TECHNOLOGY EDUCATION

CONTENTS: Syllabus for teaching Technology Education (State developed)

TECHNOLOGY EDUCATION

Preface

How to use this material

The content outlines represent excerpts from State-developed syllabi that formed the basis of the curriculum in Technology Education in New York State in the 1980's and 90's. All of the material needs to be updated to be usable in a contemporary program. To obtain information on ordering a full reference copy of a particular syllabi please go to www.nysed.gov/rscs/pubcat.pdf. **The material presented here should only be used as content organizers or identifiers as part of a local effort to modify or design courses for local use**. *The Self Study Form on Systemic Thinking* developed at West Virginia University and the *Curriculum-Analysis Procedure* are items that can be used by Technology Education programs to identify appropriate elements of a contemporary curriculum.

As schools move towards standards based instruction all efforts should be directed towards providing courses and instruction that supports student achievement of the technology standard and performance indicators under the key ideas of the standard. By delineating the standard at three levels; elementary, intermediate and commencement, benchmarks and assessments can be established in which to measure student knowledge and understanding of technology.

Each school district should strive to address the technology standards at all three levels.

Essential Elements Of New York State's Technology Education Program

The 1990's brought more debate in the education reform movement. Many states began to adopt education standards in their states as the result of poor performance by students on national and international tests[1].

During this time, New York State was developing frameworks around the subject areas taught in the schools. It was seen that Technology Education had an important role to play in the support of the more traditional subjects. The alignment of Technology Education with Mathematics and Science created a bond that was both complementary and supportive for these usually separate and distinct disciplines.

With the adoption of the Learning Standards for Math, Science, and Technology Education it became more apparent that curriculum coordination and staff development would play a key role in a successful transition to a standards based education system. Teachers were being asked to change *how* they taught. In the past many teachers struggled with the change of focus to systems and process over skill development and craftsmanship. In the new paradigm, teachers are facilitators as students search for the answers to conceptual questions (systemic thinking).

In a *standards based system* the focus moves from specific content knowledge acquisition to measuring students' abilities tied to standard levels of performance.

Issues

What content should be offered that will help students meet the standards? In Technology Education the curriculum that was developed as the result of the Regent's Action Plan and Futuring had become dated[2]. Teachers were expected to update their courses to stay current with the advance of technology. Unfortunately, this was not always the case. While specific content taught may not be the central focus for students in a standards based system, content is important in getting students to achieve the standards in an appropriate way. All content is important if it helps students perform at a higher level.

How do we change?, and why? Change is never easy, but not changing only promotes irrelevance. Many obstacles both personal and societal make it easy not to do things different. Technology teachers should not feel alone in changing, all subject teachers need professional development to stay current in their fields. Teachers should seek out opportunities to learn about the standards and take advantage of staff development specific to their subject area when ever possible. We should not lose sight of why we need to do these things. What we do effects future generations of students and how they will be influenced by a global economy.

What do we mean when we say "technology"? With the advances in the field also came confusion over the meaning. New York State adopted the name change early to keep its focus on the future. *Technology Education* had the intent to give students knowledge and skills which would prepare them to deal effectively with all forms of technology in the 21st century. As computers became more common place for the average person to use, and the recognition that everyone in the future would need to be computer literate, the word *technology* was used generally to describe all applications of computers. This generalization of the term has caused much confusion over what Technology Education is. Is it about using computers, or is it about using the computer as a tool? For Technology Education it is both. Like other subject areas, Technology Education is a field of study that sees the value of using the computer to enhance instruction and increase productivity. This is what is described as *Instructional Technology*. Because Technology Education has long used the computer as a tool it was one of the first subject areas to incorporate instructional technology into its programs.

Steps

Technology Education promotes systems thinking. We should use this same technique to review what we are doing and develop a plan for transitioning to a standards based performance program. Many programs will start by examining their course offerings to see what relevant content they are currently using that will support student achievement of the standards related to Technology Education. Taking courses in Technology Education requires student thinking to be systemic. A review by districts of their technology education programs to determine the extent to which they challenge students to analyze, synthesize and evaluate problems is a first step (see Self Study Form).

At the **elementary** level of the standards, students are expected to demonstrate their performance of the standards through indicators that use age appropriate activities that allow students to develop opinions and an awareness of technology in their lives. Various initiatives are currently developing materials to support this level. N.Y. State Systemic Initiative Summer Institutes in Design and Technology, MST Extended Performance Task research, the MSTe Project, and many individual school efforts are pioneering strategies for success at the elementary level.

The **intermediate** middle school program begins to define aspects of technology where students need to make decisions about technology that affect their lives and learn to solve problems related to technology.

The Regents have recognized the importance of technological literacy and reaffirmed the middle school mandate that every student should have one unit of technology education by the end of the eighth grade. This general experience provides students with the foundation for further studies in technology.

Introduction to Technology Grades 7 & 8 is a course of study that was ahead of its time in 1986. Still relevant, the course aims to guide students through a progression of modules that will help them define technology in their lives, develop problem solving abilities and make connections with other disciplines in support of knowledge acquisition. Schools that are already using *Introduction to Technology* as it was intended, will have kept current by updating their activities to mirror current technological advancements and be able to make connections to the standards and the performance being expected of students at the intermediate level.

At the high school **commencement** level the task becomes more complicated and critical. Although there currently is not a graduation requirement at the high school level for Technology Education, school districts are compelled to provide opportunities for students that wish to pursue it. Under the revised graduation requirements, districts will be given flexibility to design technology education programs that meet the needs of its students and community. Because of the diverse nature of technology, schools may choose to develop courses within a specific area of concentration. Currently programs centered on Pre-engineering, Communications, or Electronics are being experimented with[3]. Courses that integrate, are team-taught or are aligned with Math and/or Science are ways to support student achievement of the standards[4].

The *Provision for Technology Education* as outlined in the revised graduation requirements allows as an option the substitution of a technology education course for the third unit of math or science. Few courses currently in place fit the criteria5 that would reflect a rigorous or relevant substitution for the level of math or science expected at this level. *Principles of Engineering* is an example of a course that may work in this situation. It was developed around the same time that the frameworks and standards were being formulated and reflect this work. With heavy emphasis on math and science concepts it builds on student knowledge in these subjects using a case study approach. A course called *The World of Technology* developed by the New York State Technology Education Association has potential for reaching the previously academic track student by using learning experience activities related to many technology areas.

For districts that wish to develop a sequence of courses a *process for change* needs to be adopted that will allow schools to transition their programs to a standards based performance system. It is hoped that by the time all students are impacted by the Learning Standards and the revised graduation requirements, schools will have a plan for Technology Education in the 21st century.

NOTES:

1 The Third International Math and Science Study (TIMSS) compared student scores from 41 countries; the U.S. generally faired poorly at various levels in Math and Science.

2 An exception is Introduction to Technology Grades 7 & 8 which was used in the development of the curriculum frameworks and easily aligned with the standards for Technology at the intermediate level.

3 "Project Lead the Way" and Cisco Systems, "Network Academies" are two packaged programs that focus on engineering, communications or electronics.

4 Bayshore H.S., William Floyd H.S., and Arlington H.S. are examples of schools using integration, team-teaching or stand alone technology courses to support the standards.

5 A committee of stakeholders from around the State has developed criteria for courses in this option.

Contacts for some of the initiatives mentioned

New York State syllabus

Eric F. Suhr
Technology Education
New York State Education Department
674 Education Building Annex
Albany, NY 12234
(518) 486-3659
esuhr@mail.nysed.gov

New York State Systemic Initiative (NYSSI)
Dr. Richard Jones
New York State Education Department
(518) 473-9471

MST Performance Tasks
Ms. Linda Bopp
New York State Education Department
(518) 473-9471

MSTe Project
Mr. Michael Hacker
Executive Director, MSTe Project
(518) 434-MST; (516) 632-8770

World of Technology course
New York State Technology Education Association
Mr. Barry Borakove, Syosset High School (516) 364-5735

Self Study of Systemic Thinking Attributes in Curriculum

Course
Length of Course (weeks/months)
Institution
Audience/Students

Date
Meeting Frequency

Instructions: Review course syllabus, teaching materials, evaluation materials, workbooks and textbooks. Respond to items in each category by placing a check mark in the appropriate column.

	usually	sometime	rarely	never
1. Objective statements include the following action words/phrases:				
a. Compare, defend, contrast	___	___	___	___
b. Create, produce, develop manufacture	___	___	___	___
c. Draw conclusions, estimate time/money to perform tasks, solve problems	___	___	___	___
d. Select and access information, compile and organize information, exchange information, use information, analyze or synthesize information	___	___	___	___
e. _____	___	___	___	___

2. Teaching/learning activities

a. Class questions or projects may have multiple solutions	___	___	___	___
b. Students routinely work alone	___	___	___	___
c. Students routinely work with peers, teachers, community members	___	___	___	___
d. Students assess themselves according to self-generated criteria	___	___	___	___
e. Students assess themselves according to teacher generated criteria	___	___	___	___
f. Students compile and use information from a variety of sources	___	___	___	___
g. Students communicate with peers and others individually and in small groups	___	___	___	___
h. Students manage tools, materials and information	___	___	___	___
i. Students plan alternative ways to complete assignments	___	___	___	___
j. Students work in small groups as well as individually	___	___	___	___
k. Students seek solutions or information inside their specific course content	___	___	___	___
1. Students seek solutions or information outside their specific course content	___	___	___	___
m. Students describe tasks they are working on and how success will be measured	___	___	___	___
n.____	___	___	___	___

3. Outcomes/products

a. Written reports (problem solutions, proposals analytical study)	___	___	___	___
b. Presentation graphics and materials	___	___	___	___
c. Physical prototype of proposed solutions (artifact, structure, model)	___	___	___	___
d. Physical product/project	___	___	___	___
e. Software program	___	___	___	___
f. ____	___	___	___	___

4. Facilities/materials

a. Reference manuals, parts lists and specification sheets are readily available	___	___	___	___
b. Computer resources are available including Internet access	___	___	___	___
c. Inventories of supplies, tools and references are available	___	___	___	___
d. Small group and individual workspaces are available	___	___	___	___
e. Record-keeping/storage space is available	___	___	___	___
f. Project management software Is available	___	___	___	___
g. Students use a variety of materials/supplies	___	___	___	___
h. Assessment is performance based	___	___	___	___
i. ____	___	___	___	___

5. Assessment/evaluation of students and course

a. Assessment of students higher order thinking skills	___	___	___	___
b. Assessment of the course to match objectives	___	___	___	___
c. Assessment of Instructor	___	___	___	___
d. Assessment of learning activities	___	___	___	___
e. ____	___	___	___	___

6. Other

a. Units of instruction or presentations explain what it means to be a self-learner	___	___	___	___
b. Teacher provides structure and freedom for students to learn and subsequently fail and/or succeed in learning new tasks	___	___	___	___
c. Units of instruction or presentations explain how self-learning contributes to one's success in the world of work	___	___	___	___
d. Teacher practices self-learning in a way that models the process	___	___	___	___
e. Verbal and other awards are used to acknowledge the practice of student self-learning attributes	___	___	___	___
f. ____	___	___	___	___

7. Overall assessment

a. Strengths of this course to provide opportunities for students to develop systemic thinking skills. (List examples.)

b. Weaknesses of this course to provide opportunities for students to develop systemic thinking skills. (List examples.)

8. Improvement

The following suggestions are provided to improve opportunities for students to develop thinking skills in this course.

a. Objectives

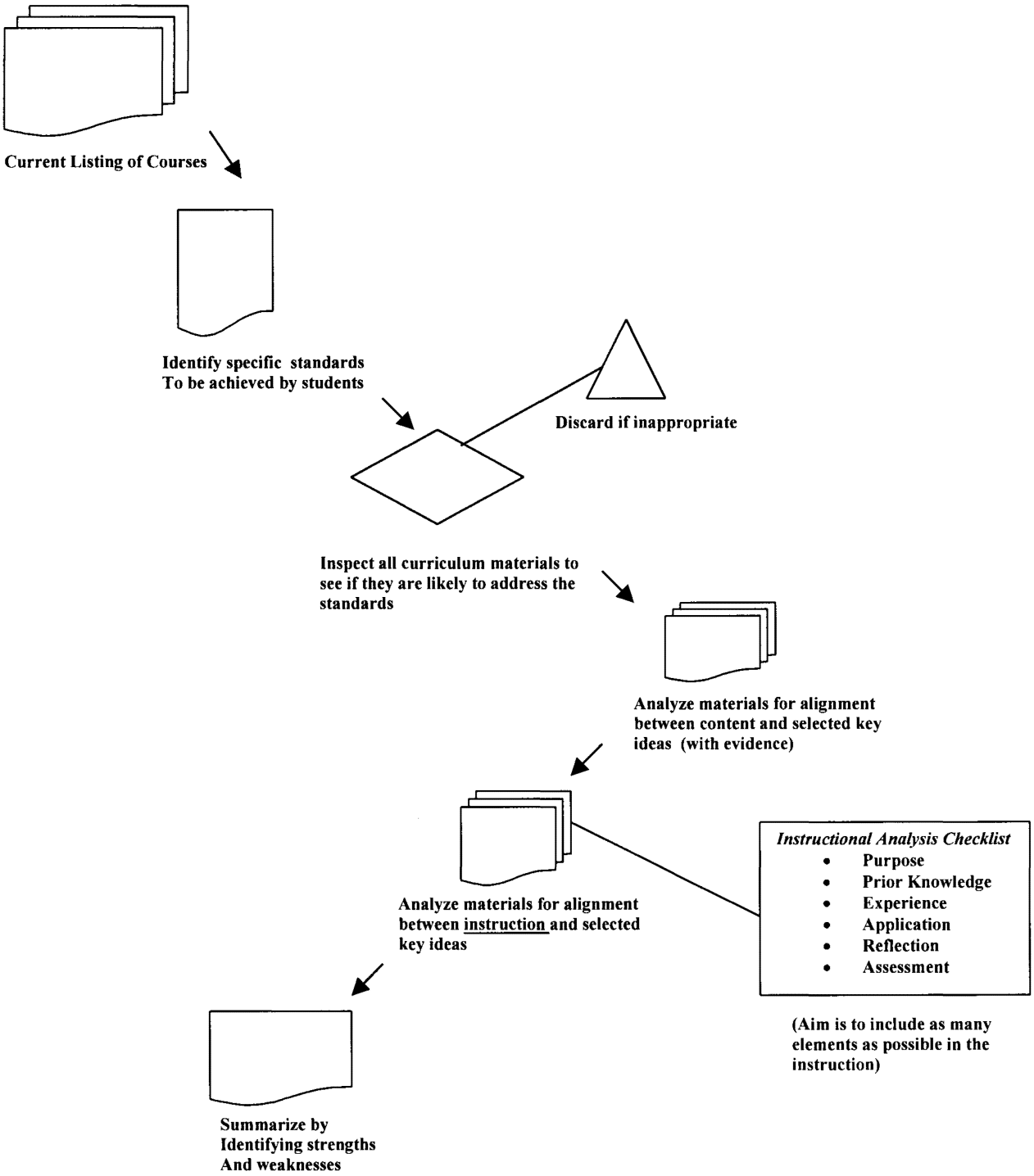
b. Course materials (worksheets, handouts, tests and evaluation criteria)

c. Class organization

d. Facilities

[Developed by: George R. Maughan and Cheryl L. Prichard, West Virginia University 1998.]

A Technology Education Curriculum-Analysis Procedure To Determine Appropriate Content For the Commencement Level*



*This procedure is based on the Project 2061 curriculum-analysis process intended to help in revising existing materials to increase effectiveness and the development of new materials while providing professional development.

