstrate knowledge and skills in dimensioning and inking.
3. Use mechanical lettering devices.
4. [illegible] the manner industry dictates and provide [illegible] results necessary to producing the [illegible]
5. [illegible] previously learned in Functional Drafting, [illegible] of working drawings.
6. [illegible] the knowledge and skills in the production [illegible] drawings and coordinate these drawings [illegible] produced in previous laboratory [illegible]
7. [illegible] lettering devices.

BLOCK V

The student [illegible]

1. [illegible] building frames with both steel [illegible]
2. [illegible] of the drafting building standard [illegible] the structural steel industry.
3. Demonstrate understanding of steel framing systems such as [illegible] column and long span.
4. Draw [illegible] construct bills-of-material and work with design [illegible] in the structural steel drafting profession.
5. Explain [illegible] and dimensioning practices used in this [illegible]
6. Prepare [illegible] detail sloping beams, column drawings, beam details, framing, bolting and truss members.
7. Prepare drawings for the construction of reinforced concrete buildings and use the drawing standard and schedules related to structural steel construction.
8. Demonstrate [illegible] of design drawings and typical [illegible]
9. Use, [illegible], structural steel industry's handbook.

BLOCK VI - [illegible]

The student [illegible]

1. Satisfactorily complete the quinmester post-test.

Course Outline

DRAFTING 3 - 9257
(Materials and Manufacturing)

Department 45, 48 - Quin 9257.03

I. MATERIALS

A. Types

1. Ferrous metals

a. Carbon steel
b. Nickel steel
c. Nickel-chromium steel
d. Molybdenum steel
e. Chromium steel
f. Chromium vanadium steel
g. Silicon manganese steel
h. Nickel-chromium-molybdenum steel

2. Nonferrous metals

a. Aluminum
b. Brass
c. Bronze
d. Copper
e. Gold
f. Lead
g. Silver
h. Tin
i. Zinc

3. Plastics

4. Powder metals and cermets

5. Miscellaneous materials

a. Rubber
b. Artificial elastomers
c. Ceramics

B. Material Properties

1. Stresses

a. Allowable
b. Beams
c. Distribution
d. Residual
e. Simple

2. Loading

a. Impact
   (1) Wear
      (a) Chipping
      (b) Upsetting
      (c) Cracking
      (d) Crushing force
   (2) Kinetic energy
b. Compressive
   (1) Resist crushing
   (2) Opposite of tensile

c. Tensile
(1) Resist pulling
(2) Opposite of compressive

3. Safety factor
a. Evaluating
(1) Uniformity of material
(2) Danger to human life
(3) Type of load
(4) Permanency of design
b. Strain

II. MANUFACTURING

A. Processes

1. Machining
a. Principles of metal cutting
b. Types of machines
(1) Types of operations
(a) Drilling
(b) Reaming
i) Plain
ii) Line
(c) Spot facing
(d) Counterboring
(e) Threading
(f) Turning
(g) Boring
(h) Grinding
(i) Milling
(j) Broaching
(2) Operation sequence and tolerances
c. Jig and fixture application and design
d. Heat treating
(1) Types
(a) Annealing
(b) Carburizing
(c) Case
(d) Cold working
(e) Cyaniding
(f) Nitriding
(2) Procedures
e. Inspection and testing

2. Casting
a. Theory of casting
b. Processes - Types
(1) Sand
(a) Pattern making
(b) Molding
(c) Cleaning
(d) Straightening
(e) Machining
(f) Assembly
(2) Permanent mold casting
(a) More variety of materials

(b) Better grain structure
(c) Greater economy

(3) Investment casting
(a) Intricate methods
(b) Wax model
(c) Poured plaster
(d) High accuracy
(e) High reproduction of detail

(4) Die casting
(a) Theory
(b) Pressure molten metal
(c) Elimination of machining
(d) Thinner sections

c. Coring
(1) Hollow spaces
(a) Weight saving
(b) [illegible]
(2) Holes
(a) [illegible] machining
(b) [illegible]
(3) Types
(a) [illegible]ment
(b) [illegible]
(4) [illegible] considerations
(a) [illegible] or tapered
(b) [illegible] backdraft

d. [illegible] considerations for castings
(1) [illegible]
(2) [illegible]
(3) Brackets and bosses
(4) [illegible]
(5) Stress consideration
(6) Wall thickness
(7) Thin sections
(8) Sharp corners
(9) Fillets and rounds
(10) Lightening holes
(11) Knife edges
(12) [illegible]
(13) Metal inserts
(14) Machining
(15) Finish
(16) Corrosion

e. Inspection of casting
(1) Inspection and foundry control and techniques
(2) [illegible]

