TECHNOLOGY EDUCATION

Grades 9-12

PROGRAM/COURSE Electronics/Communications

INDUSTRIAL ARTS EDUCATION
Module of Instruction

PHASE - Concentration ELEMENT - Technology

AREA OF CONCENTRATION: Electronics

MODULE: **5.0 Communication Electronics Systems**

SUB-MODULE: **5.1 Communication Systems**

TOPICS: Communication Fundamentals
Electrical/Electronic Systems

PREREQUISITES: None

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TOTAL TEACHING TIME: 30 Hours (8 Weeks)

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INDUSTRIAL ARTS EDUCATION
MODULE OF INSTRUCTION

PHASE - CONCENTRATION
ELEMENT - TECHNOLOGY
AREA OF CONCENTRATION - Electronics
MODULE - Communication Electronics Systems
SUB-MODULE - Communication Systems
TOPICS:
Communication Fundamentals
Electrical/Electronic Systems

OVERVIEW OF SUB-MODULE

DESCRIPTION

This is the first of two sub-modules in Communication Electronics Systems. It covers the topics of Communication Fundamentals and Electrical/Electronic Systems from the essential requirements of a communication system, information transducers, and forms of intelligence to examples of electrical and electronic communication systems. The student will investigate the basic principles of communication and the functions of major components in a complete system. Each topic includes class discussions, laboratory activities, and on-going construction of a take-home project during both sub-modules. The content outline and objectives within the topics are provided in an order from the basic essential information and skills, to intermediate, and advanced leading to a degree of specialization.

It is suggested that the student satisfactorily complete the Applied Electronics Mathematics module (1.0) before taking this sub-module.

GOAL

Upon the completion of both topics in this sub-module, the student will develop the knowledge and skills to recognize the three forms of intelligence, understand how each is processed by a typical communication system, and become aware of the career opportunities in this field of electronics. The teacher is to incorporate safe working practices and emphasize consumer information appropriate to each topic of instruction.

Provisions are made within the topics for the student to apply mathematical concepts and to develop positive work related attitudes.

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MODULE: Communication Electronics Systems
SUB-MODULE: Communication Systems

Estimated Teaching Time

Communication Fundamentals	15 Hours (4 Weeks)
Electrical/Electronic Systems	15 Hours (4 Weeks)

Prerequisites

None

Emphasis

The content of this sub-module should be related to the application of current communication technology. Emphasis is placed on the functions of communication network systems and the processing of intelligence (signals) by each system.

The estimated teaching time includes both instruction and laboratory hands-on activity for each topic in this sub-module. When planning instruction, this time estimate should be adjusted according to the student's background, experiences, acquired competencies and laboratory facilities available.

COMPETENCIES TO BE DEVELOPED

Upon satisfactory completion of this sub-module, each student should have acquired the following competencies:

1. Know and accurately identify the essential components and their function in a complete communications system.

2. Be familiar with the functions and operational characteristics of common transducers required to handle various forms of intelligence in a communications system.

3. Know and distinguish between three classifications of communications systems according to the form of intelligence processed.

4. Accurately describe the measurable characteristics of common electronic signals.

5. Be familiar with current employment information such as job descriptions, availability, education requirements, working conditions, and other factors relative to personal employment in the communication occupations, and be able to relate these factors to his/her own goals and aptitudes.

6. Know and accurately distinguish by waveform presentations, the most common methods of modulation/demodulation used in electronic communication systems.

7. Develop safe working attitudes and practices required for the construction, operation, and servicing of basic electronic circuits.

8. Be capable of constructing and testing simple transmitter and receiver circuits, and correctly describe their function according to signal processing.

9. Be capable of performing the applied mathematical functions related to the use of test equipment to measure and interpret the processing of electronic signals.

TOPIC - Communication Fundamentals

CONTENT OUTLINE

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
   d. 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

TOPIC - Communication Fundamentals

CONTENT OUTLINE

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

MODULE - Communication Electronics Systems
SUB-MODULE - Communication Systems

TOPIC - Communication Fundamentals

PERFORMANCE OBJECTIVE No. 1:

Given a simple communication system, the student will identify and explain the three essential requirements of the system to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Recognize and interpret a diagram of a simple communication system.

b. Discuss the social and technological significance of a communication system to our everyday life.

c. Explain the function of a transmitter in a communication system.

d. Identify various types of mediums used in communication systems and correlate the function of the transmitter to each.

e. Explain the function of a receiver in a communication system.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets, charts, transparencies, or other large print materials to illustrate signal-handling functions of the three components in a communication system.