Content Outlines

1. ELEMENTARY SCHOOL TECHNOLOGY EDUCATION
GRADE K-6

Part 1: Grade Level Performance

Level 1: Grades K.1 and 2: Awareness of Technology

- 1 A: Awareness of Communication Technology
- 1 B: Awareness of Production Technology
- 1 C: Awareness of Transportation Technology
- 1 D: Awareness of Power Technology
- 1 E: Awareness of Construction Technology
- 1 F: Awareness of Biologically Related Technology
- 1 G: Awareness of Information Technology
- 1 H: Awareness of Careers In Technology

Level 1: Grades 3 and 4: Technology: Past, Present and Future

- 2A: Communication Technology: Past. Present and Future
- 2B: Production Technology: Past. Present and Future
- 2C: Transportation Technology: Past, Present and Future
- 2D: Power Technology: Past. Present and Future
- 2E: Construction Technology: Past. Present and Future
- 2F: Biologically Related Technology: Past, Present and Future
- 2G: Information Technology: Past. Present and Future
- 2H: Careers In Technology: Past, Present and Future

Level 1: Grades 5 and 6: Applying Technology

- 3A: Applying Communication Technology
- 3B: Applying Production Technology
- 3C: Applying Transportation Technology
- 3D: Applying Power Technology
- 3E: Applying Construction Technology
- 3F: Applying Biologically Related Technology
- 3G: Applying Information Technology
- 3H: Applying Careers in Technology

Part 1: Performance Objectives Infused at All Levels

Problem Solving and Decision Making

- PS1: Problem Solving
- DM 1: Decision Making

Resources of Technology

- RT1: Identifying Tools and Equipment
- RT2: Identifying Functions of Tools and Equipment
- RT3: Maintenance of Tools and Equipment
- RT4: Applying Information to Complete a Task
- RT5: Selecting and Using Tools and Equipment
- RT6: Using Processing Systems

RT7: Information Technology In the Home

Impacts of Technology

ITl: Human Responsibility for Technology
IT2: Impacts of Technology on Life style
IT3:Relationship Between People and Technology
IT4: Impacts of Technology
IT5 Advantages of Technology

Safety

S 1: Understanding Safety
S2: Effects of Stress and Personal Emotions on Safety
S3: Complying with Safety Rules
S4: Dressing and Grooming for Safety
S5: Selecting and Utilizing Safety Equipment
S6: Identifying Physical and Environmental Hazards
S7: Creating a Safe Workplace
S8: Hazardous Substances and Devices
S9: Avoiding Injury While Lifting and Moving Objects

---

2. INTRODUCTION TO TECHNOLOGY
GRADES 7-8

MODULE: *GETTING TO KNOW TECHNOLOGY*

Goal: Examining the historical evolution of technological innovation as a means through which human needs and wants are satisfied.

Performance Objectives:

1. Demonstrate how the evolution of physical, biologically related, and information/ communication aspects of technology led to the shift from an agriculturally-based...to an industrially-based...to an information-based society.
2. Give one example (from each of the three aspects of technology) of an application of a modern tool, device, or method which has evolved from simple beginnings and describe how it has changed daily routines and contributed to human progress.
3. Research examples of technological innovations from each of the three aspects of technology which satisfy needs and wants and model one of these innovations.

MODULE: *LEARNING WHAT RESOURCES ARE NEEDED FOR TECHNOLOGY*

Goal: Exploring and using the seven basic resources which are necessary for technology

Performance Objectives:

4. Investigate the different forms of each resource category. Select one (or more) resource(s) and demonstrate how it (they) can be used.
5. Utilize the seven resources to produce a product, transport an object, grow living material, communicate an idea, or utilize the seven resources to implement a process and describe how full access to resources would have led to improved results.
6. Identify technological alternatives which would be appropriate for two nations (with differing non-renewable resources) to satisfy a given human need.

MODULE: *LEARNING HOW PEOPLE USE TECHNOLOGY TO SOLVE PROBLEMS*

Goal: Exploring and experiencing how people can solve technological problems by using a formalized problem solving "system."

Performance Objectives:

7. Design and implement the optimal solution to a given technological problem (which will involve biologically-related technology, information/communication technology and/or physical technology) and use a formalized problem solving method.
8. Identify constraints which prevent a technological problem from being solved. Classify the constraints as those imposed by resource limitations, values, and/or attitudes of people and scientific principles.

MODULE: *LEARNING ABOUT SYSTEMS AND SUBSYSTEMS*

Goal: Becoming familiar with the structure ,function, components and control of technological systems and gaining an understanding of the similarities that exist among physical, information/ communication and biologically related technological systems.

Performance Objectives:

9. Model a system in biologically related, information/communication and physical technology using the basic systems block diagram.
10. Apply the technological systems model to the safe assembly or construction and operation of a system which encompasses biologically related, information/ communication, and/or physical technology.
11. Add feedback to close the loop in an operable open-looped system and then safely operate the system in order to bring actual results closer to desired results.
12. Identify the subsystems of a modern, complex technological system from each of the three aspects of technology and explain how they have been combined to generate the new system resulting in improved or additional human capabilities.

MODULE: *LEARNING HOW TECHNOLOGY AFFECTS PEOPLE AND THE ENVIRONMENT*

Goal: Understanding the positive and negative impacts of technology while instilling the perception that people must assume the responsibility for adapting technology to the environment and to the human user.

Performance Objectives:

13. Demonstrate (in one or more of the three aspects of technology) outputs that are desired, undesired, expected, and unexpected.
14. Identify instances of the lack of fit between the technological system and the human user, identify techniques for improving the match between the technology, the human user, and the human-made environment, and demonstrate alternatives in order to improve the match in one or more of the given examples.
15. Identify instances of the lack of fit between the technological systems and the natural environment, identify techniques for improving the match between the technology and the natural environment, and model alternatives in order to improve the match.

MODULE: *CHOOSING APPROPRIATE RESOURCES FOR TECHNOLOGICAL SYSTEMS*

Goal: Learning how to make informed choices in selecting the proper resources for technological systems and choosing resources from seven resource categories.

Performance Objectives:

16. Identify needed resources and a range of possible alternative resources that can be used to solve a given problem situation in each of the three aspects of technology.
17. Investigate the properties of various synthetic, raw, and biological materials through testing and describe why materials are often chosen on the basis of their properties.
18. Substitute different resource inputs for those originally provided in a functioning technological sys-

tem, in order to optimize system outputs within given constraints.

19. Use a computer and appropriate computer software to access data about the resources given in a situation relating to one or more of the performance objectives above.

MODULE: *HOW RESOURCES ARE PROCESSED BY TECHNOLOGICAL SYSTEMS*

Goal: Learning how resources are processed by technological systems to meet human wants and needs and solving problems based on the conversion of energy, information, and materials from one form to another.

Performance Objectives:

20. Perform a variety of traditional and modern material conversion processes within each of the three aspects of technology.
21. Process information and communicate a message using graphic, photographic, or electronic means.
22. Perform a variety of energy conversion processes within each of the three aspects of technology.
23. Process information using computer hardware and software to reach an informed decision on a problem with several variables.

MODULE: *CONTROLLING TECHNOLOGICAL SYSTEMS*

Goal: Learning how technological systems are controlled in the three aspects of technology by feedback in closed-loop systems or by subsystems such as timers or computer programs in open-loop systems

Performance Objectives:

24. Describe examples graphically of open-loop and closed-loop systems in the three aspects of technology.
25. Demonstrate the use of human and technological sensors to monitor the output of a process.
26. Assemble and operate a closed-loop technological system when given plans and access to necessary equipment.
27. Use a computer to control a technological system when given access to the necessary hardware and software.

MODULE: *TECHNOLOGY AND SOCIETY: NOW AND IN THE FUTURE*

Goal: Learning the social and environmental impacts of technology on society from a local, national, and global perspective by accessing current and future technological systems.

Performance Objectives:

28. Anticipate the consequences of a new technology using futuring techniques when given an example of a technological system in each of the three aspects of technology.
29. Describe how emerging technologies have created new jobs and made others obsolete in each of the three aspects of technology.
30. Propose alternative technological solutions to a local, national, and global issue and model one of the alternatives.

MODULE: *USING SYSTEMS TO SOLVE PROBLEMS*

Goal: Learning how to apply knowledge of systems to solve problems in biologically related, communications/information, and physical technology and to combine various subsystems to provide integrated solutions to realistic problems or challenges.

Performance Objectives:

31. Draw and label a systems diagram which depicts the systems approach solution to a problem in each of the three aspects of technology.
32. Use a systems approach to develop a technological solution to a technological problem.
33. Use the computer as a record keeping device to document progress while developing an optimal solution to the problem proposed in performance objective

3. MATERIALS PROCESSING

MODULE: *RESOURCES FOR MATERIALS PROCESSING*

I. Raw Material Procurement
   A. Harvesting/refining
      1. Plants
      2. Animals
   B. Extracting/refining
      1. Land
      2. Air
      3. Water

II. Production Materials
   A. Ceramics
      1. Historical development
      2. Sources of raw materials
      3. Material classifications
         a. Clay
         b. Glass
         c. Hydrosetting
         d. Refractories
         e. Abrasives
      4. Applications
         a. Traditional
         b. Innovative
      5. Comparative characteristics
         a. Physical
         b. Mechanical
         c. Chemical
         d. Thermal
         e. Electrical
         f. Acoustical
         g. Optics
         h. Environmental
   B. Polymers
      1. Historical development
      2. Sources of raw materials
      3. Material classifications
         a. Thermoplastics
         b. Thermosets
      4. Applications
         a. Traditional
         b. Innovative
      5. Comparative characteristics
         a. Physical
         b. Mechanical
         c. Chemical
         d. Thermal
         e. Electrical
         f. Acoustical

g. Optics
h. Environmental

C. Forest products
1. Historical development
2. Sources of raw materials
3. Material classifications
   a. Solid wood products
   b. Wood composition
   c. Chemically derived
   d. Tree extractive products
4. Applications
   a. Traditional
   b. Innovative
5. Comparative characteristics
   a. Physical
   b. Mechanical
   c. Chemical
   d. Thermal
   e. Electrical
   f. Acoustical
   g. Optics
   h. Environmental

D. Metals
1. Historical development
2. Sources of raw materials
3. Material classifications
   a. Ferrous
   b. Nonferrous
4. Applications
   a. Traditional
   b. Innovative
5. Comparative characteristics
   a. Physical
   b. Mechanical
   c. Chemical
   d. Thermal
   e. Electrical
   f. Acoustical
   g. Optics
   h. Environmental

E. Composite materials
1. Historical development
2. Sources of raw materials
3. Material classification of components
   a. Resin matrix
   b. Fiber Reinforcements
4. Applications
   a. Traditional
   b. Innovative
5. Comparative characteristics

a. Physical
b. Mechanical
c. Chemical
d. Thermal
e. Electrical
f. Acoustical
g. Optics
h. Environmental

F. Other production materials
1. Plant and animal derivatives
2. Industrial chemicals
3. Pharmaceuticals
4. Electronic related
5. Textiles

MODULE: *PROCESSING MATERIALS*

I. Manufacturing processes
A. Separating
1. Shearing
a. Applications/examples
b. Techniques
c. Comparative effectiveness
2. Chip removal
a. Applications/examples
b. Techniques
c. Comparative effectiveness
3. Non-traditional
a. Applications/examples
b. Techniques
c. Comparative effectiveness

B. Combining
1. Mechanical fastening
a. Applications/examples
b. Techniques
c. Comparative effectiveness
2. Bonding
a. Applications/examples
b. Techniques
c. Comparative effectiveness
3. Mixing
a. Applications/examples
b. Techniques
c. Comparative effectiveness
4. Coating
a. Applications/examples
b. Techniques
c. Comparative effectiveness

C. Forming
1. Casting/molding
a. Applications/examples

b. Techniques
c. Comparative effectiveness

2. Compressing/stretching
   a. Applications/examples
   b. Techniques
   c. Comparative effectiveness
3. Conditioning
   a. Applications/examples
   b. Techniques
   c. Comparative effectiveness

MODULE: *IMPACTS OF MATERIAL PROCESSING*

I. Personal
   A. Lifestyle change
   B. Health and safety
   C. Career implications
   D. Technological dependency

II. Economic
   A. Individual profit/loss
   B. Organizational profit/loss

III. Societal
   A. Global interdependence
   B. Resource management
   C. Standard of living

IV. Environmental
   A. Value judgments
   B. Techniques of reclaiming/disposing

---

4. ENERGY

MODULE I: *INTRODUCTION TO ENERGY*

Submodule A:Energy Sources and Supplies

Topics:

A. Forms of Energy
B. Energy Conversion
C. Types of Resources and Projected Availability
D. Energy Crises

Submodule B: Energy Use

Topics:

A. How Energy is Used
B. Energy use Sectors

MODULE 11: *EXPLORING ENERGY TECHNOLOGIES*

Submodule A: Solar Energy

Topics:

A. The Nature of Solar Energy

B. Solar Heating and Cooling
C. Photovoltaics
D. Social Issues, Economic/Environmental Impacts, and Future Projections
E. Career Information

Submodule B: Other Renewable Energies
Topics:
A. Wind Energy
B. Water Power
C. Bioconversion Energy
D. Ocean Energy Resources
E. Social Issues, Economic/Environmental Impacts, and Future Projections
F. Career Information

Submodule C: Fossil Fuels
Topics:
A. Petroleum and Natural Gas
B. Coal
C. Storage and Distribution of Fossil Fuels
D. Social Issues, Economic/Environmental Impacts, and Future Projections
E. Career Information

Submodule D: Nuclear Fission
Topics:
A. Development
B. Atomic Theory
C. Uranium Mining, Fuel Processing and Fabrication
D. Reactor Types
E. Safety
F. Waste Disposals Spent Fuel Storage and Reprocessing
G. Social Issues, Economic/Environmental Impacts, and Future Projections
H.Career Information

Submodule E: Nuclear Fusion
Topics:
A. Nuclear Fusion Theory
B. Containment Designs
C. Social Issues, Economic/Environmental Impacts, and Future Projections
D. Career Information

Submodule F: Geothermal Energy
Topics:
A. Geothermal Energy Development
B. Geothermal Reservoirs
C. Extraction Techniques
D. Conversion Technologies
E. Social Issues, Economic/Environmental Impacts, and Future Projections
F. Career Information

MODULE III: *TYPES OF ENERGY CONVERSION SYSTEMS*

Topics:

A. 1st and 2nd Laws of Thermodynamics
B. Fuel Conversion
C. Generation of Electricity
D. Other Methods of Producing Electricity

MODULE IV: *ENERGY CONSERVATION*

Topics:

A. Definition, Terms, and Importance
B. Energy Conscious Design
C. Residential, Commercial, Industrial, and Transportation
D. Personal Commitment

---

5. ENERGYAND POWER

MODULE I: *INTRODUCTION TO ENERGY AND POWER*

Submodule A: Energy Sources, Supplies, and Use

Topics:1. Forms of Energy
2. Energy Conversion
3. Types and Availability of Resources
4. Energy Crises
5. How Energy is Used
6. Where Energy is Used

Submodule B: Concepts in Power

Topics:1. Early Power
2. Power Measurement and Theory

MODULE II: *EXPLORING ENERGY TECHNOLOGIES*

Submodule A: Solar Energy

Topics:1. The Characteristics of Solar Energy
2. Solar Heating and Cooling
3. Photovoltaics
4. Social Issues, Economic and Environmental Impacts, and Projections
5. Career Information

Submodule B: Other Renewable Energy Forms

Topics:1. Wind Energy
2. Water Power
3. Bioconversion Energy
4. Ocean Energy Resources
5. Geothermal Energy
6. Social Issues, Economic and Environmental Impacts, and Projections
7. Career Information

Submodule C: Fossil Fuels
Topics:1. Petroleum and Natural Gas
2. Coal
3. Storage and Distribution of Fossil Fuels
4. Social Issues, Economic and Environmental Impacts, and Projections
5. Career Information

Submodule D: Nuclear Fission and Fusion
Topics:1. Atomic Theory
2. Development of Nuclear Fission and Fusion
3. Uranium Mining, Fuel Processing, and Fabrication
4. Reactor Types and Containment Designs
5. Safety
6. Waste Disposal, Spent Fuel Storage, and Reprocessing
7. Social Issues, Economic and Environmental Impacts, and Projections
8. Career Information

MODULE III: *EXPLORING POWER TECHNOLOGY*
Submodule A: Internal Combustion Engines
Topics:1. Reciprocating Engine Design
2. 2- and 4-Stroke Cycle Engines
3. Compression Ignition (Diesel)
4. Gas Turbines
5. Airstream, Reaction (Jet) Engines
6. Rocket Engines
7. Innovative Engine Designs

Submodule B: External Combustion Engines
Topics:1. Steam Engines
2. Steam Turbines
3. Stirling Engine

Submodule C: Fluid Power
Topics:1. Hydraulics
2. Pneumatics

MODULE IV: *TYPES OF ENERGY AND POWER CONVERSION SYSTEMS*
Topics:1. Laws of Thermodynamics
2. Fuel Conversion Systems
3. Commercial Electricity Generation
4. Other Methods of Producing Electricity