3. Forging
a. Types
(1) Drop forging
(a) Power driven ram
(b) [illegible] anvil
(2) Hammering

(3) Press forging
(4) Upset forging

b. Forging basic design considerations
(1) Draft angle
(2) Forging plane or parting plane
(3) Parting line
(4) Die lock
(5) Progressive dies
(6) Die cost
(7) Capacity
(8) Fillet and round
(9) Proper web
(10) Finish allowances
(11) Left-and right-hand parts
(12) Lightening holes

4. Extruding
a. Principles
b. Shapes
c. Impact

5. Stamping

6. Forming sheet metal
a. Layout
b. Bend radius
c. Types
(1) Braking
(2) Rolling
(3) Hydraulic press
(4) Explosion
(5) Drawing
(6) Stamping
(7) Electro forming
(8) Cutting
(9) Blanking
(10) Spinning
(11) Stretch forming

7. Tube Bending

B. Production Engineering and Quality Control

III. WELDING

A. Processes and Application
1. Pressure welding
a. Resistance
b. Thermit
c. Butt
d. Seam
e. Spot
f. Projection
g. Percussive
h. Flash and upset butt
i. Electrostatic
j. Electromagnetic

2. Fusion welding
a. Gas

b. Arc
c. Metal arc
d. Shielded tungsten arc
e. Carbon arc
f. Shielded carbon arc
g. Atomic hydrogen
h. Fusion Thermit

3. Application
a. Strength
b. Stress
c. Heat treatment
d. Joint strength

B. Welding Design Considerations
1. Dimensioning
2. Weld access
3. Balanced joints
4. Tolerances
a. Limits
b. Stock allowances
5. Corrosion prevention
a. Drainage
b. Simple design
6. Use of the handbook

C. Brazing and Soldering
1. Brazing
a. Bonding process
b. Types
(1) Furnace
(2) Torch
(3) Induction
c. Process
(1) Cleaning
(2) Flux
(3) Rigidly connected
(4) Filler material
(5) Brazing temperature
(6) Capillary action
(7) Cooling
(8) Flux removed

2. Soldering
a. Joining with low temperature
b. Types
(1) Tin-lead
(2) Lead-silver
(3) Aluminum

IV. WORKING DRAWINGS

A. Detail Drawings
1. Types

2. Title and record strips
3. Numbering system
4. Material list
5. Dimensioning
    a. Principles
    b. Lines, symbols and finish marks
    c. Rules of dimensioning
    d. Placement and size of dimensions
    e. Allowances and tolerances
    f. Classification of fits
6. Surface finish
7. Surface quality
8. Selection of materials
9. Checking
10. Heat treating
11. Drawing changes

B. Assembly Drawings
1. Types
2. Techniques of representing parts
3. Identification of parts
4. Notes and specifications
5. Drawing changes
6. Dimensioning for assembly
7. Subassemblies

C. Inking
1. Application of ink drawings
2. Inking equipment
    a. Lettering devices
    b. Pens
3. Techniques of inking

V. STRUCTURAL DRAFTING

A. Types of Building Frames
1. Steel
2. Reinforced concrete

B. Steel Frame Buildings
1. Steel framing systems
    a. Wall-bearing
    b. Beam and column
    c. Long span
2. Steel structural shapes
3. Design drawings
4. Shop drawings
5. Erection and shipping marks
6. General dimensioning practices
7. Bills-of-material
8. Beam connections
9. Beam detail drawing
10. Column detail drawing
11. Detailing skewed members

12. Detailing sloping beams
13. Riveting and bolting
14. Riveting truss members
15. Detailing truss members

C. Reinforced Concrete Buildings
   1. Reinforced concrete drawing standards
   2. Concrete building symbols
   3. Schedules
      a. Horizontal
      b. Vertical
   4. Design drawings
   5. Placing drawings
   6. Typical bar bends and slants
   7. Column ties

D. Use of Handbook

VI. QUINMESTER POST-TEST

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APPENDIX

QUINMESTER POST-TEST SAMPLE

Quinmester Post-Test

Name _____ Date _____ Score ____

Multiple Choice Test Items

Each statement needs a word, figure or phrase to make it correct. Only one of the choices listed is correct. Place the letter of the choice you make in the space provided at the left.