2. Demonstrate a simple walkie-talkie, telephone or radio communication system. Discuss the three essentials of the system.

   Alternative strategies:
   - Audio/visual materials - filmstrips, slides or video tapes to illustrate communication system theory.
   - Student constructed teaching aids

3. Student research - students will collect magazine articles and advertisements illustrating one or more components of a communication system. Use material in class discussions and for reference library or bulletin board.

TOPIC - Communication Fundamentals

PERFORMANCE OBJECTIVE No. 2:

Given three forms of intelligence, the student will identify a communication system designed for that intelligence and describe the transducer(s) required to transmit and receive to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:

In order to do this, the student must be able to:

a. Differentiate between digital, audio and video forms of intelligence.

b. Identify at least one communication system used to process each form of intelligence.

c. Describe the function and operation of common transducers for processing intelligence in a communication system.

d. Read and interpret graphic diagrams and symbols used to represent common transducers and signals.

e. Safely assemble simple transducer circuit(s) and use laboratory equipment to test and/or investigate the operation.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - define three forms of intelligence commonly processed by communication systems. Discuss possible mediums and transmitter/receiver components required.

2. Laboratory experiments - students will investigate the operational properties of common audio, video, and/or digital informational transducers.

3. Demonstration/discussion - video tape equipment. Discuss information processing from camera to VCR to monitor.

4. Research assignment - applications of digital transducers in communication systems.

5. Audio/visual materials - all can be used to illustrate communication systems, transducers, and recording mediums.

TOPIC - Communication Fundamentals

PERFORMANCE OBJECTIVE No. 3:

Given the necessary laboratory equipment, tools and materials, the student will generate various AC and DC voltages or signals and make observations and measurements of their characteristics to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple diagrams and schematics.

b. Safely operate and interpret a VOM, signal generator and oscilloscope.

c. Safely assemble a simple modulator and/or detector circuit.

d. Differentiate between a voltage and a signal.

e. Identify and measure the variable characteristics of an AC or DC signal.

f. Recognize signal waveforms and displays on an oscilloscope representing simple forms of modulation or detection.

INSTRUCTIONAL STRATEGIES:

1. Laboratory experiments:
   - Use VOM to measure and verify calculations of voltage(s), current(s), and resistance(s).
   - Use oscilloscope and function generator to observe and measure characteristics of various AC and DC voltages and signal waveforms.
   - Breadboard transistor modulation circuit. Use scope to measure and observe input/output waveforms.
   - Breadboard a diode detector, three-transistor receiver. Use scope to observe signal processing.

2. Lecture/discussion - use charts, transparencies or other large print materials to illustrate and differentiate between voltage and signal waveforms.

3. Computer assisted instruction - waveform measurements.

TOPIC - Communication Fundamentals

PERFORMANCE OBJECTIVE No. 4:

Given an electronics laboratory situation, the student will demonstrate an awareness of safety theory, rules and regulations by practicing positive safe daily behavior to the expectations of the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Identify the root causes of accidents and understand the potentials for their prevention and control.

b. Recognize negative behavior and practices in the electronics laboratory and understand their consequences.

c. Develop cooperative working attitudes.

d. Follow rules and regulations pertaining to the safe use of tools, machines, equipment and materials in the electronics laboratory.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - review safety theory, rules and regulations. Discuss physiological effects of electric current.
   - Use prepared charts and hand-out materials.
   - Reinforce with your own audio/visuals.
   - Post general rules and regulations.

2. Post special operating instructions at each machine.

3. Commercial films or filmstrips where appropriate in content outline.

4. Include safe practices and behavior in every demonstration.

5. Include safe behavior in regular student evaluations.

6. Posters - commercial or student prepared.

TOPIC - Communication Fundamentals

PERFORMANCE OBJECTIVE No. 5:

Given an outline of the essentials of career planning, the student will develop a tentative career plan for an occupation in the field of electronic communications to a degree of completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Identify various career clusters and job availability in the field of electronic communications.

b. Recognize personal strengths and weaknesses as they relate to his/her aptitudes and abilities in electronics.

c. Set realistic personal career goals.

d. Locate and interpret job information about a particular communication occupation.

e. Plan for the development of strategies to achieve personal goals.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - identify communications career clusters. Discuss job descriptions, opportunities, requirements, and source information.