MODULE V: *ENERGY CONSERVATION PRINCIPLES*
Topics:1. Definition, Terms, and Importance
2. Energy Conscious Design
3. Residential, Commercial, Industrial, and Transportation Sectors
4. Personal Commitment

6. GRAPHIC COMMUNICATIONS

I. MODULE: *PREPARATION FOR GRAPHIC REPRODUCTION*
Topics:
A. Measurement
B. Design Foundations

II. MODULE: *ELECTRONIC IMAGING/DESKTOP PUBLISHING*
Topics:
A. Microcomputer Imaging System
B. Computer Training
C. Telecommunications

III. MODULE: *GRAPHIC IMAGING/PRE-PRESS*
Topics:
A. Mechanical Preparation
B. Line and Tone Reproduction
C. Image Carrier Preparation

IV. MODULE: I*MAGE REPRODUCTION/PRINTING*
Topics:
A. Printing Systems
B. Finishing Operations

V. MODULE: *INDUSTRY RELATED CONCERNS*
Topics:
A. Industrial Organization and Careers
B. Emerging Technologies and Impacts
C. Legal Considerations

I. MODULE: *PREPARATION FOR GRAPHIC REPRODUCTION*
A. Topic: Measurement
1. Metric System
a. Length and width
b. Volume
c. Temperature
2. Printers system of measure
a. Typographic
b. Layout
c. Material weight and size
B. Topic: Design Foundations
1. Typography
a. Type classification
b. Letter spacing, word spacing and alignment
c. Headline and body composition
d. Copyfitting
2. Design Elements or principles
a. Lines, shape and mass
b. Balance, dominance, proportion and unity

c. Contrast and rhythm
d. Texture and color

3. Layout/Design steps
a. Thumbnail
b. Rough
c. Comprehensive
d. Mechanical
e. Dummy

II. MODULE: *ELECTRONIC IMAGING/DESKTOP PUBLISHING*

A. Topic: Microcomputer Imaging System

1. Hardware
a. Central processing unit and memory
b. Keyboard, mouse and digital tablet
c. Disk and tape storage
d. Dot matrix, ink-jet and laser image printers
e. Line, halftone, gray scale and OCR scanning
f. Image capture devices
g. Printer network and file serving operations
h. Safety considerations

2. Software applications for graphic production
a. Word processing
b. Drawing
c. Painting
d. Illustrating
e. Text and graphic integration

B. Topic: Computer Training

1. The user/system interface
a. Menu and cursor control
b. Floppy and hard disk procedures
c. File and file folder procedures

2. Word processing/typesetting
a. Type and font selection
b. Word and letter spacing
c. Left, right and justified alignment
d. Tabs and indents
e. Spell check and proofing

3. Drawing and illustrating
a. Manual and auto draw procedures
b. Ruling, tinting and filling
c. Surprinting and reversing
d. Object manipulation
(1) duplicating
(2) stretching
(3) resizing
(4) moving
e. Exporting files

4. Analog and digital imaging
a. Video digitizers and image capture devices
b. Scanners—line, halftone and gray scale

5. Integrating text and graphics
    a. Importing files
    b. Placing graphics
    c. Flowing text
    d. Page editing
6. Image output
    a. Printer network
    b. Choosing printers
    c. Print menus and options
    d. Printer operation

C. Topic: Telecommunications
1. Land and satellite systems
    a. System overview
    b. Communication software and hardware
2. Communication procedures
    a. Preparing files for transfer
    b. Setting up a communication session
    c. Sending and receiving files
3. Applications
    a. Electronic mail
    b. FAX
    c. Service bureau communication

III. MODULE: *GRAPHIC IMAGING/PRE-PRESS*

A. Topic: Mechanical Preparation
1. Working with photographs and illustrations
    a. Cropping and scaling
    b. Resizing
    c. Windows and holding lines
2. The paste-up
    a. Layout tools, supplies and equipment
    b. Layout lines and work marks
    c. Attaching copy
    d. Multicolor—overlays and register marks

B. Topic: Line and Tone Reproduction
1. Film characteristics
    a. Nature of light
    b. Color sensitivity, contrast and film speed
    c. Structure of film
2. Camera fundamentals
    a. Camera types
    b. Loading copy and film
    c. Exposure control
    d. Camera accessories
3. Line, halftone and continuous tone imaging
    a. Contacting
    b. Projection printing by enlarger
    c. Line photography
    d. Halftone photography

4. Chemical processing
    a. Processing steps
    b. Tray and machine processing
    c. High contrast, rapid access and continuous tone
    d. Image evaluation
    e. Safety considerations

C. Topic: Image Carrier Preparation
  1. Film assembly
    a. Tools, supplies and equipment
    b. Masking sheet layout
    c. Attaching film images
    d. Registration and alignment
  2. Plate and stencil making
    a. Equipment and supplies
    b. Offset plates
    c. Screen stencils
    d. Plate and stencil processing and finishing
    e. Safety considerations

D. Topic: Pigments and Substrates
  1. Pigments
    a. Properties
    b. Ingredients
    c. Ink types
  2. Substrates
    a. Book paper
    b. Writing paper
    c. Cover paper
    d. Bristol paper
    e. Other

IV. MODULE: *IMAGE REPRODUCTION/PRINTING*

A. Topic: Printing Systems
  1. Basic processes
    a. Lithography
    b. Flexography
    c. Gravure
    d. Screen
  2. Other reproduction processes
    a. Xerographic
    b. Laser
    c. Ink-jet
  3. Image transfer
    a. Feeder unit: loading and controlling
    b. Registration unit: types and adjustments
    c. Printing unit: configuration and adjustments
    d. Ink, pigment or toner unit: set-up and adjustments
    e. Dampening unit: preparation and adjustments
    f. Delivery unit: adjusting and controlling
    g. Safety considerations

4. Press configurations
    a. Sheet-fed and web-fed
    b. Single and multicolor
    c. Perfecting

B. Topic: Finishing Operations
1. Cutting and trimming
    a. Safety considerations
    b. Cutter operation
    c. Sequence of cuts
2. Folding
    a. Machine operation
    b. Types of folds
    c. Sequence of folds
3. Special operations
    a. Scoring
    b. Slitting
    c. Perforating
    d. Die cutting
4. Assembling
    a. Manual and automatic
    b. Gathering, collating and inserting
5. Binding
    a. Padding
    b. Side and saddle binding
    c. Perfect and casebound

V. MODULE: *INDUSTRY RELATED CONCERNS*

A. Topic: Industrial Organization and Careers
1. Industrial organization
    a. Segments/classifications of industrial services
    b. Types of printing establishments and communications enterprises
2. Graphic communications center
    a. Personnel organization
    b. Career planning

B. Topic: Emerging Technologies and Impacts
1. Emerging technologies
    a. Electronic imaging
    b. Reproduction processes
2. Outcomes of graphic communications
    a. Social impacts of mass communications
    b. Ecological impacts of graphic processes

C. Topic: Legal Considerations
1. Copyright and trademark
    a. Author and designer rights
    b. Printer obligations
2. Ethics in communications
    a. Model release
    b. Libel, plagiarism and counterfeiting
    c. Privacy, freedom of information, freedom of expression and censorship

7. ELECTRICITY/ELECTRONICS

MODULE: *ELECTRICITY IN THE HOME*
SUBMODULE: LOW VOLTAGE APPLICATIONS

1. Electrical Technologies

A. Electrical versus Electronic
B. Technological Systems Applications
   1. Power and energy
   2. Manufacturing
   3. Construction
   4. Communication (including fiber optics)
   5. Transportation
   6. Agriculture
   7. Aerospace/military
C. Home Applications
   1. Generation and distribution (heat, light, etc.)
   2. Major appliances
   3. Communication/entertainment
   4. Automotive
   5. Personal computers
   6. Health and medical

11. Safety Education [Not sequential. To be integrated in Content Outline where appropriate.]
A. Safety Practices
   1. Rules and regulations
   2. Tools, machines, and equipment
B. Electrical Safety
   1. Home environment
   2. Laboratory environment

111. Electrical Construction and Fabrication*
A. Tools and Hardware
   1. Electrical hand tools
   2. Wire selection and preparation
   3. Connectors- temporary/pressure
B. Electrical Diagrams
   1. Bill of materials
   2. Graphic symbols
   3 . Schematics
   4. Wiring/pictorials
   5. CAD
C. Fabrication and/or Breadboarding
   1. Drilling
   2. Mounting
   3. Assembly
   4. Modular component/circuit assembly
D. Soldering - Desoldering
   1. Preparation and safety
   2. Tools and materials
   3. Technology

IV. Electrical Theory
- A. Electrical Classification of Materials
  - 1. Conductors
  - 2. Insulators
  - 3. Semiconductors
  - 4. Electron theory
    - a. Electrical Current
- B.
  - 1. Movement of particles
  - 2. Direct and alternating
- C. Electrical Circuit
  - 1. Source
  - 2. Load
  - 3. Conductors
  - 4. Control - switches

V. Low Voltage Systems
- A. Simple Series Circuits
  - 1. Observing voltage and current
  - 2. Applications
- B. Simple Parallel Circuits
  - 1. Observing voltage and current
  - 2. Applications
- C. Basic Servicing Techniques
  - 1. Continuity/voltage tests
  - 2. Battery testing and charging
  - 3. Installing telephone jacks/plugs
- D. Applications
  - 1. Battery-powered systems
    - a. Automotive
    - b.
    - c. Toys and games
    - d. Camping equipment
    - e. Cameras, etc.
  - 2. Multivoltage/Step-Down Transformer
    - a. Voltages
    - b. Windings/color codes
  - 3. Home systems
    - a. Bells, buzzers, chimes, etc.
    - b. Telephones
    - c. Alarms
    - d. Low voltage lighting
    - e. Toy train/racing sets, etc.

MODULE: *ELECTRICITY IN THE HOME*
SUBMODULE: LINE VOLTAGE APPLICATIONS

1. Common Sources of Electricity
   - A. Cells and Batteries

B. Generators
C. Solar Cells

11. House Wiring Systems
    A. Generation and Distribution Systems
        1. Electrical service
        2. Kilowatt-hour meter
        3. Service center
        4. Circuits
        5. Fuses and circuit breakers
        6. Checking and resetting
    B. Electrical Lines and Wiring
        1. National Electrical Code
        2. Common wire sizes and color codes
        3. Wall, surface, and underground lines
        4. Extension cords
        5. Exterior wiring systems
    C. Basic Servicing
        1. Continuity/ground tests
        2. Replacing switches and receptacles
        3. Junction and outlet boxes

111. Appliance Systems
    A. Lighting Systems
        1. Incandescent devices
        2. Fluorescent devices
        3. Track and recessed lighting
        4. Common ratings and specifications
    B. Heating System s
        1. Common elements/devices
        2. Controls: manual, electronic, programmable
        3. Common ratings and specifications
    C. Electromagnetic Systems
        1. Magnetic effect
        2. Universal motors
        3. Motor-driven applications

IV. Consumer Education
    A. Manufacturer Specifications and Ratings
        1. Operating instructions and parameters
        2. Efficiency ratings
    B. Criteria for Evaluating and Purchasing Products
    C. Consumer Protection and Services
        1. Warranty and guarantee
        2. Consumer publications
        3. National Board of Fire Underwriters and U.L. Listings

MODULE: *ELECTRONICS*

1. Introduction to Electronics - Systems and Subsystems
    A. Common Systems
        1. Communications
        2. Knowledge/information
        3. Production/manufacturing
        4. Transportation
        5. Energy
    B. Component Subsystems
        1. Passive
        2. Active
        3. Integrated circuits

11. Introduction to Basic Passive Devices and Circuit Applications
    A. Resistors
        1. Common types - fixed, variable, special
        2. Laboratory skills
            a. Symbols
            b. Units of measurement
            c. Color code charts
            d. Testing
        3. Applications
            a. Limiting current
            b. Energy consumption
            c. Heat dissipation
    B. Capacitors
        1. Common types - fixed, variable, special
        2. Symbols, units of measurement, and testing opens/shorts
        3. Applications - filters, tuners, timing, etc.
    C. Inductors
        1. Common types - air core, iron core
        2. Symbols, units of measurement, and testing
        3. Applications - antennas, tuners, transformers, and relays

111. Introduction to Basic Active Devices and Circuit Applications
    A. Diodes
        1. Common types - silicon, germanium, and LED's
        2. Symbols, specifications, lead identification, and testing
        3. Applications - rectification, blocking, LED indicators
    B. Transistors - Bipolar
        1. Common types - NPN/PNP
        2. Symbols, specifications, lead identification, and testing
        3. Applications - switching, amplification
    C. Silicon Controlled Rectifier (SCR)
        1. Common types
        2. Symbols, specifications, lead identification, and testing
        3. Applications - alarm systems, trigger systems, etc.

IV. Laboratory Experimentation and Circuit Fabrication [Not sequential. To be integrated in Content Outline where appropriate.]

A. Methods of Circuit Construction and Safety Practices
   1. Use of functional system block diagrams
      a. Guitar am amplifier
      b. Light dimmer
      c. Strobe light
      d. Crystal detectors, etc.
   2. Use of laboratory equipment
   3. Use of tools and machinery
   4. Printed circuit fabrication
   5. Wire wrapping and soldering
   6. Testing and troubleshooting

B. General Safety Instruction
   1. Personal safety - physiological effects of current/voltage
   2. Emergency first aid for electrical shock
   3. Accident prevention

V. Introduction to Integrated Circuits

A. Digital and Linear Types
   1. Definition of each, specific to operation
   2. Common types and uses

B. Laboratory Experimentation with Digital IC's
   1. Operating characteristics
   2. Pin locations, wiring considerations, and handling
   3. Using digital logic information - binary number system

C. Laboratory Experimentation with Linear IC's
   1. Operating characteristics
   2. Using linear devices

D. Impacts of Integrated Circuit Technology
   1. Human needs as an influence on technology
   2. Technology as an influence on human needs
   3. Future trends - global interdependence, cultural transitions, industrial to information based society
   4. Robotics

Vl. Career Exploration [Not sequential. To be integrated in Content Outline where appropriate.]

A. Examination/Research of Diverse Electricity/Electronics Opportunities

B. Developing a Career Plan

Vll. Consumer Awareness [Not sequential. To be integrated in Content Outline where appropriate.]