___ 1. Ferrous metals are:

a. Nickel steels
b. Aluminums
c. Brasses

___ 2. A nonferrous metal is:

a. Silver
b. Silicon manganese
c. Carbon steel

___ 3. Forces that have a crushing action are:

a. Loading
b. Compressive
c. Tensile

___ 4. The most important feature in designing a safety factor in a part is:

a. Kinetic energy
b. Danger to human life
c. Uniformity of material

___ 5. Specifications for material can be found in:

a. The field of the drawing
b. Spec sheets
c. Bill-of-material

___ 6. The opposite of a tensile force is:

a. Compression
b. Stress
c. Impact

___ 7. Artificial elastomers are products that are:

a. Metal like
b. Ceramic
c. Rubber like

___ 8. Ferrous metals contain:

a. Zinc
b. Iron
c. Copper

___ 9. Plastics have a feature that is very important in the industry. This feature is that plastic is:

a. Fireproof
b. Very inexpensive
c. Lightweight

___10. A tensile force will:

a. Resist pull
b. Resist crushing
c. Allow impact

True-False Test Items

Each of the following statements is either true or false. If the statement is true, draw a circle around the letter T following it; if the statement is false, draw a circle around the F. If a statement is false in part it is entirely false.

1. Pressure type welding is usually related to resistance welding. T F
2. Fusion welding is related to electrostatic welding. T F
3. Corrosion has a great effect on the welding of many metals. T F
4. Brazing and soldering are the same except for the metals used in both operations T F
5. Aluminum cannot be soldered and that is why we braze this type of metal. T F
6. Flux is used in both soldering and brazing. T F
7. Spot welding is a form of pressure welding. T F
8. Welding can only be done in the shop because of the equipment necessary for field operations. T F
9. Soldering and brazing is used more in the structural trades while welding is used more in the electronic field of drafting. T F
10. Welding is the melting of the parent metal which operation separates it from brazing. T F

Completion Test Items

Fill in the blank or blanks with the words or word that makes the statement correct.

1. Cutting a hole with a high degree of accuracy is done with a _____.
2. The operation of squarely seating a washer or the head of a bolt is called _____.
3. Annealing is a word that is related to _____.
4. A pattern maker works with parts that are called _____.
5. The inside radius on a forging or casting is called a _____.
6. The outside radius on a forging or casting is called a _____.
7. X-ray machines are used in the _____ of castings or forgings.
8. Bend radius is related to _____ sheet metal parts.
9. Spinning is an operation in the forming of _____.
10. The process of controlling the production of parts that leave the shop is called _____.

Short Answer Questions

Answer the following questions by a single word, phrase or short sentence.

1. Machine dimensions should appear on what type of drawings?
2. What word or words describe drawing changes?
3. Where besides on the face of drawings do item numbers appear?
4. Where is the heat treatment information placed on the drawing?
5. What information should appear on detail drawings?
6. How should parts be identified on assembly drawings?
7. How many fabrication dimensions should appear on the assembly drawing?
8. What is the name of a popular lettering device used mainly for inking?
9. What is the reason for showing hidden lines on any drawing?
10. Why are there rules for dimensioning?

Essay Questions

Read each question carefully before attempting to answer it. Write the answers on a standard answer sheet which you can secure from your instructor. Be accurate and neat in your owrk. When calculations are required in order to arrive at the answer, show all work on the answer sheet. Do not copy the question; simply number each question in the left-hand margin.

1. What type of information is found in the hand book?

2. Why are column ties used in structural drafting?

3. Why is reinforced concrete so popular in the construction trades in Florida:

4. What is the purpose of reinforced concrete schedules?

5. Explain why some walls are bearing walls.

6. Why are erection and shipping marks used?

7. How is the detail drawing used in structural drafting?

8. How are connection and installation drawings used in this type of industry?

9. How is riveting and bolting used effectively in the structural trade?

10. What materials other than steel and concrete are used in this type of construction? How are they used?

ANSWER KEY TO QUINMESTER POST-TEST

Multiple Choice Test Items

1. a
2. a
3. b
4. b
5. c
6. a
7. c
8. b
9. c
10. a

True-False Test Items

1. T
2. F
3. T
4. F
5. F
6. T
7. T
8. F
9. F
10. T

Completion Test Items

1. Reamer
2. Spot facing
3. Heat treating
4. Castings
5. Fillet
6. Round
7. Inspection
8. Forming
9. Sheet metal
10. Quality control

Short Answer Questions

1. Detail
2. Revisions
3. Bill-of-material
4. Remarks column-Bill-of-Material
5. Machining
6. Item circles
7. None
8. LeRoy
9. Clarity only
10. Standardization

Essay Questions

Check each answer for accuracy and determine the score by clarity, neatness and shortness of answer.