2. Career training/orientation films and filmstrips.

3. Slide discussion - review strategies for achieving career goals.

4. Resource personnel - local telephone, cable, radio or TV broadcast company to discuss occupational descriptions and/or employment opportunities.

5. Military or college recruiting personnel.

6. Research assignment - investigate and collect material for various communication careers. Use for reports, bulletin board or notebook requirements.

MODULE - Communication Electronics Systems
SUB-MODULE - Communication Systems
TOPIC - Electrical/Electronic Systems

CONTENT OUTLINE

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

CONTENT OUTLINE

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

e. Telemetry systems
   - Principles
   - Applications

f. Microwave systems
   - Principles
   - Applications

g. Satelite systems
   - Principles
   - Applications

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

TOPIC - Electrical/Electronic Systems

PERFORMANCE OBJECTIVE No. 1:

Given five examples of electrical communication systems, the student will identify the major system functions and describe the operation and application of the system to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:

In order to do this, the student must be able to:

a. Differentiate between electrical and electronic communication systems.

b. Read and interpret simple diagrams and graphic symbols representative of communication systems.

c. Recognize the major signal-handling functions of common electrical communication systems.

d. Explain the basic operational principles of telegraph, teletypewriter, telephone, facsimile, and picture-phone communication systems.

e. Describe common code systems as they relate to the operation of the above communication systems.

f. Identify common applications of electrical communication systems.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use charts, transparencies, audio-visual materials to develop and explain operation and application of common electrical communication systems.

   Alternative strategies:
   - Visit telephone, telegraph or facsimile installation.
   - Student developed charts or transparencies to illustrate a common electrical communication system.

2. Laboratory experiments - telegraph and/or telephone system. Identify major component parts and function.

3. Research assignment - development of code systems and application to communication systems.

MODULE - Communication Electronics Systems
SUB-MODULE - Communication Systems
TOPIC - Electrical/Electronic Systems

PERFORMANCE OBJECTIVE No. 2:

Given the necessary equipment, tools and materials, the student will perform a minimum of three laboratory experiments which illustrate the transmission and/or reception of code, voice, and modulated forms of intelligence to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple diagrams, graphic symbols and schematics.

b. Identify and select common electronic components.

c. Safely assemble, operate and test a simple telegraph, telephone and transmitter or receiver circuit.

d. Recognize the major signal-handling functions of a simple communication system.

e. Safely operate and interpret common electronic laboratory test equipment.

INSTRUCTIONAL STRATEGIES:

1. Demonstration/disussion - use of test equipment and breadboarding techniques. Emphasize identification of components and selection.

2. Laboratory experiments:
   - Telegraph
   - Telephone
   - AM transmitter
   - AM receiver

3. Prepared instruction sheets - include block diagrams, schematics and student record of observations, measurements, and conclusions about circuit operation.

4. Use a combination of experiments to reinforce the understanding of a project. Select two or more sections (circuits) of a receiver or transmitter system.

5. Commercially prepared communication circuit workbooks.

TOPIC - Electrical/Electronic Systems

PERFORMANCE OBJECTIVE No. 3:

Given five examples of electronic communication systems, the student will identify the major system functions and describe the operation and common applications of the system to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple diagrams and graphic symbols representative of electronic communication systems.

b. Recognize the major signal-handling functions of radio transmitters:
   - Input
   - Power supply
   - Exciter
   - Power amplifier
   - Antenna

c. Recognize the major signal-handling functions of radio receivers:
   - Power supply
   - Antenna
   - Tuner
   - Detector
   - Amplifier
   - Output

d. Identify common methods of modulation/demodulation employed in common electronic communication systems.

e. Explain the application of microwave and/or satelite systems to electronic communications.

INSTRUCTIONAL STRATEGIES:

1. Lecture/Discussion - define one-way and two-way electronic communication systems. Introduce electronic block diagrams to illustrate examples of each.

   Alternative strategies:
   - Use charts or transparencies developed by students.
   - Assign oral/written reports on various systems.
   - Incorporate demonstrations in class discussions.

2. Demonstrate signal modulaton with function generator and oscilloscope. Discuss application to electronic communication systems.