A. Developing Criteria for Evaluating Electronic Products/Services
   1. Human needs
   2. Quality, efficiency and cost
   3. Frequency of repair

B. Impacts on Resources and Environment

8. TECHNICAL DRAWING

MODULE: *BASIC TECHNICAL DRAWING*

1. Introduction
    - A. Historical Development
        1. Cave drawings (traces)
        2. Hieroglyphics (picture writing)
        3. Oudea fortress (first-plan record)
        4. Vitruvius (architect)
        5. Alberti (architecture)
        6. DaVinci (theory of perspective)
        7. Gaspard Monge (descriptive geometry)
        8. Claude Crozert (USA, descriptive geometry)
        9. William Minifie (USA, technical drawing text)
        10. Alteneder & Sons Co. (drawing instruments)
        11. Blueprint process
        12. Drafting machine
        13. American National Standards Institute/American Society of Mechanical Engineers
        14. Computer-aided drafting and design
    - B. Technical Drawing Terms
        1. Descriptive geometry
        2. Mechanical drawing
        3. Engineering drawing and drafting
        4. Technical drawing
        5. Engineering graphics
        6. Technical sketching
        7. Blueprint reading
    - C. Branches of Technical Drawing
        1. Architectural drawing
        2. Structural drafting
        3. Machine drawing
        4. Sheet metal drawing
        5. Electrical drafting
        6. Aeronautical drawing
        7. Civil drafting
        8. Marine drawing
    - D. The Universal Language
        1. Definition
        2. Worldwide acceptance
        3. Drawings vs. foreign language
        4. Use in a technical world
    - E. Artistic vs. Technical Drawing
        1. Definitions
        2. Differences and similarities
        3. Need for both
    - F. Aims of Technical Drawing
        1. Technique
        2. Accuracy
        3. Neatness
        4. Speed

11. Tools/Equipment and Materials
    A. The Meaning of Technical Drawing
        1. Definition
        2. Purpose
    B. Drawing Equipment
        1. Used by draftspersons (T-square, triangle, lead pointer, etc.)
        2. Purpose of each item
        3. Use
    C. Drawing Papers and Their Uses
        1. Drawing paper
        2. Tracing paper (vellum)
        3. Tracing cloth (linen)
    D. Drawing Pencils
        1. Types
        2. Hardness/softness
        3. How to sharpen
    E. Alphabet of Lines
        1. Definition
        2. Purpose of each line (border, object, section, etc.)
        3. Choosing the right pencil and constructing a line
    F. Horizontal, Vertical, Inclined, Parallel, and Perpendicular Lines
        1. Use of T-square in line construction
        2. Use of triangle in line construction
        3. Use of T-square with triangles in line construction
    G. Types of Scales and Their Uses
        1. How to read a scale
        2. Architect's scale
        3. Engineer's scale
        4. Mechanical draftsperson's scale
    H. Construction of Circles and Irregular Curves
        1. The Giant Bow Set
        2. Compass
        3. French curve
        4. Circle templates
    1. The Drafting Machine
        1. Parts/assembly and set-up
        2. Use
    J. Tradespeople Using Technical Drawing
        1. Designers, fabricators, engineers, etc.
        2. Ways they use technical drawing
        3. Time-efficient items (automatic pencil, thin lead automatic pencil, Ames Lettering Guide, templates)
        4. Characteristics of their worlds of work

III. Lettering
    A. Origin of Letters
        1. Definition of pictograph
        2. History of lettering (cave people to ANSI)
        3. The need for standardized lettering
    B. Modern Letter Forms
        1. Roman

2. Gothic
3. Text

C. Uniformity in Lettering
1. Line thickness
2. Line slant (vertical/inclined)
3. Uppercase and lowercase
4. Numbers and fractions

D. Pencil Technique
1. Choice of pencils
2. Sharpening for lettering

E. Guidelines
1. Purpose (horizontal, vertical)
2. Spacing of guidelines
3. Guideline devices (Braddock-Rowe Triangles, Ames Lettering Instrument)

F. Composing Letters, Numbers, Fractions, and Words
1. Width to height comparisons of letters/numbers
2. The stroke sequence

G. Lettering Devices
1. Leroy Lettering Instrument
2. Wrico Lettering Instrument
3. Varigraph
4. Tacro-Scriber
5. Unitech Lettering Set

IV. Sketching

A. Purposes
1. Communicate through pictures
2. Formulate ideas
3. Provide flexibility/design changes
4. A graphic record

B. Sketching Equipment
1. Pencils
2. Paper
3. Erasers

C. Techniques of Sketching
1. Freehand lines
2. Straight lines
3. Arcs and circles
4. Ellipses, squares, and cubes

D. Estimating Proportions
1. Method of blocking horizontal and vertical lines
2 . Method of transferring distances
3. Method of eyeballing objects

E. Levels of Sketching
1. Temporary
2. Permanent
3. Presentation

F. Sketching an Object
1. Pictorial/oblique, isometric
2. By visualizing a single view from an object

V. One- and Two-View Drawings
- A. Purpose of One- and Two-View Drawings
  1. Simplicity
  2. Elimination of duplication
- B. Process of Visualization
  1. Center lines
  2. Hidden lines
  3. Contours
  4. Views that illustrate most detail
- C. Process of Implementing One- and Two-View Drawings
  1. Drawing center lines
  2. Drawing hidden lines
  3. Drawing appropriate line weights

Vl. Dimensioning
- A. ANSI Standard Dimensioning Practices
  1. Dimension lines used
  2. Dimension line weights
  3. Dimension placement
  4. Arrowheads
  5. Inch marks
  6. Dimension figures
  7. Dimension notes
- B. Size Dimensions Contrasted With Location Dimensions
  1. Size dimensions
  2. Location dimensions
  3. Tolerancing
- C. Dimensioning Geometric Figures
  1. Prisms
  2. Cylinders
  3. Holes
  4. Cones
  5. Pyramids
- D. Specialized Dimensions
  1. Angles
  2. Arcs
  3. Fillets and rounds
  4. Finish marks
  5. Continuous curves
  6. Mating parts
- E. Notes on a Drawing
  1. General notes and their size
  2. Local notes
  3. Use of leaders

VlI. Three-View Drawings
- A. Purpose of Multi-View Drawings
  1. Exact method of communication
  2. Universal language
- B. Process of Visualization and Implementation

1. Ability to see an object abstractly ("the mind's eye")
2. Drawing the visualized object
3. "Glass box" method

C. Planes of Projection in Multi-View
1. Top view and dimensions (width and depth)
2. Front view and dimensions (width and height)
3. Right side view and dimensions (height and depth)
4. Elimination of bottom, left side, and rear views

D. Relationship of Views
1. Proper placement
2. Alignment

E. Types of Lines
1. Hidden lines
a. Purpose
b. Method of constructing dashes and spaces
c. Weight of line
2. Center lines
a. Purpose
b. Method of constructing in views containing circles
c. Weight of line
3. Visible/object lines
a. Purpose
b. Weight of line
4. Construction lines
a. Purpose
b. Weight of line

Vlll. Career Exploration
A. Careers in Technical Drawing
B. Job Categories and Descriptions
C. Job Availability
D. Job Benefits/Environment
E. Opportunities for Advancement and Job Security
F. Education and Training Required for Job Entry

MODULE: *APPLICATIONS OF BASIC TECHNICAL DRAWING*

1. Geometric Construction
A. Importance of Geometry in Technical Drawing
1. Identification and use of instruments
2. Methods of solving geometric problems
3. Accuracy in geometric constructions

B. Geometric Shapes in Technical Drawing
1. Points
2. Lines - straight, parallel, intersecting, perpendicular, skew, regular and irregular
3. curved Angles - acute, right, obtuse, straight, reflex, complementary, and supplementary
4. Circle and related parts - circumference, diameter, segment, tangent, chord, concentric, eccentric
5. Triangles - right, equilateral, isosceles, scalene
6. Quadrilaterals - parallelograms (square, rectangle, rhombus, and rhormboid), trapezoid, and trapezium
7. Polygons - pentagon, hexagon, heptagon, octagon, nonagon, decagon, dodecagon

8. Regular solids - prisms, pyramids, cones, cylinders, and tetrahedrons
9. Spheres
10. Related terms- frustum, truncation, altitude, axis, vertex, base, element

C. Solving Geometric Problems - Definition of Terms, Applications, Procedures for:

1. Bisecting a line
2. Dividing a line into equal segments
3. Transferring angles and shapes
4. Bisecting angles
5. Drawing triangles to given specifications
6. Circumscribing and inscribing polygons
7. Drawing an arc through three given points
8. Transferring of an arc distance to a straight line
9. Drawing a circle tangent to a line
10. Drawing a line tangent to a point on a circle
11. Drawing an arc tangent to two straight lines
12. Drawing an arc tangent to a line and arc
13. Drawing an arc tangent to two other arcs
14. Drawing an ellipse (concentric circle and four center points method)

II. Sectioning

A. Purpose of Section Drawing

1. Preferred means of communicating an idea over a multi-view drawing
2. Process of visualizing sections

B. Understanding Special Terms

1. Cutting plane line
2. Direction of sight
3. Section lines
4. Break lines
5. Ribs/webs

C. Types of Sectional Views

1. Full section
2. Half section
3. Broken out section
4. Revolved section
5. Removed section (locating/labeling)
6. Rotated section
7. Ribs and spikes in section

D. Section Lines

1. Angle/direction
2. Weight of lines
3. Spacing

E. Section Line Symbols

1. General or cast iron
2. Specialized symbols

F. Break Symbols

1. Purpose
2. Round objects
3. Drawing “S” break with a template and/or compass
4. “S” break freehand
5. Metal or wood objects

6. Long and short
G. Dimensioning
1. General dimensions
2. Over section lines
H. Selecting and Implementing Section Views

111. Isometric Views
A. Pictorial Drawing
1. Definition
2. Importance
B. Types of Pictorial Drawings
1. Isometric/characteristics
2. Oblique/characteristics
3. Perspective/characteristics
C. Isometric Drawing Equipment
1. Compass
2. 30 degree triangle
3. Dividers
4. Cross-section paper
5. Isometric ellipse template
6. Other isometric templates
D. Sketching an Isometric
1. Establishing a base line
2. Establishing the 30 degree isometric axis
3. Setting the height, width, and depth
4. Ellipses, arcs, curves and circles
5. Angles and intersections
E. Mechanical Drawing of an Isometric
1. Basic isometric block shapes
2. Establishing basic axis lines (major and minor axis)
3. Measuring of height, width, and depth
4. Completing faces
5. Angles in isometric/non isometric lines
6. Compass ellipse construction
7. Template ellipse construction
8. Isometric sectioning~
9. Isometric dimensioning
F. Methods of Shading
1. Purpose
2. Pencil
3. Ink
G. Production Illustration
1. Purpose
2. Assembly (isometric)
3. Sectional (isometric)

IV. Auxiliary Views
A. Inclined Surfaces
1. Definition
2. Distortion in regular views

B. The Auxiliary View
    1. Definition
    2. Purpose
C. Tradespeople Using Auxiliary Views
    1. Sheetmetal workers, product manufacturers, etc.
    2. Ways auxiliary views are used on the job
    3. Career categories
    4. Job descriptions, availability, benefits
    5. Opportunities for advancement and job security
    6. Education and training requirements for job entry
D. The Three Auxiliary Views
    1. Depth
    2. Height
    3. Width
E. Drawing Primary Auxiliary Views
    1. Establishing the line of sight
    2. Projection lines
    3 Establishing a reference plane
    5. Transferring points
    6. Completing- the view

Perpendicular projection lines from the plane

V. Developments
A. Developments (Patterns or Stretchouts)
    1. Definition
    2. Importance in today's technological world
    3. Terms
    4. Common uses (packaging, duct work, construction)
B. Geometric Solid Shapes
    1. Prisms
    2. Cylinders
    3. Cone
    4. Pyramid
    5. Truncations, inclination of solids
C. Types of Developments
    1. Parallel line
    2. Radial line
    3. Problem solving formulas and techniques
        a. True length of a line
        b. True size and shape of surfaces
        c. Triangulation
        d. R/S X 360 degrees = included angle of a cone
D. Transition Pieces
    1. Definition
    2. Methods of development
    3. Types of transitions
E. Steps in Analyzing Surface Developments
    1. Lay out stretchout line
    2. Set off segments of perimeter onto stretchout line

3. Set off heights on fold lines
4. Connect exterior points on development to complete pattern

Vl. Drawing Reproduction
- A. Identification of Drawing Surfaces
  1. Opaque
  2. Translucent tracing paper
  3. Cloth
  4 Film
  5. Fade-out grid and lined stock
  6. Illustration board
     a. Reproduction Processes
- B. Reproduction Processes
  1. Blueprint
  2. Diazo (dry process, wet process)
  3. Electrostatic (xerography)
  4. Thermographic
  5. Photographic
  6. Microfilm
  7. Microfiche
- C. Factors Considered in Reproduction
  1. Quality of copy reproduced

---

9. DESIGN AND DRAWING FOR PRODUCTION
DESIGN ACTIVITY BRIEF OUTLINE

TECHNICAL DRAWING AREA: Choose one of the six major technical drawing areas to be covered this year. Subgroups, such as isometric, should appear in parenthesis.

DESIGN ACTIVITY:

1. These statements should be made in narrative form perhaps as a scenario or a situation describing a need to be fulfilled.
2. Specific criteria for the successful design and drawing should be stated, offering guidance for the problem solver as well as considerations toward evaluation. To avoid complex design solutions which involve drawing skills exceeding the capability or experience of the students, care should be exercised in selecting and stating the design problem. The design problem should be structured to focus on and achieve the limited number of objectives identified for the period of instructional time by the teacher. Lack of precision in specifying criteria in stating the design problem may create a need for considerable individual instruction evolving from misinterpretation.
3. Critical thinking and creative problem-solving skills need to be emphasized as important processes in this step.

RESEARCH AND CRITICAL ANALYSIS: The teacher and/or students should analyze the nature of the problem and its ramifications. Environmental, societal and cultural impacts need to be considered.

HISTORICAL REFERENCES: Historical precedents and futuring must be revealed in lecture, discussion or additional activities. Visual aids, slides, video, models, media, other print materials, cultural institutions and community resources may be used when appropriate.

SKILLS: Competency in the conventions of drawing would cover the skills required to express one's ideas visually. Drawing conventions, uses of materials and professional conduct are stressed to communicate ideas visually.

LINKAGE: The application of the design to the real world will be made by linkage to mass production methods, transportation or communication systems. The factors of cost, materials, method, labor, technology, processes, ecological and environmental impact are considerations. Information regarding pertinent careers should be provided.

STUDENT REQUIREMENTS & CRITERIA FOREVALUATION:

DESIGN: Criteria specific to the quality of the design solution are to be evaluated.

DRAWING: Qualities relevant to the uses of materials, techniques, scale, etc. are to be evaluated.

---

10. COMMUNICATION SYSTEMS

MODULE 1. *INTRODUCTION—COMMUNICATING INFORMATION*

- A. SYSTEMS OVERVIEW
  - 1. A communication systems model
    - a. Input, process and output stages
    - b. Monitor feedback, control and adjust
    - c. Resources
  - 2. Types of systems for communicating information
    - a. Audio systems • Radio and Telephone
    - b. Video systems • Television
    - c. Integrated media systems • Computer assisted multimedia
- B. DEVELOPING THE MESSAGE
  - 1. Client data and information gathering
    - a. Client interview
    - b. Message identification
    - c. Market identification
  - 2. Identifying the approach
    - a. Brainstorm communication solutions
    - b. Identify appropriate media
  - 3. Client confirmation
    - a. Presentation of proposal
    - b. Customer modifications and acceptance
  - 4. Organizing production
    - a. Scheduling and contracting
    - b. Identifying and selecting resources

MODULE 2. *ELECTRONIC GRAPHIC AND DRAWING SYSTEMS*

- A. ELECTRONIC STILL IMAGING
  - 1. Recording
    - a. Camera operation
    - b. Applications
  - 2. Output
    - a. Monitor display
    - b. Image printing
    - c. Presentation graphics
    - d. Desktop publishing
- B. PRESENTATION GRAPHICS
  - 1. System requirements
    - a. Hardware
    - b. Software
  - 2. Visual considerations
    - a. Image selection and placement
    - b. Color
- C. COMPUTER ASSISTED ILLUSTRATING
  - 1. System requirements
    - a. Hardware
    - b. Software
  - 2. Input procedures
    - a. Drawing techniques
    - b. Importing and manipulating images
- D. ELECTRONIC PUBLISHING
  - 1. System requirements
    - a. Hardware
    - b. Software
  - 2. Basic typography
    - a. Measurement
    - b. Type selection
    - c. Formatting
  - 3. Output devices
    - a. Low resolution printers
    - b. High resolution imagesetters
  - 4. Telecommunication applications
    - a. File sharing
    - b. Telepublishing
    - c. Accessing services

MODULE 3. *GRAPHIC PRODUCTION SYSTEMS*

- A. PRE-PRESS
  - 1. Photographic image input
    - a. Black and white photographs
    - b. Color images
  - 2. High contrast photography
    - a. Line photography
    - b. Halftone photography
  - 3. Proofing and platemaking
    - a. Digital

b. Photographic
c. Electrostatic

B. IMAGE TRANSFER
1. Printing systems
a. Offset (lithography)
b. Flexography (relief)
c. Gravure (intaglio)
d. Screen (stencil)
e. Electrostatic (xerography)
2. Electronic systems
a. Laser
b. Ink Jet
c. Thermal
d. Sublimation

MODULE 4. *ELECTRONIC COMMUNICATION SYSTEMS*
A. AUDIO SYSTEMS • RADIO AND TELEPHONE
1. Recording and playback
a. Analog (disc, tape and records)
b. Digital (disc and tape)
2. Audio production resources
a. Equipment (source, amplify and playback)
b. Mediums (tape, disc and record)
c. Facilities (studio and control room)
d. People (station manager, program director, on-air staff, sales/marketing, chief of production and staff, chief engineer and technical staff, traffic manager, news director/reporters)
e. Capital (advertising sales, rate cards, promotion, networks and owners)
3. Studio and live production
a. Equipment (mixing board, console, microphone, cart machine, tape recorder, CD player, turntable and amplifier)
b. Techniques (miking, recording, equalizing, mixing, editing, dubbing and duplicating)
c. Music and voice recording
d. Airshifts (morning, noon and evening)
e. Station format (music, personalities and programming)
4. Telecommunications applications
a. Telephone
b. Message systems

