R E P O R T R E S U M E S

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A BASIC PLAN FOR THE ORGANIZATION AND MANAGEMENT OF INSTRUCTION IN VOCATIONAL RADIO AND TELEVISION.

MISSISSIPPI STATE DEPT. OF EDUCATION, JACKSON

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DESCRIPTORS- *CURRICULUM GUIDES, GRADE 11, GRADE 12, *TRADE AND INDUSTRIAL EDUCATION, ELECTRONICS, *TELEVISION, *RADIO, *TELEVISION REPAIRMEN,

DESIGNED BY A CURRICULUM COMMITTEE OF INSTRUCTORS AND TRADESMEN, THIS CURRICULUM GUIDE WAS PREPARED AFTER AN ANALYSIS OF THE TRADE BY DEFINING BLOCKS OF KNOWLEDGE, OPERATIONS, ON-THE-JOB ACTIVITIES, INFORMATIONAL UNITS, EQUIPMENT, TOOLS, AND SUPPLIES NECESSARY FOR TRAINING. THE GUIDE IS FOR USE AS A STARTING POINT FOR PLANNING, PREPARING, PRESENTING, AND EVALUATING INSTRUCTION. THE INSTRUCTIONAL BLOCKS OF -- (1) FUNDAMENTALS OF ELECTRONICS, (2) RADIO, (3) BLACK AND WHITE TELEVISION, AND (4) COLOR TELEVISION ARE INTENDED TO HELP THE TRAINEE DEVELOP KNOWLEDGE AND SKILLS NEEDED AT THE BEGINNER'S LEVEL AS A RADIO-TELEVISION REPAIRMAN. AN ANALYSIS OF OPERATIONS COMMON TO ALL INSTRUCTIONAL BLOCKS AND SUGGESTED JOBS AND RELATED SUBJECT MATTER FOR INDIVIDUAL BLOCKS ARE LISTED IN OUTLINE FORM. THE MATERIAL IS DESIGNED TO BE DEVELOPED INTO A 1,080-HOUR COURSE OF GROUP, SUBGROUP, AND INDIVIDUAL INSTRUCTION TAUGHT BY A TRADE INSTRUCTOR TO GRADE 11 AND GRADE 12 STUDENTS WHO HAVE MADE A VOCATIONAL COMMITMENT TO THE ELECTRONICS, RADIO, AND TELEVISION TRADE. THE STUDENTS SHOULD HAVE A GENERAL MECHANICAL AND ELECTRICAL APTITUDE AND HAVE HAD A COURSE IN GENERAL MATHEMATICS OR ALGEBRA. A LIST OF NECESSARY TRAINING EQUIPMENT IS PROVIDED. THE BIBLIOGRAPHY INCLUDES RECOMMENDED TEXTS AND SUGGESTED REFERENCES. THIS DOCUMENT IS AVAILABLE FOR $1.00 FROM CURRICULUM LABORATORY, BOX NU, STATE COLLEGE, MISSISSIPPI 39762. (HC)

BASIC PLAN

for the

Organization and Management of Instruction

in

VOCATIONAL
RADIO & TELEVISION

PRELIMINARY DRAFT --- FOR DISCUSSION ONLY

Prepared and Issued by the
CURRICULUM LABORATORY
TRADE AND TECHNICAL EDUCATION
STATE DEPARTMENT OF VOCATIONAL AND TECHNICAL EDUCATION
Jackson, Mississippi

Located in the
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ACKNOWLEDGMENTS

This publication was developed by a group of instructors and tradesmen attending a workshop held on the campus of Mississippi State University on April 7 and 8, 1967. The group, called a Curriculum Committee, took the traditional approach and developed an analysis for the trade. The trade was systematically broken into its major segments, called blocks, and then into the basic manipulative tasks, called operations. Next, typical on-the-job activities, which contained the operations, were listed to give the trainee experience in useful and productive work. Then, informational topics which, when understood by the tradesman, would contribute to the intelligent use of his skills, were identified by the committee. Finally, the equipment, tools, and supplies necessary for training were listed.