3. Audio/visual materials to explain modulation/demodulation techniques.

4. Independent study by students of modulation methods and application to a specific communication system.

5. Resource personnel - local telephone or cable TV company to discuss importance of satelite networks in telecommunications.

TOPIC - Electrical/Electronic Systems

PERFORMANCE OBJECTIVE No. 4:

Given a schematic diagram and appropriate hardware, tools and equipment, the student will fabricate an electronic project to a degree of competency and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret a schematic diagram.

b. Prepare a bill of materials, interpret component specifications and determine cost from appropriate electronic catalogs.

c. Recognize and select common electronic components and hardware.

d. Safely perform simple component testing.

e. Develop and/or follow a sequence of operations for the construction of an electronic project.

f. Fabricate and assemble a printed circuit board.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - review project selection and relation to content outline. Emphasize system function(s), resources, and consumer aspects of the parts list and completed project.

2. Demonstrations - where appropriate according to class progress:
   a. Fabricating techniques
      - point-to-point wiring
      - printed circuits
   b. Hand tool and machine operations
   c. Assembly techniques
      - Component selection and testing
      - Soldering techniques
   d. Operation testing and troubleshooting

3. Audio/visual materials - use transparencies, slides, or other large print devices to illustrate schematic symbols, bill of materials, and electronic catalog interpretations.

4. Field trip - observe electronic circuit fabrication and production at local industry. Discuss observations and relationship to class procedures.

TOPIC - Electrical/Electronic Systems

PERFORMANCE OBJECTIVE No. 5:

Given one form of electrical or electronic communication system, the student will identify three career clusters and describe one occupation associated with the development, manufacture, or operation to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Identify three career clusters in the fields of electrical or electronic communications.

b. Locate and interpret job information about a particular communication occupation.

c. Recognize the impact of regulations for system operation and personnel licensing on job descriptions and education/training requirements.

d. Evaluate an occupation in terms of description, availability, benefits, working conditions, security, education and his/her personal goals, aptitudes and abilities.

INSTRUCTIONAL STRATEGIES:

1. Lecture discussion - define career categories: engineers, technicians, assemblers/fabricators, installers, service and repair personel.

   Alternative strategies:
   - Use slides or film presentations on communication occupations.
   - Invite local communications personnel to discuss job descriptions, opportunities, etc.
   - Invite technical school or college representatives.
   - Use career workbooks for reinforcement.
   - Bulletin board display and/or career library.

2. Written assignment - select one occupation related to a specific communication system and evaluate in terms of availability, benefits, working conditions, and education.

3. Include occupational information in regular class discussions about specific communication systems.

INDUSTRIAL ARTS EDUCATION
Module of Instruction

PHASE - Concentration ELEMENT - Technology

AREA OF CONCENTRATION: Electronics

MODULE: **5.0 Communication Electronics Systems**

SUB-MODULE: **5.2 Transmitter/Receiver Systems**

TOPICS: Transmitter Systems
Receiver Systems

PREREQUISITES: 5.1 Communication Systems Sub-Module

Prepared by

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TOTAL TEACHING TIME: 30 Hours (8 Weeks) Date: January 1984

INDUSTRIAL ARTS EDUCATION
MODULE OF INSTRUCTION

PHASE - CONCENTRATION
ELEMENT - TECHNOLOGY
AREA OF CONCENTRATION - Electronics
MODULE - Communication Electronics Systems
SUB-MODULE - Transmitter/Receiver Systems
TOPICS:
Transmitter Systems
Receiver Systems

PREREQUISITE - Communication Systems Sub-Module

OVERVIEW OF SUB-MODULE

DESCRIPTION

This is the second of two sub-modules in Communication Electronics Systems covering the topics of Transmitter and Receiver Systems from the signal-handling functions of common transmitter and receiver circuits to the operation of basic AM, FM and TV transmitter and receiver systems. The student will investigate basic circuit functions and system operation through class discussions, laboratory activities, and the completion of a take-home project illustrating a simple transmitter or receiver system. The student should have satisfactorily completed the Communication Systems sub-module prior to taking this sub-module.

GOAL

Upon completion of both topics in this sub-module, the student will develop the knowledge and skills to be an educated consumer of electronic communication systems, and be able to use basic tools, machines, and test equipment required for the construction and simple maintenance of electronic circuits. The teacher is to incorporate safe working practices and highlight related careers appropriate to each topic during instruction.

Provisions are made within the topics for the student to apply mathematical concepts to the operation of fundamental electronic communication systems and to develop positive work related attitudes.