B. VIDEO SYSTEMS • TELEVISION
1. Video recording and playback
a. Analog
b. Digital
2. Production resources
a. Equipment (cameras, lighting, audio, dubbing, computers and editing)
b. Formats (2",1", 3/4",1/2", 8mm)
c. Facilities (studios, mobile units, editing, control room and transmitter)
d. People (station manager, news director, engineer and reporter)
e. Capital (advertising sales, networks, stock holders and owners)
3. Production planning
a. Target audience/demographics
b. Approach method (information, promotion, persuasion and entertainment)

c. Format (commercials, public service announcements, interviews, news broadcasts, documentaries, electronic field productions, electronic news gathering and short features)
d. Storyboarding
e. Scriptwriting
f. Supporting floor plans and drawings
g. Budgeting and scheduling

4. Production techniques
a. Composition and camera techniques
b. Directing
c. Scenery
d. Audio
e. Lighting
f. Editing
g. Dubbing
h. Graphics (titles, animations and computer generation)
i. Single camera productions
j. Multi-camera productions

5. Broadcast considerations
a. On-air program schedule
b. Market share and ratings

C. INTEGRATED MEDIA SYSTEMS (COMPUTER-ASSISTED MULTIMEDIA)

1. Computer animation
a. Hardware and software requirements
b. Image motion and effects

2. Sound digitizing
a. Inputs and digital interface devices

3. Image capture
a. Inputs and digital interface devices
b. Applications

4. Media integration and production
a. Computer generated video (encoders and genlock)
b. Interactive video (software drivers and interfaced peripherals)

MODULE 4D: *COMMUNICATION THROUGH THE INTERNET*

1. What is the Internet
a. History
b. Present Status and Current Usage
c. Internet vs. Proprietary On-line Services
d. Domains

2. Applications
a. E-mail and Listservs
b. The World-Wide Web
c. Usenet and Internet Relay Chat
d. FTP, Gopher and Telnet
e. Audio and Video Communication

3. Information Gathering
a. Education
b. Business
c. Health
d. Religion

e. Human Connections
4. Skills
a. Search Strategies
b. Conventions and Netiquette
c. Programming (e.g., HTML, JAVA)
5. Issues
a. Privacy
b. Security
c. Free Speech
6. The Future of the Internet
7. Applications to presentation graphics and animated presentations

MODULE 5. *INDUSTRY RELATED CONCERNS*

A. INDUSTRIAL ORGANIZATION AND CAREERS
1. Industrial organization
a. Segments/classifications of services
b. Types of establishments and enterprises
2. Communications careers
a. Personnel organization
b. Career planning

B. ETHICAL CONSIDERATIONS AND IMPLICATIONS
1. Copyright and trademark
a. Author and designer rights
2. Ethics in communications
a. Model release
b. Libel, plagiarism and counterfeiting
c. Privacy, freedom of information and freedom of expression

---

11. CONSTRUCTION

I. System Command Input
A. Desired project
1. Project selection
2. Project specifications
3. Pre-construction planning
B. Expected impacts (environmental, economic, societal, personal)

II. Resources
A. People
1. Job classification/career preparation
2. Organizational structure
3. Recruitment
B. Information
1. History
a. Residential
b. Non-residential
2. Safety
3. Technical knowledge

a. Research and development
b. Planning
c. Engineering

C. Materials
1. Raw material sources
2. Conversion from raw materials to construction materials
3. Procurement
4. Comparative characteristics

D. Tools/machines
1. Function/selection
2. Operating techniques
3. Maintenance

E. Capital
1. Sources
2. Disbursement

F. Energy
1. Types
2. Applications

G. Time
1. Quantity
2. Management

III. Processes

A. Foundation Systems
1. Materials
2. Types

B. Superstructures
1. Materials
2. Types

C. Enclosure Systems
1. Materials
2. Flooring, walls, ceiling, roofing
3. Insulating

D. Utility Systems
1. Types
2. Materials

IV. Outputs

A. Completed Project
1. Site completion
2. Maintenance

B. Impacts
1. Environmental
2. Economic
3. Societal
4. Personal

V. Control

A. Reasons
1. Quality assurance

2. Profitability

B. Methods
   1. Monitor outputs
   2. Compare outputs with inputs
   3. Adjust processes

---

12. MANUFACTURING

I. System Command Input
   A. Desired project
      1. Product selection
      2. Product specifications
      3. Pre-production planning
   B. Expected impacts (environmental, economic, societal, personal)

II. Resources for Manufacturing
   A. People
      1. Job classification/career preparation
      2. Organizational structure
      3. Recruitment
   B. Information
      1. History
         a. Handcrafting
         b. Mechanization/Automation
      2. Safety
      3. Technical knowledge
         a. Research and development
         b. Planning
         c. Engineering
   C. Materials
      1. Raw material sources
      2. Conversion from raw materials to industrial materials
      3. Procurement
      4. Comparative characteristics
   D. Tools/machines
      1. Function/selection
      2. Operating techniques
      3. Maintenance
   E. Capital
      1. Sources
      2. Disbursement
   F. Energy
      1. Types
      2. Applications
   G. Time
      1. Quantity
      2. Management

III. Processes of Manufacturing
   A. Forming

1. Casting/molding
2. Compressing/stretching

B. Separating
1. Shearing
2. Chip removal
3. Non-traditional

C. Combining
1. Mechanical fastening
2. Adhesion/cohesion
3. Mixing
4. Coating
5. Assembling

D. Conditioning
1. Thermal, chemical, and mechanical
2. Applications

IV. Outputs of Manufacturing

A. Products
1. Packaging
2. Distribution
3. Reclamation
4. Servicing

B. Impacts
1. Environmental
2. Economic
3. Societal
4. Personal

V. Control of Manufacturing

A. Reasons
1. Quality assurance
2. Profitability

B. Methods
1. Monitor outputs
2. Compare outputs with inputs
3. Adjust processes

---

13. PRODUCTION SYSTEMS

MODULE: *BASIC SYSTEMS OF MANUFACTURING*

I. System Command Input

A. Desired product
1. Needs assessment
2. Product specifications
3. Pre-production planning

B. Expected impacts
    1. Environmental
    2. Economic
    3. Societal
    4. Personal

II. Resources
  A. People
    1. Job classification/career preparations
    2. Organizational structure
    3. Recruitment
  B. Information
    1. History
      a. Handcrafting
      b. Mechanization (Industrial Revolution)
      c. Automation
    2. Safety
    3. Technical knowledge
      a. Research and development
      b. Planning
      c. Engineering
  C. Materials
    1. Raw material secural
    2. Conversion from raw materials to industrial materials
    3. Procurement (purchasing)
    4. Comparative characteristics
  D. Tools/machines
    1. Function/selection
    2. Operating techniques
    3. Maintenance
  E. Capital
    1. Sources
    2. Disbursement
  F. Energy
    1. Types
    2. Applications
  G. Time
    1. Quantity
    2. Management

III. Processes
  A. Forming
    1. Casting/molding
    2. Compressing/stretching
  B. Separating
    1. Shearing
    2. Chip removal
    3. Non-traditional
  C. Combining
    1. Mechanical fastening

2. Adhesion/cohesion
3. Mixing
4. Coating
5. Assembling

D. Conditioning
1. Thermal
2. Chemical
3. Mechanical

IV. Outputs
A. Products
1. Packaging
2. Distribution
3. Reclamation
4. Servicing

B. Impacts
1. Environmental
2. Economic
3. Societal
4. Personal

V. Control
A. Reasons
1. Quality Assurance
2. Profitability

B. Methods
1. Monitor
2. Compare
3. Adjust

---

14. TRANSPORTATION SYSTEMS

MODULE: *LAND TRANSPORTATION SYSTEMS*

1. System Command Input
A. Desired Result
1. Specifications for movement of goods and people
2. Safety considerations
3. Vehicle design specifications
4. Economic qualifications

B. Expected Impacts
1. Environmental
2. Economic
3. Societal
4. Personal

Il. Resources
A. People
1. Job classifications
2. Career opportunities

- B. Information
  - 1. Historical technical advances
  - 2. Information systems
    - a. Maps
    - b. Operating and servicing manuals
  - 3. Safety
- C. Materials
  - 1. Vehicle construction materials
  - 2. Characteristics and design considerations
- D. Tools/Machines
  - 1. Identification
  - 2. Function/selection
  - 3. Utilization and safe operating techniques
  - 4. Maintenance
- E. Capital
  - 1. Source
  - 2. Effect on development
- F. Energy
  - 1. Types and sources
  - 2. Conversion and applications
- G. Time
  - 1. Requirements/quantity
  - 2. Management and outcomes

III. Process
- A. Modes
  - 1. Fixed (rail)
  - 2. Random (auto, recreational)
  - 3. Stationary (pipeline, conveyor, elevator)
- B. Vehicle Subsystems
  - 1. Propulsion (engine types)
  - 2. Structure (frame, body)
  - 3. Suspension (wheels, tracks, air cushion)
  - 4. Guidance and control

IV. Output
- A. Service Provided/Goods Delivered
- B. Impacts
  - 1. Environmental
  - 2. Economic
  - 3. Societal
  - 4. Personal

V. Monitor and Control
- A. Types and Methods
- B. Purposes

---

15. AC/DC ELECTRONIC THEORY

I. MODULE: *INTRODUCTION TO UNDERSTANDING ELECTRICITY AND ELECTRONICS*

Topics:

A. Safety
B. Calculations/Notations

II. MODULE: *DC FUNDAMENTALS*

Topics:

A. Electron Theory
B. Voltage
C. Resistance/Ohms Law

III. MODULE: *DC CIRCUITS*

Topics:

A. Series Circuits
B. Parallel Circuits
C. Complex Circuits

IV. MODULE: *MAGNETISM AND CURRENT GENERATION*

Topics:

A. Magnetic Theory
B. Alternating Current
C. Transformers

V. MODULE: *CAPACITANCE AND INDUCTANCE*

Topics:

A. Capacitive Devices
B. Inductive Devices

VI. MODULE: *AC REACTIVE CIRCUITS*

Topics:

A. Resistive Circuits
B. Capacitive Reactance Circuits
C. Inductive Reactance Circuits
D. Inductive/Capacitive Reactance Circuits

VII. MODULE: *AC/DC CONVERSIONS CIRCUITS*

Topics:

A. Semiconductor Diode
B. Power Supply

---

16. AEROSPACE

Aerospace education is that branch of general education concerned with communicating knowledge, skills and attributes about aerospace activities and the total impact of air and space vehicles upon our society. The aerospace curriculum has been identified by the following submodules.

SUBMODULES:

A. Historical Evolution of Aerospace
B. Fundamentals of Flight
C. Navigation/Communications
D. Meteorology/Flight Physiology
E. Propulsion Systems
F. Space Technology—Unmanned
G. Space Technology—Manned
H. Aerospace Careers and Occupations

---

17. ARCHITECTURAL DRAWING

I. Culture and History
- A. The Monumental Civilizations
  1. Egypt - mass structures
  2. Middle Eastern civilizations
- B. Greek Architecture (Classical Period)
  1. Post and lintel design
  2. Column orders (Doric, Ionic, Corinthian)
- C. Roman Architecture
  1. Column orders (Composite, Tuscan)
  2. Arch
  3. Vault
  4. Dome
- D. Early Christian and Byzantine Architecture
  1. Basilicon churches
  2. Centralized structure
- E. Gothic Architecture (1100-1500)
  1. Early Gothic (pointed arch, buttress, flying buttress)
  2. High Gothic
  3. Late Gothic
- F. The Renaissance (1420-1770)
  1. Europe
  2. England
- G. The Twentieth Century
  1. Technological advances
  2. New construction methods and materials
  3. Contemporary architects
  4. Specialized building, skyscrapers, residential buildings, town planning

II. Tools and Techniques
- A. Architectural Scales
  1. Significance
  2. Reduced scale 1/4 and 1/8
  3. Shape, divisions, types
  4. Use and care
- B. Drafting Instruments and Equipment
  1. T-squares/triangles/adjustable triangles

2. Drafting machines
3. Compass/dividers/flexible curves
4. Technical inking pens (esp. Rapidograph)
5. Erasing shield

C. Drawing Papers
1. Tracing vellum
2. Papers for rough copy and overlay designs
3. Diazo prints

D. Drawing Pencils
1. Hardness identification standards
2. Mechanical lead holders
3. Wood pencils
4. 0.5 mm pencils

E. Computerized Drafting and Design Systems
1. Types of computer-aided drafting equipment
2. Ways computer-aided drafting is used
3. Architectural floor plan/detailing
4. Schedule generation from architectural plans using CADD
5. 3-D floor plans for generating elevation plans, sections and other details.

F. Timesavers
1. General purpose templates (esp. Timely #T-35)
2. Roof pitch gauge/stair guides/area nomograph
3. Four inch triangles for detailed areas/closets
4. Overlays/underlays/grids (title block master)
5. Ames type guideliner for brick and siding
6. Type set lettering, wax lettering/symbols
7. Cadd symbol libraries

G. Architectural Drawing Techniques
1. Line character/quality
2. Line technique/silhouette emphasis/major feature/distance technique
3. Symbols

H. Sketching as an Aid to Design

III. Lettering

A. Purposes of Lettering

B. Spacing Letters and Words
1. Use of optical spacing
2. Special letters: A, X, I, H

C. Use of Guidelines
1. Guidelines for words/proportion to drawing
2. Various heights used for words
3. Guidelines for numbers and fractions

D. Types of Pencils (H, 2H, 3H)

E. Basic Styles of Lettering
1. Condensed
2. Expanded
3. Slanted

F. Lettering Forms
1. Gothic
2. Old Roman

3. Architectural style
4. Pressure sensitive
5. Microfont
6. Templates

C. Border and Title Block

1. Margin sizes for border line
2. Location of title block and information
   a. owner's name and address
   b. type of structure
   c. architect's name and address
   d. title of sheet and sheet number
   e. date
   f. scale
   g. initials of detailing drafter and supervisor

IV. Aesthetics

A. Elements of Design

1. Lines and their purpose
   a. straight
   b. curved
   c. vertical
   d. horizontal
2. Form and its purpose
   a. rectangles
   b. squares
   c. geometric shapes
3. Color and its purpose
   a. color harmonies
   b. hue
   c. value
   d. tint
   e. shade
   f. intensity
4. Light and shadow
   a. reflection vs. absorption
   b. intensity
5. Space
   a. defining space
   b. space relationships
6. Materials
   a. textures that create various moods
   b. rough vs. smooth

B. Principles of Design

1. Balance
   a. formal vs. informal
   b. symmetrical and asymmetrical
2. Emphasis/subordination
   a. dominations vs. subordination
   b. use of elements of design
   c. focal point

3. Proportion
    a. pleasing ratio dimension (2:3, 3:5, 5:8)
    b. interior space harmonious with its accessories
4. Unity/repetition
    a. wholeness of any or all of the elements of design
    b. use of consistent line and color
    c. repetition to tie structure together aesthetically
5. Variety/opposition
    a. aesthetic value and interest
    b. contrasting elements
6. Transition

C. Creativity
1. Definition of creativity
2. Definition of imagination

D. Functional Design
1. Purpose of functional design
2. Form follows function concept
3. Relation to environment

E. Design Process
1. Basic idea to final design
2. Principles and elements of design used without sacrificing function

V. Environmental Factors

A. Energy Planning and Orientation
1. Purpose
2. Passive solar systems
    a. collectors
    b. storage facilities
    c. distribution channels
    d. controls
    e. southern exposure
    f. thermal mass
    g. vent and window placement
3. Active solar planning - collector designs
4. Environmental and construction planning
    a. overhang protection (summer/winter)
    b. vegetation
    c. building materials
    d. ceiling design
    e. building location and placement (orientation)
    f. earth sheltered homes
    g. room location for morning and nighttime hours
5. “Organic” integration of structure and land form (as per Frank Lloyd Wright)

B. Density Planning
1. Purpose
2. Redevelopment
    a. short term
    b. long range
3. Neighborhood planning

a. community
b. regions
c. future planning/expected rate of growth

C. Ecological Planning
1. Land pollution
2. Air pollution
3. Water pollution
4. Visual pollution
5. Sounds levels

D. Internal Building Environmental Factors
1. Radon gas
2. Air pollution from building materials

MODULE: *PLANNING AND DRAWING*

I. Site Plan

A. Building Orientation
1. Terrain (outline and elevation)
2. Structures nearby
3. Prevailing wind direction
4. Angle of sun (latitude of site)
5. Areas of water
6. Existing landscaping/desired landscaping
7. Prominent physical features
8. Local building code requirements (setback)
9. Open space considerations
10. Total lot area
11. Security considerations

B. Landscaping
1. Types of vegetation for climate
2. Location of vegetation
3. Shade and windbreak conditions
4. Privacy and security requirements
5. Concealment (e.g., shrubs for foundation)
6. Define areas of property
7. Control of foot traffic

C. Lines, Symbols, and Conventions
1. Utilities
2. Structures
3. Landscaping
4. Features (fence, contour, boundary)

II. Area/Room Plan

A. Tailoring Areas to the Client
1. Financial resources
2. Building style preferred
3. Number of people who will occupy house
4. Special interests/hobbies
5. Number of cars
6. Preference for open or closed type plan
7. Unusual furniture requirements

8. Accessibility/accommodation for Handicapped

B. Living, or Public, Area
1. Square footage desired
2. Halls
3. Dining room
4. Living room
5. Study, den, or library
6. Family or recreation room
7. Porch or patio
8. Guest lavatory

C. Sleeping, or Private, Area
1. Bedroom
2. Lavatory

D. Utility, or Work, Areas
1. Kitchen
2. Garage or carport
3. Utility room
4. Workshop
5. Storage

E. Traffic Pattern
1. Anticipated flow of people
2. Hallways
3. Stairs
4. Entrances

III. Floor Plan

A. Drawing Floor Plans
1. Importance as most common architectural drawing
2. Perspective
3. Information provided
4. Use for other drawings

B. Types of Floor Plan Drawings
1. Simple sketches
2. Completely dimensioned, detailed plans
3. Single-line drawing
4. Abbreviated floor plan
5. Pictorial floor plan
6. Ink presentation plan
7. Cadd modeling

C. Floor Plan Symbols
1. Doors and windows
2. Stairs
3. Appliances and fixtures
4. Sanitation facilities
5. Building materials
6. Regional variations

D. Steps in Drawing Floor Plans
1. Block in overall dimensions
2. Add thickness of outside walls
3. Lay out inside walls positions

4. Locate doors and windows by their centers
5. Darken object lines
6. Add door and window symbols
7. Add stairs
8. Erase extraneous lines
9. Outline kitchen and bathroom fixtures
10. Add masonry work and fireplaces
11. Dimension the drawing

E. Second Floor Plan
1. Trace major outline of first floor
2. Remove first floor plan
3. Note alignment of stairwell, plumbing walls, and chimneys

F. Size Description
1. Complete dimensions
2. Limited Dimensions

G. Dimensioning Accuracy
1. Importance
2. Cost of errors in time, efficiency, and money

H. Dimensioning Floor Plans
1. Always give feet and inches
2. Dimensions read from bottom or right of drawing
3. Use foot and/or inch marks
4. Avoid bisecting a room or area in the center with a dimension line
5. Avoid duplicating wall thickness when placing dimension lines
6. Indicate main entrance with a significant arrow

I. Module Construction
1. Designed within module limits
2. Standard Sizes
3. Saves time, labor, and materials
4. Standard grid
5. Grid dimensions/non-grid dimensions

J. Floor plan Timesavers
1. 1/4 scale template
2. Stair guides
3. Four inch triangles for small areas/closets
4. Underlay title block master
5. Ames type guideliner for lettering
6. 0.5 mm pencils
7. Erasing shields
8. Diazo prints

K. Computer-Aided Drafting and Design Systems (CADD)
1. CADD as a developmental tool
2. CADD as a time saver
3. Architectural floor plan/detailing
4. Developing elevations from floor plans
5. Developing wall sections from floor plans
6. Developing pictorials from floor plans

L. Drawing Techniques for Floor Plans
1. Line contrast/density
2. Organize dimensions

3. Dimensioning style/technique
4. Lettering style/technique
5. Symbols
6. Sketching as an aid to designing/redesigning areas
7. Overlays as an aid to designing/redesigning areas

MODULE: *ARCHITECTURAL DRAWING TECHNIQUES*

I. Dimensioning
- A. Types of Dimension Plan
  1. Floor plan
  2. Elevation plan
  3. Section plan
  4. House framing plan
  5. Roof framing plan
- B. Floor Plans
  1. Purpose of dimensions
  2. Complete dimensions
  3. Limited dimensions
  4. Rules for floor plan dimensioning
  5. Rules of the American National Standard Drafting Manual
- C. Elevation Plans
  1. Difference from floor plan
  2. Datum line
  3. Rules for dimensioning above and below datum line
  4. Basic standards and rules for elevation drawings
- D. Section Plans
  1. Purposes
  2. Differences from elevation and floor plans
  3. Rules for dimensioning section plans
  4. Details
- E. House Framing Plans
  1. Purpose
  2. Difference from a section plan
  3. Control dimensions
- F. Roof Framing Plans
  1. Purpose
  2. Difference from section and house framing plans
  3. Rules for dimensioning roof framing plans

II. Sections/Framing
- A. Purpose of Sections/Framing Drawing
- B. Architectural Symbols
  1. Purpose/types
  2. Material symbols
  3. Door symbols
  4. Window symbols
- C. Types of Foundations
  1. Purpose
  2. Slab foundation
  3. T-foundation

4. Advantages and disadvantages

D. Floor Framing Plans
1. Types of plans
   a. single line floor framing
   b. double line floor framing
2. Size of materials and positions
   a. girder
   b. sill
   c. sole plate
   d. joists
   e. sub-flooring
   f. header

E. Wall Framing Plans
1. Purpose and identification
2. Size of materials and position
   a. stud
   b. corner
   c. lintel
   d. trimmer
   e. sill
   f. sole plate
   g. cut in brace
   h. let in brace
   i. top plate

F. Wall Framing Plans
1. Purpose and identification
2. Types of roofs
   a. gable roof
   b. hip roof
   c. other
3. Size of materials and position
   a. rafter
   b. ridgeboard
4. Roof detail elements
   a. span
   b. run
   c. rise
   d. slope

G. Stair Plans and Placement
1. Purpose and identification
2. Types of stairwell plans
3. Materials and suggested material sizes
   a. tread width
   b. riser width
   c. headroom clearance
   d. stairwell openings
   e. landings
   f. banister heights
4. Using formulas to calculate total run

III. Exterior Elevations
- A. Elevation Design
  1. Purpose
  2. Relationship with floor plan
- B. Fundamental Shapes
  1. Types of structures: one story, one and one half story, two story, split level, bilevel
  2. Roof styles: gable, hip, flat, shed, other
- C. Factors Affecting Appearance
  1. Balance
  2. Texture
  3. Color
  4. Patterns
  5. Relationship between surfaces, doors, windows, and chimneys
- D. Elevation Drawing
  1. Projection from floor plan
  2. Determining heights
  3. Determining roof pitch
  4. Symbols
  5. Dimensioning

IV. Perspectives
- A. Exteriors
  1. Isometric drawings
  2. Perspective drawings (vanishing point, horizontal line)
  3. One-point perspective
  4. Two-point perspective
  5. Vertical placement
  6. Drawing a simple two-point perspective
  7. Projecting a two-point perspective
- B. Interiors
  1. One-point perspective
  2. Two-point perspective
  3. Interior pictorial grids
- C. Rendering
  1. Media
  2. Shade
  3. Shadow
  4. Texture
  5. Sequence
  6. Techniques
  7. Perspective composition
- D. Architectural Models
  1. Three-dimensional aspects
  2. Model construction
  3. CADD modeling
- E. Perspective Timesavers
  1. Perspective drawing board
  2. Perspective grids
- F. Drawing Techniques for Perspectives
  1. Line contrast/accent/accuracy

2. Symbols
3. Sketching as an aid to design

G. Computer-Aided Drafting and Design Systems (CADD) for Architectural Applications

1. Floor Plan
   a. Space diagram
   b. Automatic wall generation
   c. Automatic window and door insertion
   d. Symbol generation from standard library
2. Automatic generation of other plans from CADD floor plan
   a. Elevation
   b. Sections
   c. Roof plans
3. Presentation
   a. 3-D modeling
   b. Perspective, isometric, shading and rendering

MODULE: *CAREER EXPLORATION*

A. Careers in Architectural Drawing

1. Career categories
2. Job description (tracer, detailer, architect, etc.)
3. Job availability
4. Job benefits
5. Opportunities for advancement and job security
6. Education and training requirements for job entry

B. Careers in Fields Related to Architectural Drawing

1. Career Categories
2. Job descriptions (technical illustrator, engineer, teacher, architect, etc.)
3. Job availability
4. Job benefits
5. Opportunities for advancement and job security
6. Education and training requirements for job entry

MODULE: *INTRODUCTION TO ARCHITECTURAL DRAWING*

TOPICS: Culture and History
Tools and Techniques
Lettering
Aesthetics
Environmental Factors

---

18. AUDIO ELECTRONICS

MODULE: *AMPLIFIER THEORY*

SUB-MODULE: *Amplification Systems*

1. Safety Education
   a. Safety theory
      Cause and prevention
   b. Safety applications
      Eye safety

Tool and machine safety
Soldering safety
Human safety
Laboratory rules and regulations

2. Audio Theory
   a. The physics of sound
      Sound theory
      Basic components and symbols
      Schematic diagrams
   b. Measuring sound and distortion
3. Amplifier Devices
   a. Amplification theory
   b. Amplification devices
4. Power Supply Systems
   a. Power supply theory and circuits
   b. Power requirements and regulation
5. Amplifier Circuits
   a. Basic circuit configurations
   b. Basic amplifier systems
6. Stereo Integrated Circuits
   a. Single stereo integrated circuits
   b. Basic stereo controls
7. Bridged Stereo Amplification IC's
   a. Bridged amplifier circuits
   b. Bridged amplifier controls
8. Multi-stage IC Amplifiers
   a. Driver and power IC circuits
   b. Complex amplifier controls
9. Audio Project Construction
   a. Planning a project
   b. Project construction

AMPLIFIER APPLICATIONS

MODULE: *AUDIO ELECTRONICS*
SUB-MODULE: *Amplification Systems*

1. Intercom Systems
   a. Intercom theory
   b. Intercom circuits and systems
2. Amplifier Systems
   a. Stereo amplifier systems
   b. Quadraphonic amplifier systems
3. Public Address Systems
   a. Simple PA systems
   b. Complex PA systems
4. Tape Recording/Playback Systems
   a. Tape recording theory
   b. Record/Playback systems
5. Speaker Systems
   a. Transducer theory

b. Common speaker systems
6. Stage Sound Systems
a. Stage sound system theory
b. Common stage sound systems
7. Consumer Education
a. Equipment specifications and features
b. Equipment construction and purchase
8. Career Education
a. Audio electronics careers and occupations
b. Local opportunities and requirements
9. Environmental Education
a. Manufacturing pollution
b. Sound pollution

---

19. AUTOMOTIVE TECHNOLOGY

I. MODULE: *INTRODUCTION*

Topics:

A. Careers
B. Tools
C. Work habits
D. Safety
E. References

II. MODULE: *BASIC ELECTRICITY/ELECTRONICS*

Topics:

A. Ohms Law
B. DC Motors
C. Meters
D. Semiconductors
E. Introduction to Computers

III. MODULE: *AUTOMOTIVE SYSTEMS*

Topics:

A. Engine Theory
B. Electrical Systems
C. Ignition Systems
D. Charging Systems/Starting Systems
E. Fuel Systems
F. Computer/Emission Systems
G. Engine Performance/Diagnosis
H. Lubrication Systems
I. Cooling, Heating/AC Systems
J. Brake Systems
K. Steering/Suspension/Tires/Alignment
L. Drive Trains
M. Vehicle Surfaces

IV. MODULE: *ENVIRONMENTAL IMPACTS*

Topics:

A. Hazardous/Toxic Wastes and Controls
B. Air Quality
C. New York State "Right to Know"

V. MODULE: *WORK PLACE COMMUNICATIONS*

Topics:

A. Customer Relations
B. Parts and Inventory Control
C. Service Records
D. Management Skills
E. Billing
F. Marketing

VI. MODULE: *CONSUMER ISSUES*

Topics:

A. Purchasing
B. Repair Facilities
C. Maintenance and Prevention Records
D. Car Insurance
E. New York State Inspection

---

20. CREATIVITY AND INNOVATION

MODULE 1:

Focus 1: Sensing Problems and Challenges
Focus 2: Innovators/Inventions
Focus 3: Introduction to Applied Visual Techniques

MODULE 2:

Focus 1: Data Finding
Focus 2: Problem Defining
Focus 3: Modeling: Structure-Movement-Control

MODULE 3:

Focus 1: Idea Finding
Focus 2: Solution Finding
Focus 3: Creative Activity Brief

MODULE 4:

Focus 1: Acceptance Finding
Focus 2: Complex/Unclarified Problems
Focus 3: Problem Solving Systems

---

21. COMMUNICATIONS ELECTRONICS

MODULE: *COMMUNICATION ELECTRONICS SYSTEMS*
SUB-MODULE: *Communication Systems*
Topic - Communication Fundamentals

1. Principles of communication
   a. Mediums
      - Sight and sound
      - Wire and cable
      - Electromagnetic waves
   b. Transmitters/Receivers
      - Functions
      - Input/output signals
2. Transducers
   a. Audio
      - Microphones
      - Earphones and speakers
   b. Video
      - Camera tubes
      - Picture tubes (CRT's)
      - Video monitors
   c. Digital
      - Electro-mechanical
      - Photo-sensitive
      - Heat-sensitive
      - Recording mediums
      - Magnetic tape
      - Punched-paper tape
3. Communication systems
   a. Digital systems
      - Telegraph
      - Teletypewriter (Telex)
      - Data (computer)
   b. Audio Systems
      - Telephone
      - Radio
   c. Video systems
      - Facsimile
      - Picture-phone
      - Television
      - Cable
4. Electronic signals and processing
   a. DC signals
      - Voltage vs. signal
      - Waveforms
      - Applications
   b. AC signals
      - Waveforms
      - Variable characteristics
      - Applications

c. Electromagnetic waves
- Generation
- Frequency spectrum

d. Signal transmission
- Modulation methods
- Digital vs. analog

e. Signal reception
- Demodulation (Detection)
- Output systems

5. Communication career information

a. Career categories
- Job descriptions
- Availability
- Information sources

b. Education/training requirements
- Technical schools
- Colleges
- Military opportunities
- On-the-job training

SUB-MODULE: *Communication Systems*

Topic: Electrical/Electronic Systems

1. Electrical systems

a. Telegraph systems
- Principles
- Codes
- Applications

b. Teletypewriter systems
- Principles
- Codes
- Applications

c. Telephone systems
- Basic circuits and signals
- Cable and relay networks
- Switching and automation

d. Facsimile systems
- Basic transmitter system
- Basic receiver system
- Applications

e. Picture-phone
- Video and voice signals
- Transmitter/receiver systems

2. Electronic systems

a. Two-way systems
- Simplex
- Duplex
- Multiple-channel
- Amateur radio (HAM)

b. Mobile systems
- Base and mobile stations

Repeater stations
Citizen's Band

c. Broadcast systems
AM radio
FM and FM multiplex
SCA
Television

d. Navigation systems
Radar
Sonar
Radio Direction Finding
Radio Control Guidance

e. Telemetry systems
Principles
Applications

f. Microwave systems
Principles
Applications

g. Satellite systems
Principles
Applications

3. Regulations and requirements
a. System operation
b. Personnel licensing
c. Federal Communications Commission

---

22. COMPUTER APPLICATIONS

I. MODULE: *INTRODUCTION TO COMPUTER TECHNOLOGY*
Topics:
A. History and Evolution
B. Personal Computer Systems

II. MODULE: *INTEGRATED SOFTWARE GROUPS*
Topics:
A. Word Processing
B. Database Management
C. Spreadsheet Management
D. Telecommunications

III. MODULE: *COMPUTER GRAPHICS*
Topics:
A. Charting of Information
B. Desktop Publishing
C. Computer Animation
D. Computer Aided Drawing (CAD) Applications