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Estimated Teaching Time

Transmitter Systems	15 Hours	(4 Weeks)
Receiver Systems	15 Hours	(4 Weeks)

Prerequisites

Communication Fundamentals	15 Hours	(4 Weeks)
Electrical/Electronic Systems	15 Hours	(4 Weeks)

Emphasis

The content should be related to the application of current communication technology. Emphasis is placed on the signal-handling functions of common circuits employed in transmitter and receiver systems towards the development of consumer awareness in product operation, specifications and manufacture. Laboratory exercises should provide the opportunities for students to assemble, operate and test simple electronic circuits and/or systems illustrating communication functions.

The estimated teaching time includes both instruction and laboratory hands-on activity for each topic in this sub-module. When planning instruction, this time estimate should be adjusted according to the student's background, experiences, acquired competencies and laboratory facilities available.

COMPETENCIES TO BE DEVELOPED

Upon satisfactory completion of this sub-module, each student should have acquired the following competencies:

1. Be familiar with specific occupational descriptions and other factors relative to personal decision-making and employment in the electronic communications technologies.

2. Develop safe working attitudes and practices required for the construction, operation, and servicing of basic electronic circuits.

3. Know and identify the operational functions of basic electronic circuits commonly employed in transmitter and receiver systems.

4. Accurately describe the operational characteristics and system functions of common AM transmitter and receiver systems.

5. Accurately describe the operational characteristics and system functions of common FM transmitter and receiver systems.

6. Accurately describe the operational characteristics and system functions of basic television communication systems.

7. Be capable of constructing, testing, and operating simple transmitter and receiver circuits, and recognize their system functions according to signal processing.

8. Be familiar with the functions and operational characteristics of transmission lines and antennas required in common communication systems.

9. Be capable of performing the applied mathematical functions required for the interpretation of meter readings and basic electronic equipment specifications.

TOPIC - Transmitter Systems

CONTENT OUTLINE

1. Basic transmitter circuits
   a. Oscillators and generators
      . Classifications
      . Applications
   b. Amplifier circuits
      . Characteristics
      . Frequency classifications
      . Functions
   c. Waveshaping circuits
      . Principles
      . Applications
   d. Modulator circits
      . Functions
      . Characteristics
   e. Miscellaneous circuits
      . Buffers
      . Frequency multipliers

2. Radio transmitter systems
   a. Basic transmitters
      . CW transmitter
      . Interrupted CW transmitter
   b. AM transmitter systems
      . Tone modulated
      . Voice modulated
      . Single-sideband
      . Vestigial-sideband
   c. FM transmitter systems
      . Direct and indirect
      . Preemphasis
      . FM multiplex

3. Television transmitter systems
   a. Sound and video sections
   b. Black/white television transmitter
   c. Color television transmitter

4. Transmission lines and antennas
   a. Transmission line characteristics
   b. Types of transmission lines
   c. Types of antenna systems
      . Antenna fields and polarization
      . Characteristics
   d. Antenna arrays
      . Driven arrays
      . Parasitic arrays

MODULE - Communication Electronics Systems
SUB-MODULE - Transmitter/Receiver Systems

TOPIC - Transmitter Systems

PERFORMANCE OBJECTIVE No. 1:

Given a basic radio transmitter system, the student will identify each of the fundamental circuits and describe their function and simple operation to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple diagrams, graphic symbols and signal waveforms illustrating a basic radio transmitter system.

b. Identify system and circuit functions by interpreting input/output signal waveforms.

c. Recognize the signal-handling functions of oscillators, amplifiers, modulators, and waveshapers in a radio transmitter.

d. Differentiate between various classifications and functional uses of amplifier circuits in a transmitter system.

e. Identify common classifications of radio transmitter systems.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets, charts, transparencies, or other large-print materials to identify and illustrate the signal-handling functions of major transmitter circuits.

2. Demonstrate the signal processing functions of important transmitter stages using an oscilloscope. Students will complete block diagrams on instruction sheets.

3. Laboratory experiment(s) - use prepared material and laboratory apparatus for students to assemble and observe:
   - Oscillator circuits
   - Power amplifier circuit
   - Basic CW transmitter
   - Interrupted CW transmitter

4. Project construction - have students begin the construction of a take-home project related to the Content Outline for either topic in this sub-module. This can be almost any transmitter, receiver, or transceiver system the instructor and student(s) select.