IV. MODULE: *COMPUTER CONTROL*

Topics:

A. Computer Aided Manufacturing (CAM)

B. Robotics

---

23. CAD

I. MODULE: *FUNDAMENTALS OF CAD*

Topics:

A. Evolution of CAD and its Terminology

B. Application of Computers for Design and Drafting

C. Benefits, Careers, and Impact of Computer Aided Design

II. MODULE: *COMPONENTS OF A COMPUTER AIDED DESIGN SYSTEM*

Topics:

A. Central Processing Unit

B. Secondary Storage Devices

C. Display Terminals

D. Operator Input Devices

E. Hardcopy and other Output Devices

III. MODULE: *FUNDAMENTAL OPERATION OF A CAD SYSTEM*

Topics:

A. Systems Software Configuration and Operation

B. Coordinate Systems and Basic Geometric Construction

C. Setting Drawing Aids and Parameters

D. File Management and Transfer

IV. MODULE: *DRAWING DEVELOPMENT AND EDITING*

Topics:

A. Drawing Functions

B. Editing Functions

C. Display Control Functions

D. Information Retrieval

V. MODULE: *CAD APPLICATIONS*

Topics:

A. Technical Drawings

B. Industrial Standards and Codes

C. Dimensioning and Annotating Drawings

D. Plotting Drawings

VI. MODULE: *GEOMETRIC MODELING*

Topics:

A. 3D Wireframe Modeling

B. Constructing Solid Models

C. Engineering Analysis

D. Shading and Animating Models

VII. MODULE: *DESIGN DEVELOPMENT AND EVALUATION*
Topics:
A. Identification of the Problem
B. Research and Analysis
C. Implementing a Solution
D. Design Testing and Evaluation
E. Portfolio Generation and Presentation

---

24. COMPUTER AIDED MANUFACTURING (See 34. Product Design and Engineering)

---

25. COMPUTER GRAPHICS (See 31. Media Production Technology)

---

26. CONSTRUCTION, ENGINEERING AND MANAGEMENT

1. MODULE: *INTRODUCTION TO CONSTRUCTION, ENGINEERING AND MANAGEMENT*
Topics:
A. Construction as a System
B. Construction Throughout History

11. MODULE: *MANAGEMENT*
Topic:
A. The Role of Management in Construction

111. MODULE: *ENGINEERING*
Topic:
A. The Role of Engineering in Construction

IV. MODULE: *CONSTRUCTION SYSTEMS AND RESOURCES*
Topic:
A. The Universal Systems Model
B. Resources for Construction

V. MODULE: *TYPES OF CONSTRUCTION*
Topic:
A. Light and Heavy Construction
B. Buildings
C. Civil Construction Projects
D. Other Structures

VI. MODULE: *RESEARCH AND PLANNING FOR CONSTRUCTION*
Topic:
A. Needs Assessment

B. Site Selection
C. The Design Process
D. Estimating and Contracting
E. Scheduling

VII. MODULE: *CONSTRUCTION PROCESSES*
Topic:
A. Site Preparation
B. The Foundation
C. Types of Superstructures
D. Building a Superstructure
E. Enclosing the Structure
F. Utility Systems
G. Completing the Interior

VIII. MODULE: *CONTROLLING CONSTRUCTION SYSTEMS*
Topic:
A. Financial Control
B. Quality Assurance

IX: MODULE: *POST CONSTRUCTION*
Topic:
A. Finishing the Interior
B. Finishing the Exterior
C. Landscaping
D. Maintenance and Repair

X. MODULE: *THE IMPACT OF CONSTRUCTION*
Topic:
A. How Construction Affects Our Lives
B. Construction in the Future

---

27. DIGITAL ELECTRONICS

UNIT 1 ARITHMETIC

MODULE1: *INTRODUCTION TO DIGITAL ELECTRONICS*

MODULE 2: *PULSE AND WAVEFORM ANALYSIS*

MODULE 3: *NUMBER SYSTEMS*
Binary Related Radices
Binary Related Arithmetic
Codes

UNIT 2 LOGIC

MODULE 1: *LOGIC GATES*
- Switch Logic
- Logical Building Blocks
- Logic Families

MODULE 2: *BOOLEAN ALGEBRA*
- Boolean Equations
- De Morgan's Theorem
- Boolean Laws

MODULE 3: *LOGIC IMPLEMENTATION*

MODULE 4: *SIMPLIFICATION*
- Karnaugh Maps
- Additional Mapping Techniques
- Complete Logic Problem Solution

MODULE 5: *ARITHMETIC CIRCUITS*
- Adders
- Subtractors

MODULE 6: *SEQUENTIAL LOGIC*
- R-S Flip Flop
- D Latch
- J-K Master/Slave Flip Flop
- Monostable Multivibrator
- Astable Multivibrator

MODULE 7: *COUNTERS*
- Shift Registers
- Ripple Counter
- Divide by N

MODULE 8: *READOUT DEVICES*
- LED's and LCD's
- Decoder/Driver

---

28. ENERGY APPLICATIONS

Performance Objective #2:
Energy Systems and Energy Applications
- A. Energy system identification
- B. Relate the concept of energy systems to technology systems areas

Strategies
(1) World energy sources Energy systems technology

TOPIC I: TECHNOLOGY SYSTEMS ENERGY APPLICATIONS

Performance Objective #1
To demonstrate a knowledge of the evolution of energy from sources to end use application for each of the technology systems

Strategies
(1) Identify and model an energy converter common to all of the system of technology

Performance Objective #2
To identify, model and performance test energy application devices and procedures in each of the four technology systems areas

Strategies:
(1) Conduct a human needs assessment and engineering evaluation for a target population, relating energy applications and production (Example: development of a mass transit shelter)
(2) Investigation of energy end use and communications methods. (Example, The New York Power Pool—tracing the end use application of energy by the utilities)
(3) Electricity: the invaluable input to the telecommunication industry
    A. Technological timeline for electrical communication systems
    B. Energy consumption and the telecommunication industry
    C. Telecommunication trace of major inventions
(4) Production of an energy conversion device, with emphasis placed upon the application of energy, and the human needs (design) requirement.
    A. Product selection
    B. Facility evaluation
    C. Manufacturing
    D. Energy applications/manufacturing processes
(5) Human needs. Developing a plan and a three-dimensional model of a redesigned facility for:
    A. Increased energy efficiency
    B. Improved physiological comfort levels

Activities include:
    A. Energy audit
    B. Human needs assessment
    C. Floor plan analysis, etc.

(6) Human needs. A home heating problem.
    A. Determine heating needs
    B. Provide necessary energy sources to meet heating needs

Activities include:
    A. Deciding upon home variables
    B Estimate heat loss
    C. Using the degree day method
    D. Choose energy sources
    E. Determine heating costs
    F. Survey available renewable energy sources
    G. Compare delivered to on-site energy sources
    H. Justification statement

(7) Transportation. Investigation of social, economic and technical aspects of transportation with regard to energy applications.
A. Characteristics of a transportation system
B. Analyze transportation vehicles
C. Evaluate power and storage systems in relation to energy systems
D. Construct and performance test selected transportation

---

29. HISTORY OF TECHNOLOGY
INSTRUCTIONAL FORMAT

MODULE 1 — *DEVELOPMENT OF TECHNOLOGY*
MODULE 2 — *DEVELOPMENT OF RESOURCES*
MODULE 3 — *SYSTEMS DEVELOPMENT*
MODULE 4 — *DEVELOPMENT OF TRANSPORTATION SYSTEMS*
MODULE 5 — *DEVELOPMENT OF PRODUCTION SYSTEMS*
MODULE 6 — *DEVELOPMENT OF COMMUNICATION AND INFORMATION SYSTEMS*
MODULE 7 — *DEVELOPMENT OF ENERGY PRODUCTION SYSTEMS*
MODULE 8 — *IMPACT OF THE DEVELOPMENT OF TECHNOLOGY ON THE HUMAN RACE*

---

30. LAND TRANSPORTATION

I. Introduction
1. History
2. Resources for Technology

II. Resources for Technology
3. Energy and Power
4. Safety
4. Computer Use for Technology

III. Systems for Technology
5. Electrical Power Systems
6. Ignition Systems
7. Charging & Starting Systems
8. Fuel Systems
9. Internal Combustion Engines
10. External Combustion Engines
11. Small Engine Operation
12. Emission Control Systems
13. Lubrication Systems
14. Cooling Systems
15. Electrical Lighting Systems
16. Brake Systems
17. Suspension Systems
18. Power Trains
19. Fluid Power Systems
20. Mechanical Power Systems
21. Computer Systems

22. Material Transfer Systems
23. Highway Systems
24. Rail Systems

IV: Impacts of Technology
25. Purchasing Vehicles
26. Repair Facilities
27. Vehicle Design
28. Troubleshooting
29. Owner Maintenance
30. Vehicle Surfaces
31. Careers

---

31. MEDIA PRODUCTION TECHNOLOGY

I. MODULE: *COMMUNICATION TECHNOLOGY REVIEW*
Topics:
A. Electronic Mass Communication Systems (EMCS)
B. Graphic Mass Communication Systems (GMCS)

II. MODULE: *ORIENTATION TO MEDIA SYSTEMS AND PRODUCTION FACILITIES*
Topics:
A. Audio Media Technology
B. Visual Media Technology
C. Multimedia/Integrated Media Technology
D. Interactive Media Technology

III. MODULE: *MEDIA LEARNING ACTIVITIES (MLAS)*
Topics:
A. Graphic Equipment Operation
B. Audio Equipment Operation
C. Video Equipment Operation

IV. MODULE: *APPLYING MEDIA TO THE MESSAGE*
Topics:
A. Communication Concepts
B. Proposal Development Approval

V. MODULE: *PRODUCING THE MESSAGE*
Topics:
A. Electronic/Graphic Preproduction
B. Electronic Production
C. Graphic Production
D. Electronic/Graphic Postproduction

VI. MODULE: *PRESENTATIONS AND CRITIQUES*
Topics:
A. Media-assisted Presentations

B. Assessment and Evaluation

I. MODULE: *REVIEW—COMMUNICATION TECHNOLOGY*

Topics:

A. Electronic Mass Communication Systems (EMCS)

I . Historical time Line

2 . Audio systems

3. Visual systems

4. Multimedia systems

5. Impacts of EMCS

6. EMCS models

B. Graphic Mass Communication Systems (GMCS)

1. Historical time line

2. Still imaging systems

3. Printing and publishing systems

4. Drawing and illustration systems

5. Impacts of GMCS

6. GMCS models

II. MODULE: *ORIENTATION—MEDIA TECHNOLOGY AND PRODUCTION FACILITIES*

Topics:

A. Audio Media Technology

1. Record and playback procedures

2. Telephone and telecommunications procedures

3. Radio production processes

B . Visual Media Technology

1. Photographic still imaging processes

2. Electronic still imaging procedures

3. Printing production processes

4. Presentation graphics procedures

5. Computer-assisted drawing and illustration

6. Facsimile procedures

C. Multimedia Integrated Technology

1. Video production processes

2. Television production processes

3. Audio/visual presentation techniques

4. Video conferencing procedures

5. Multimedia production processes

D. Interactive Media Technology

1. Computer procedures

2. Interfacing computers and/or other media devices

III. MODULE: *MEDIA LEARNING ACTIVITIES*

Topics:

A. Graphic Equipment Operation

1. 35mm or view camera

2. Flood or strobe lighting system

3. Still video camera or cameraback

4. Color illustration, image manipulation and page layout software

5. Scanner, digitizer or image capture hardware and software

6. Presentation graphics and animation software

B. Audio Equipment Operation
1. Sound digitizing and editing hardware and software.
2. Analog recording and mixing devices
3. Digital play and record devices
4 . MIDI system

C. Video Equipment Operation
1. Video camera, recorder or camcorder
2. Manual or automatic video editing system
3. Audio dub to video feature
4. Video enhancer, special effect generator or character generator

IV. MODULE: *APPLYING MEDIA TO THE MESSAGE*

Topics:

A. Communication Concepts
1. Need to communicate
2. Team identification
3. Problem solving strategies
4. Media determination

B. Proposal Development/Approval
1. Proposal preparation
2. Determine budget and schedule
3. Present proposal to client(s)
4. Obtain feedback - make adjustments

V. MODULE: *PRODUCING THE MESSAGE*

Topics:

A. Electronic/Graphic Preproduction
1. Market/format
2. Script/storyboard/design
3. Input devices
4. Processing devices
5. Output devices
6. Quality control devices

B. Electronic Production
1. Recording/shooting
2. Splicing (physical/electronic)
3. Dubbing
4. Editing
5. Recorded productions
6. Live productions

C. Graphic ~production
1. Electronic imagesetting
2. Image conversion
3. Image carrier preparation
4. Image transfer

D. Electronic/Graphic Postproduction
I . Product evaluation
2. Final editing, finishing and binding
2. Feedback and adjustment

3. Distribution
4. Impacts
5. Final message evaluation

VL. MODULE: *PRESENTATIONS AND CRITIQUES*

Topics:

A. Media-Assisted Presentations
1. Room characteristics and layout
2. Equipment selection and placement
3. Presentation techniques

B. Assessment and Evaluation
1. Assessment tools and techniques
2. Evaluation procedures

---

32. PHOTOGRAPHY
BLACK AND WHITE IMAGING

I. Inputs
A. Address a need for b/w still images
1. Why
2. What
3. To whom
4. How
5. Personal preference
B. Select appropriate film medium
1. Brainstorm ideas
2. Consider various possibilities
3. Select best choice

II. Resources
A. Facilities
1. Instructional
2. Film processing
3. Print processing
4. Finishing
B. Equipment
1. Camera/accessories
2. Film processing
3. Contact system
4. Enlarger/accessories
5. Print processing
6. Finishing/mounting
C. Materials
1. Film type; format
2. Developers
3. Photographic paper
4. Chemicals
5. Mount board

III. Processes
  A. Image recording
    1. Camera types
    2. Camera controls
    3. Accessories
    4. Film characteristics
    5. Film structures
    6. Film types
  B. Composition
    1. Placement
    2. Point of View
    3. Simplicity

  C. Lighting
    1. Principles
    2. Types
    3. Applications
  D. Film processing
    1. Tank loading
    2. Chemical preparation/monitoring
    3. Film processing
    4. Film evaluation
    5. Film drying
    6. Chemical handling/disposal
  E. Projection printing
    1. Contact proof
    2. Evaluation and cropping
    3. Test print
    4. Projection printing
    5. Corrective printing
    6. Special effects
  F. Print processing
    1. Chemical preparation/monitoring
    2. Print processing
    3. Print evaluation
    4. Print drying
    5. Safety
    6. Chemical handling/disposal
  G. Print finishing
    1. Toning
    2. Spotting
    3. Coloring
    4. Mounting
    5. Matting/framing

IV. Outputs
  A. Impact
    1. Commercial/artistic/documentary
    2. Social/personal

V. Feedback/Control
   A. Human/mechanical/automatic
      1. Client/photographer
      2. Controls and devices
      3. Electronics/programs

---

33. PRINCIPLES OF ENGINEERING

II. STATEMENT OF PURPOSE: GOALS

The course has been developed:

1. In response to national studies which suggest implementation of pre-college courses that survey and stimulate interest in and access to careers in engineering and technology.
2. To explore the relationship between science, technology and engineering in an 11th/12th year course.
3. As a capstone course for students which brings math, science and technology together.
4. To enhance general technological literacy.

The goal of the course is to provide a one year introduction to engineering for academically able 11th or 12th grade students.

III. COURSE DESCRIPTION

The course is an integrative hands-on laboratory based set of case studies which will convey the concepts and principles, skills and techniques, and attitudes described in the sections on students outcomes.

IV. THE LEARNING ENVIRONMENT

The course will be taught in a laboratory setting providing access to tools and materials for individual, small group and large group projects. Tools will include hand tools for wood, metal, electronic, and simple chemical projects as well as computers to be used for design, problem solving, as laboratory devices and for control devices.

V. ORGANIZATION OF THE SYLLABUS

This syllabus is organized around a set of major concepts, skills, and attitudes that are generic and necessary to all engineering endeavors. These concepts, skills, and attitudes will be conveyed through a set of real-world case studies. Students will apply and reinforce these designed outcomes therefore, within several different contexts.

VI. THE CASE STUDY APPROACH

The case studies developed for the original introduction of the course cover a wide spectrum of content and approach to the major themes and concepts. Some of the original case studies will be modified and replaced by individual teachers as the course develops in future years.

The original cases of the first year are:
AUTO SAFETY
ERGONOMICS OF COMMUNICATION TECHNOLOGY
MACHINE AUTOMATION
STRUCTURES

VII. STUDENT OUTCOMES: CONCEPTS

A. The major Engineering Concepts to be developed are:

1. MODELING
2. SYSTEMS
3. OPTIMIZATION
4. TECHNOLOGY SOCIETY INTERACTION
5. DESIGN
6. ETHICS

B. Performance Objectives Related to Concepts

Upon completion of the set of Case Studies involved in the course, students will be competent in:

1. MODELING
   a. Use of words, pictures, and mathematics to describe a system.
   b. Manipulation of models of systems through the use of apparatus, computer simulations and mock-ups.
2. SYSTEMS
   a. Describing a system in terms of input and output.
   b. Explaining and demonstrating how a specific system is made up off sub-systems.
   c. Demonstrating how a system is controlled through feedback.
   d. Contrasting open and closed loops systems.
3. OPTIMIZATION
   a. Explaining the consequences involved in trade- off situations.
   b. Setting criteria in real-world decision making situations.
   c. Explaining how constraints often conflict with the ability to meet the desired outcome in decision making situations.
   d. Developing the ability to use techniques such as applying algorithms and appropriate trial and error in making decisions.
   e. Using cost-benefit analysis and cost-effective analysis in making decisions. Cost is considered as human, societal, political environmental, as well as economic.
4. TECHNOLOGY-SOCIETY INTERACTION
   a. Applying the system of technology assessment regarding the future impact on society of the application of specific technologies.
   b. Describing the process of considering alternative approaches to the solution off technology-society problems. These alternatives fit into the categories of:
      1) Education (behavior modification).
      2) Legislation (rules and laws).
      3) Technological fixes (applying technology to the solution of a problem).
   c. Actually getting involved in voluntary action such as lobbying, recycling, and/or developing a technological fix in a real world situation.
5. DESIGN
   a. Participating in the design process.
   b. Considering human and environmental factors in the design of a system or device.
   c. Applying design principles such as form and function, color, balance, unity, etc. in the design process.
   d. Selecting appropriate materials when designing.
   e. Considering the effect of production capabilities, marketing, time, and cost in designing a product.
6. ETHICS
   a. Considering the legal and professional responsibilities of contractual agreements and activities.
   b. Exhibiting social responsibility by considering the:
      1) Benefit or risk to society.
      2) Benefit or risk to individuals.
      3) Environmental risk

4) Long term vs short term risk and gains in making decisions.

c. Being aware of the moral dilemmas involved in employment.

1) Do you blow the whistle on your employer even at the risk of losing your job?

2) How do you weigh the benefit vs risk in making a decision?

VIII. THE CONCEPT/CONTENT MATRIX

As each of the case studies were developed the authors used a matrix of content vs each of the above concepts. For example, one of the content areas of the Machine Automation module was "GEAR MECHANISMS". In the gear mechanisms column of the matrix the various concepts were considered with suggested activities.

MODELING: Build a simple gearbox

SYSTEMS: Explain the concept of gear ratio and compound gear transmission.

OPTIMIZATION: Explain the relationships among cost, speed, and strength.

TECHNOLOGY-SOCIETY INTERACTIONS: Explain the effect of the automatic transmission on society.

DESIGN: Design and build a gear mechanism that will transmit motion at right angles.

ETHICS: Discuss the responsibility of auto manufacturers regarding the problem of transmission systems which "jump" from park to reverse when the car is parked with the engine running.

It is not necessary that each box in the matrix have an activity associated with it. By using the matrix the authors are able to insure that each of the concepts is treated adequately enough so that students would be exposed to and involved in an activity which emphasized that concept. This system ensures that by the time the student has completed all five of the case studies he or she should be able to meet the complete set of performance objectives.

IX. STUDENT OUTCOMES: SKILLS IN TECHNOLOGY, MATHEMATICS AND SCIENCE

A. Skills to be developed and/or enhanced:

1. Problem definition and solution
2. Communication skills
   a. Person to person.
   b. Person to group.
   c. Person to machine.
   d. Machine to machine.
3. Using technical tools, techniques, resources
   a. Computer assisted design.
   b. Computer simulations.
   c. Sources of information.
   d. Hand tools, machines, equipment, and instruments.
   e. Application software and computer hardware.
4. Selection of materials and processes
   a. Properties of materials.
   b. Strength of materials.
   c. Cost of materials.
5. Measurement

a. Calibration and standards.
b. Various measuring devices.

6. Application of Mathematics and Science
   a. Skills (e.g. graphing, computation, experimentation).
   b. Concepts (e.g. force, conservation of energy, probability, rate).

B. Performance Objectives which when met demonstrate the acquisition of the skill:

1. Students will analyze a situation and define and solve problems involved in that situation.
2. Students will develop and demonstrate skill in:
   a. Explaining a situation, solution etc. to other individuals on a one to one basis, and while working in teams.
   b. Presenting an oral report to the group.
   c. Programming a machine to solve a problem.
   d. Programming a machine to communicate with another for the purpose of controlling its activity.
3. Students will exhibit skill in using technical tools, techniques, resources, as they:
   a. Use computers and interfaces for CAD and CAM.
   b. Use the class and school library, resource people, and computer data bases as sources of information.
   c. Develop skills in computation through estimation, use of calculators, equations, and computers for solving problems.
   d. Develop skills in the use of hand tools, machines, equipment, and instruments.
   e. Develop skill in the use of application software and computer hardware.
4. Students will exhibit skill in the selection of materials and processes through their knowledge of:
   a. Properties and processing of materials.
   b. Selection of appropriate technical process.
   c. Costs related to material properties and processing.
5. Students will exhibit skill in measurement through:
   a. Calibration of measuring devices against known standards.
   b. Use various measuring devices for measuring distance, area, volume, time, force, mass, velocity, and acceleration.
6. Students will apply mathematics and science concepts and skills to the solution of problems related to case studies, such as:
   a. Calculating heat loss through a material.
   b. Calculating mechanical advantage vs velocity ration in gear mechanisms.

X. STUDENT OUTCOMES: ATTITUDES

Appropriate attitudes relative to professional and social obligations of the engineer, and relationships among science, technology and society should be inculcated through the Principles of Engineering course. By discussion and action students will demonstrate their understanding that:

A. Science, technology, and society interact.
B. Technology can be used to solve human problems.
C. Technology is part of a larger system. (Societal, Economic, Political).
D. Humans should use technology to their best long-term advantage.
E. Engineers must maintain high standards of ethical conduct and competence.
F. Engineers shall hold paramount the safety, health, and welfare of people, in the performance of their professional duties.

XI. EVALUATION

In the introductory year of the syllabus, evaluation of student performance will be through a combination of processes.

A. Paper and pencil tests using questions generated by both the author of the case study, and the individual teacher.
B. Evaluation of student projects developed in the classroom and the laboratory as part of the case study.
C. Discussions between the teacher and the student, and small teams.

During the first year the effectiveness of the individual case studies in meeting the goals of the syllabus will be evaluated by the authors and members of the oversight committee through class observations, phone conversations, and scheduled feedback meetings.

---

34. PRODUCT DESIGN AND ENGINEERING

SEMESTER ONE

I. MODULE: *PRODUCT ENGINEERING*

Topics:

A. Product Selection and Specifications
B. Product Development
C. Prototype and Testing

II. MODULE: *PRODUCTION ENGINEERING*

Topics:

A. Management
B. Capital
C. Process Selection
D Plant Layout
E. Personnel Selection and Training
F. Quality Assurance Program

SEMESTER TWO

III. MODULE: *TRADITIONAL MANUFACTURING*

Topics:

A. Precision Measurement and Inspection
B. Principles of Machine Set-up and Operation

V. MODULE: *COMPUTER AIDED MANUFACTURING*

Topics:

A. Computer Numerical Control
B. Robotics
C. Communication and Integration

VI. MODULE: *TRENDS AND IMPACTS*

Topic:

A: Trends and Impacts

---

35. PRODUCTION RESEARCH AND DEVELOPMENT

1.0 *Inputs (Resources)*
- 1.1 History of Research and Development
  - 1.1.1 Accidental/intuitive discovery
  - 1.1.2 Trial and error
  - 1.1.3 Organized R&D programs
- 1.2 Personnel
  - 1.2.1 Job classifications and opportunities
  - 1.2.2 Career preparation
  - 1.2.3 Organizational structure
- 1.3 Economics
  - 1.3.1 Budgeting
  - 1.3.2 Controlling
- 1.4 Materials and Supplies
  - 1.4.1 Availability
  - 1.4.2 Properties (mechanical, physical, etc.)
- 1.5 Technical Ability
  - 1.5.1 Knowledge
  - 1.5.2 Experience
- 1.6 Facility
  - 1.6.1 Equipment
  - 1.6.2 Location
  - 1.6.3 Size
- 1.7 Safety
  - 1.7.1 Standards
  - 1.7.2 Programs

2.0 *Processes (Systems of R&D)*
- 2.1 Research (“to find new knowledge”)
  - 2.1.1 Identify problem
  - 2.1.2 Review information
  - 2.1.3 Plan for research
  - 2.1.4 Collect data
  - 2.1.5 Analyze data
  - 2.1.6 Develop conclusions and recommendations
- 2.2 Development (“putting knowledge to work solving problems”)
  - 2.2.1 Designing
  - 2.2.1.1 Ideation/problem solving
  - 2.2.1.2 Sketches/drawings
  - 2.2.1.3 Financial feasibility
  - 2.2.1.4 Models/prototypes
  - 2.2.1.5 Re-design
- 2.2.2 Engineering
  - 2.2.2.1 Flowcharting
  - 2.2.2.2 Procure equipment
  - 2.2.2.3 Tooling
  - 2.2.2.4 Utilize personnel
  - 2.2.2.5 Procure materials
  - 2.2.2.6 Trial run

2.2.2.7 De-bug

3.0 *Outputs of Research and Development*

3.1 Innovation

3.1.1 Products

3.1.2 Processes

3.2.1 Environmental

3.2.2 Economic

3.2.3 Personal

3.2 Impacts

3.2.1 Environmental

3.2.2 Economic

3.2.3 Personal

---

36. RESIDENTIAL STRUCTURE

I. Inputs (Resources)

A. History

1. Human need
2. Material availability

B. Personnel

1. Job classifications and opportunities
2. Career preparation

C. Planning

1. Needs assessment
2. Design considerations
3. Print reading
4. Owner/architect/contractor relationships

D. Finance Management

1. Savings/credit
2. Budgeting

E. Materials and Supplies

1. Characteristics
2. Procurement

F. Site

1. Selection
2. Preparation

G. Tools and Equipment

1. Basic
2. Specialty

H. Technical Ability

1. Knowledge
2. Experience

I. Safety

1. Standards
2. Programs

II. Processes (Systems)
  A. Foundation Systems
    1. Material Utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  B. Framing (walls, floor, roof, ceiling)
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  C. Sheathing (walls, floors, roof)
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  D. Roofing
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  E. Exterior Doors, Windows
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  F. Siding
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  G. Electrical
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  H. Plumbing
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  I. Heating/Cooling
    1. Material utilization
    2. Methods
      a. Standard procedures
      b. Innovative techniques
  J. Insulation
    1. Material utilization
    2. Methods
      a. Standard procedures

b. Innovative techniques

K. Interior Wall and Ceiling Treatment
1. Material utilization
2. Methods
a. Standard procedures
b. Innovative techniques

L. Flooring
1. Material utilization
2. Methods
a. Standard procedures
b. Innovative techniques

K. Interior Trim, Doors, and Cabinetry
1. Material utilization
2. Methods
a. Standard procedures
b. Innovative techniques

III. Outputs (Projects and Impacts)

A. Project
1. Quality assurance
2. Site completion
3. Maintenance
4. Energy management

B. Impacts
1. Environmental
2. Economic
3. Personal

C.
1.
2. Size
3. Speed
4. Color
5. Cost

---

37. THE WORLD OF TECHNOLOGY

I. Introduction to the World of Technology

Key Ideas addressing MST Learning Standard 5—Technology

A. Engineering Design
• An iterative process involving modeling and optimization used to develop technological solutions to problems within given constraints.

B. Tools, Resources and Technological Processes
• Technological tools, materials and other resources should be selected on the basis of safety, cost, availability, appropriateness and environmental impact; technological processes change energy, information, and material resources into more useful forms.

C. Computer Technology
• Computers, as tools for design, modeling, information processing, communication, and system control,

have greatly increased human productivity and knowledge.

D. Technological Systems
- Technological systems are designed to achieve specific results and produce outputs, such as products, structures, services, energy or other systems.

E. History and Evolution of Technology
- Technology has been the driving force in the evolution of society from an agricultural to an industrial to an information base.

F. Impacts of Technology
- Technology can have positive and negative impacts on individuals, society, and the environment and humans have the capability and responsibility to constrain or promote technological development.

G. Management of Technology
- Project management is essential to ensuring that technological endeavors are profitable and that products and systems are of high quality and built safely, on schedule, and within budget.

H. Linkages
- Linkages to other MST learning Standards
- Linkages to Learning Standards in other disciplines

II. Information Systems

(As a context for enhancing understanding of the key ideas in Section I above)

A series of elements which interact by processing, storing and using information.

A. Access Information to Research a Design Solution
- utilizing telecommunications
- importing assorted media
- transmitting information
- communicating information
- accessing traditional information sources

B. Multimedia Presentation
- using presentation software
- accessing the Internet / World Wide Web
- integrating video, audio and animation
- composing the printed image
  desktop publishing, graphic design
- using chemical and digital photography

III. Physical Systems

(As a context for enhancing understanding of the key ideas in Section I above)

A series ofelements which interact with each other to produce physical products

A. Materials Engineering
- testing materials to determine characteristics
- selecting appropriate materials / trade-offs
- designing materials such as composites

B. Processing Materials
- selecting appropriate processing techniques
- utilizing appropriate tools, instruments, and equipment
- practicing safety

C. Computer Processing & Control
- using computer control with a feedback system
- computer modeling to demonstrate a design solution
- computer simulation to test a design solution

IV. Biological and Chemical Systems

(As a context for enhancing understanding of the key ideas in Section I above)

A series of elements that interact with each other to enhance the quality of life and the environment.

A. Waste & Environmental Management
- studying and observing the environmental impacts of technology
- developing methods to recycle materials
- devising systems to reclaim natural resources
- investigate methods of bio-processing using living organisms

B. Agriculture & Food Production
- studying and using controlled environment agriculture systems
- using microorganisms to produce food

C. Chemical Processing
- producing fuels from bio-mass
- processing petroleum products into polymers
- developing and testing health and hygiene products
- comparing natural and synthetic polymers

D. Medical Technology
- researching and designing prosthetic devices
- developing adaptive devices for people with disabilities
- using medical instrumentation to monitor health functions

PEDAGOGICAL DELIVERY

Contemporary pedagogical practices will be utilized in this course of study. Learning experiences will be design and inquiry based. Both extended task activities, as well as shorter, more focused resource tasks/practical tasks will be utilized to maximize learning.

Each learning experience will reinforce the following elements for students:

A. Engineering Design Process (real-world design & problem solving)
- open-ended problems with constraints & specifications
- design, draw, build and test
- modeling and optimizing solutions

B. Team Building Skills (working on a design team)
- group dynamics
- social and leadership skills
- delegating and accepting responsibility
- 3 R's (respect, responsibility and results)

C. Technical Writing
- providing a context for written communication
- producing engineering reports
- maintaining written logs
- documenting learning in a design portfolio

D. Public Speaking
- preparing an oral presentation
- developing poise and self confidence
- improving oral communications skills

Format of Extended Task Learning Activities

Design Brief

- A real life situation forms the context of the activity
- Define the problem to be solved
- Determine design criteria: specifications and constraints

Develop Solutions

- Form design teams/cooperative learning groups
- Investigate possible solutions
- Generate alternative solutions
- Test solutions
- Optimize solutions
- Test and evaluate final design solution

Assessment

- Performance of final design solution relative to constraints and specifications
- Student design portfolios containing: reports, drawings, daily logs, data and analysis
- Multimedia and oral presentation of design solution
- Standardized authentic assessment instrument