5. Combine laboratory experiments with project construction. Use breadboarding techniques to investigate basic transmitter circuit operation. These same circuits can then be incorporated in project construction on PC boards.

6. Audio/visual - use films, filmstrips, videotape to explain construction of commercial transmitter systems and the generation of electromagnetic waves.

7. Field trip - local broadcast or cable TV station to observe transmitter installation and operation.

8. Applied mathematical functions - should be included to reinforce understanding of transmitter specifications and operation.

TOPIC - Transmitter Systems

PERFORMANCE OBJECTIVE No. 2

Given a typical modulated radio transmitter system, the student will identify and describe the signal-handling functions of the major sections to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple diagrams and/or schematics for basic AM and FM radio transmitter systems.

b. Recognize audio and digital forms of intelligence processed by AM and FM transmitter systems.

c. Differentiate between the operating characteristics of AM and FM transmitter systems.

d. Describe the operating principles of common AM and FM modulation systems relative to the components of the radiated signal.

e. Identify the intelligence and R.F. sections of common AM and FM transmitter systems.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - Use prepared instruction sheets, charts, transparencies, or other large-print materials to illustrate AM and FM modulation systems required to process audio and digital forms of intelligence.

2. Demonstration/discussion - demonstrate signal-handling functions of common modulators with function generator and oscilloscope. Emphasize signal components and measurement.

3. Laboratory experiment(s):
   - AM Modulator
   - FM Modulator
   - Tone-Modulated transmitter
   - Voice-Modulated transmitter

4. Research assignment - have students select one form of intelligence (audio, video or digital) and develop a list of transmitter systems used to process that intelligence.

TOPIC - Transmitter Systems

PERFORMANCE OBJECTIVE No. 3:

Given a basic television transmitter system, the student will identify the major functions of the sound and video sections, and describe the purpose of the sync and deflection circuits in both black/white and color transmissions to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:

In order to do this, the student must be able to:

a. Read and interpret simple diagrams and/or schematics for a basic TV transmitter system.

b. Recognize the sound and video sections of a TV transmitter.

c. Differentiate between black/white and color TV transmitter systems.

d. Describe the modulation systems common to the sound video sections of B/W and color TV transmitters.

e. Identify the purpose of the sync and deflection sections in the transmission of B/W and color video signals.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets with transparencies, charts or other large-print materials to illustrate component parts of B/W and color TV signals. Discuss how each part is developed and handled in the transmitter system.

2. Audio/visual materials to explain the sound and video sections of TV transmitter systems.

3. Resource personnel or field trip - local TV broadcast or cable installation.

4. VCR equipment - incorporate use in class demonstrations and/or laboratory experiments.

TOPIC - Transmitter Systems

PERFORMANCE OBJECTIVE No. 4:

Given an illustration of an antenna system, the student will identify and describe the form of transmission line and type of antenna illustrated to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple polar radiation patterns for an antenna system.

b. Differentiate between driven and parasitic antenna elements and their effect on radiation patterns.

c. Describe the operation and mathematical relationships applicable to simple Hertz and Marconi antennas.

d. Recognize the electrical and physical relationships of four types of transmission lines.

e. Explain the importance of impedance and SWR ratings in the design and operation of an antenna system.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets, charts, transparencies, or other materials to illustrate transmission line and antenna systems. Students should develop polar diagrams on graph paper to reinforce understanding and mathematical concepts.

2. Demonstration - use walkie-talkie, CB, cordless telephone, etc. to illustrate radiation characterisitics of simple antenna systems.

3. Use transmission line and antenna specifications with other reference material to define operating characteristics and dB relationships.

4. Independent study - have students select a specific transmitter system and research material on transmission lines and antenna system(s) employed in commercial installation.

TOPIC - Transmitter Systems

PERFORMANCE OBJECTIVE No. 5:

Given the necessary equipment, tools, and materials, the student will perform a minimum of four laboratory experiments during this sub-module involving the assembly, operation, and testing of simple radio transmitter and receiver circuits (or systems) to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:

In order to do this, the student must be able to:

a. Read and interpret simple diagrams and schematics.

b. Identify and select electronic components.

c. Safely assemble, operate and test simple radio transmitter and receiver circuits (or systems).

d. Recognize and record the signal-handing functions of major transmitter and receiver circuits.

e. Safely operate and interpret common electronic laboratory test equipment.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets and commercially prepared materials to illustrate electronic component identification and specifications.

2. Demonstration(s) - where appropriate according to class progress:
   a. Breadboarding techniques
   b. Operation of test equipment
      - Function generator
      - VOM
      - Oscilloscope
   c. Operation testing and troubleshooting
   d. Recording observations

3. Audio/visual - use transparencies, slides, mock-ups and models to reinforce class discussions and demonstrations.

4. Student prepared teaching aids (demonstration circuits).

TOPIC - Receiver Systems

CONTENT OUTLINE

1. Basic receiver circuits
   a. Tuner circuits
      . Principles
      . Characteristics
   b. Mixers and converters
      . Linear vs. nonlinear
      . Heterodyning
   c. Demodulators or detectors
      . Functions and characteristics
      . Types
   d. Miscellaneous circuits
      . Antennas
      . Limiters and separators
      . AFC and AGC circuits
      . Feedback circuits

2. AM receiver systems
   a. Simple receivers
      . Crystal receiver
      . TRF receiver
   b. Superheterodyne receiver
   c. Special AM receiver systems
      . BFO systems
      . Single-sideband receivers
      . Double-conversion receivers

3. FM receiver systems
   a. Basic FM receiver
   b. FM multiplex receiver
   c. Quadraphonic systems

4. Television receiver systems
   a. Basic receiver functions and sections
   b. Sync and deflection systems
   c. Video and sound systems
   d. Basic B/W receiver
   e. Basic color receiver
   f. VCR systems
      . CCTV

TOPIC - Receiver Systems

PERFORMANCE OBJECTIVE No. 1:

Given a basic radio receiver system, the student will identify each of the fundamental circuits and describe their function and simple operation to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:

In order to do this, the student must be able to:

a. Read and interpret simple diagrams and signal waveforms illustrating a basic radio receiver system.

b. Identify system functions by interpreting input/output signal waveforms.

c. Recognize the signal-handling functions of mixers or converters, detectors, amplifiers and transducers in a radio receiver system.

d. Describe the support functions provided by limiters, separators, AFC, AGC, and/or feedback circuits in a receiver system.

e. Identify common classifications of radio receiver systems.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets, charts, transparencies, or other large print materials to identify the signal-handling functions of basic receiver circuits.
   Alternative strategies:
   - Have students compile a notebook with functional block diagrams of receiver systems and stages. Desired information can be completed through individual experimentation and/or projects.
   - Have students develop and construct circuit panels for class demonstrations to illustrate signal-handling functions of basic receiver stages.

2. Laboratory experiment(s) - students will breadboard and record observations about the operation of:
   - Tuner circuits
   - Mixers/Converters
   - Demodulators
   - AGC circuits

3. Project construction - students can continue the fabrication of a project initiated during the Topic of Transmitter Systems, or begin a new project related to Receiver Systems. Possibilities include transistorized or IC radios from crystal tuners to superhet AM/FM receivers.

4. Combination of experiments and projects - use breadboard techniques to investigate and observe basic receiver circuits. Experimentation circuits can then be incorporated into a take-home project.

5. Audio/visual - use films, filmstrips, videotape, etc. to explain construction and operation of commercial receiver systems.

6. Student reference library - require students to collect magazine articles and advertisements about communication receiver systems. Articles can be cataloged for future project construction, bulletin boards, or research assignments.

7. Applied mathematical functions should be a major part of laboratory work and class assignments to reinforce understanding of receiver circuits and systems.

8. Career bulletin board - a student collection of job listings specifically related to communication occupations in your area.

TOPIC - Receiver Systems

PERFORMANCE OBJECTIVE No. 2:

Given an AM receiver system, the student will identify and describe the function and operation of the tuning, detection, amplification and transducer circuits to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple AM receiver diagrams and/or schematics.

b. Recognize audio, video and digital forms intelligence processed by AM receiver circuits.

c. Describe the function and operation of common tuner, detector, amplifier and transducer circuits employed in AM receiver systems.

d. Safely assemble operate and test a simple AM receiver system.

e. Safely operate and interpret common electronic laboratory test equipment.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets with charts, transparencies or other audio/visual materials to illustrate signal-handling functions of AM receiver systems for audio, video, and digital forms of intelligence. Discuss development of AM receivers from the simple crystal tuner to special superhet receivers for single-sideband signals and BFO systems.

2. Class demonstration(s) - show signal-handling functions of major AM receiver circuits with oscilloscope and CCTV.

3. Laboratory experiment(s) - AM heterodyne receiver system.

4. Research assignment - have students develop a list of AM receivers commercially available in your area and identify the function and type of signal each is required to handle. Or, have students develop a list of receiver specifications for common types of AM systems. Identify the receiver, meaning, and consumer significance of each.

TOPIC - Receiver Systems

PERFORMANCE OBJECTIVE No. 3:

Given an FM receiver system, the student will identify and describe the function and operation of the tuning, detection, amplification, and transducer circuits to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Read and interpret simple FM receiver diagrams and/or schematics.

b. Differentiate between FM monophonic, multiplex, and quadraphonic systems.

c. Describe the function and operation of common tuner, detector, deemphasis, amplifier, and transducer circuits employed in FM receiver systems.

d. Safely assemble, operate and test a simple FM receiver system.

e. Safely operate and interpret common electronic laboratory test equipment.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets with charts, transparencies or other audio/visual materials to illustrate signal-handling functions of basic FM receiver circuits. Develop functional block diagrams of complete monophonic, stereo, and quadraphonic systems.

2. Laboratory experiment(s) - breadboard and observe the operation of simple FM receiver system. Have students identify those circuits employed only in FM systems as well as those common to AM and FM receivers.

3. Demonstration/discussion - show signal-handling functions of circuits employed in multiplex and quadraphonic receivers. Identify signal components and mathematical aspects of filter/matrix networks.

4. Student research - have students develop a list of FM receiver specifications and determine definitions for consumer awareness.

TOPIC - Receiver Systems

PERFORMANCE OBJECTIVE No. 4:

Given a B/W or color TV receiver system, the student will identify and describe the major system functions and the circuit(s) performing those functions to a degree of accuracy and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:

In order to do this, the student must be able to:

a. Read and interpret diagrams and/or schematics for TV receiver systems.

b. Differentiate between black/white and color TV receiver systems.

c. Identify the functions of the tuner, I.F., detector, sound, video, sync, deflection and transducer circuits common to B/W and color TV receivers.

d. Describe the operational differences between common TV antenna systems. (simple, MATV, CATV, satelite)

e. Explain the basic operation of video cassette recording systems.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - use prepared instruction sheets with charts, transparencies, etc. to identify components of TV signals and major signal-handling functions of TV receivers.

2. Demonstration/discussion - use video and laboratory test equipment to illustrate the signal-handling functions of the four basic TV receiver sections. Diagram and discuss the operation of the complete B/W and color receivers.

3. Laboratory experiment(s) - can be used to reinforce class discussions if equipment is available. Experiments should illustrate simple receiver troubleshooting and diagnosis.

4. Student constructed teaching aids to illustrate the operation of MATV, CATV, CCTV and/or video cassette recording systems.

TOPIC - Receiver Systems

PERFORMANCE OBJECTIVE No. 5:

Given a common radio or TV receiver product, the student will analyze the construction features and estimate its durability and worth to make an educated purchase decision to a degree of competency and completeness considered acceptable to the instructor.

SUPPORTING COMPETENCIES:
In order to do this, the student must be able to:

a. Identify and interpret common operational or performance specifications associated with the manufacture and use of communication transceiver and receiver products.

b. Differentiate between essential and non-essential operational features to the performance of consumer communication products.

c. Recognize components, devices and assembly techniques that determine cost and durability of consumer communication products.

d. Identify, use and interpret consumer publications prior to purchasing communication products.

INSTRUCTIONAL STRATEGIES:

1. Lecture/discussion - develop a list of considerations for the selection and purchase of a common receiver product. Have students identify the criteria (specifications) for each consideration which may be used to make a decision.

2. Class assignment - develop a decision-making checklist to aid in the selection and purchase of each type of consumer communication product. Students may then use the checklist to investigate and report on a particular product in class.

3. Bulletin board display - consumer publications, articles or other illustrations about electronic products related to systems covered in this sub-module.

4. Independent research - use library materials and consumer publications to define product specifications. Report to the class on important operating features for AM, FM and TV receiver systems consumers should be aware of.

5. Field trip - to observe fabrication methods and techniques used in the production of communication products which are relevant to their durability and worth. Students may also observe product testing procedures by consumer agencies.