The members of the Curriculum Committee are to be commended for their efforts and their cooperative attitude in the development of this basic plan. The Committee was composed of:

H. M. Cook, Instructor, Hinds Junior College, Raymond

L. H. Holt, Instructor, Meridian Junior College, Meridian

C. F. Moore, Instructor, Holmes Junior College, Goodman

Herman Ray Nelson, Instructor, Hinds Junior College, Raymond

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This publication will serve as the starting point for the development of instructional materials to be used by the trade instructor.

HOW TO USE THIS PUBLICATION

As a tool for teaching, this publication is primarily designed for use in planning, preparing, presenting, and evaluating instruction. As a tool, it lists operations, jobs, and informational topics--with the job as the focal point. Each job should be assigned to students, either as a group, a subgroup, or individually. The following procedure is recommended as an effective teaching sequence.

Step I. -- Tell how the job is done.
Give a full explanation of the steps necessary to perform the job. Emphasize the proper sequence; stress techniques requiring special care; point out the hazards to persons and the equipment.

Step II. -- Show how the job is done.
Demonstrate the proper procedure for performing the job. Re-emphasize the sequence, techniques, and hazards. Make sure each student can see what is being done and understands the steps.

Step III. -- Have the student do the job.
Assign each student the task of applying what he has just learned. Supervise his work; correct any variation from proper procedure or any hazardous techniques. Re-explain when necessary.

Step IV. -- Check the student for proficiency.
Assign a similar job to the student to be performed independently. Observe his work and examine the completed product or service. He is proficient when he can perform the job without supervision in a prescribed length of time.

Students who have demonstrated proficiency in one job move to the next job. The teaching steps *tell, show, do, check* are used again. Students who are not proficient perform additional jobs of a similar nature and are retaught in weak areas.

Additionally, this publication can be used (1) by the director and the instructor in a local program in communicating with their craft committee, (2) by the local director in supervising instruction and program operation, and (3) by the state supervisory staff in communicating with local school administrators and in supervising the operation of local programs.

TABLE OF CONTENTS

RADIO AND TELEVISION SERVICE AND REPAIRMAN

The radio and television service and repairman uses electronic testing instruments, such as ohmmeters, voltmeters, oscilloscopes, multimeters, and signal or cross bar generators. His hand tools include pliers, screwdrivers, metal snips, punches, hammers, electric soldering equipment, drills, vises, and hacksaws.

He locates the source of trouble in a radio or television receiver by first tuning it on various channels and wave bands to observe noises, non-lighting or heating of tubes, picture aberrations, and other interferences. He tests and replaces tubes where necessary and adjusts controls.

Minor adjustments, replacements, and repairs are done in the home or place of business of the customer. When extensive testing and major servicing are indicated, the serviceman takes the receiving set to the shop where, with the chassis removed from the cabinet, he visually checks for apparent defects; inspects wiring and solders loose connections; looks for discoloration, scale, or corrosion on condensers, resistors, and transformers which might indicate defective parts. Following a schematic diagram and using his electronic instruments, he tests voltages and resistances of circuits to isolate defects. Using his hand tools, he repairs and/or replaces defective capacitors, resistors, selection rectifiers, filters, transformers, and other faulty parts. He makes final adjustment of controls to obtain the desired density, linearity, focus, color convergence, and size of picture.

The television serviceman also installs antennas, selecting the antenna appropriate for the type of receiving set and the location of the transmission station. He bolts crossarms and elements in position and uses brackets and guy wires to secure the assembled antenna in place, observing insurance codes and local ordinances. After connecting the antenna to the receiving set, he orients the antenna and installs a reflector to obtain the strongest possible signal reception and checks the receiving set on all channels for desired results.

Detailed description may be found in the Dictionary of Occupational Titles, third edition, under TELEVISION SERVICE-AND-REPAIRMAN (any ind.) 720.281, and TELEVISION-INSTALLATION MAN (any ind.) 823.781.

COURSE DESCRIPTION

GENERAL OBJECTIVES

To develop knowledges and skills that make the trainee a radio and television repairman employable on a beginner's level.

ASSUMPTIONS

1. That those enrolling in training have had little or no previous experience in electronic or radio and television work.
2. That trainees have a nontechnical background in general science.
3. That they need additional instruction in the fundamentals of mathematics.

DESIRABLE PREREQUISITES

1. That trainees have a vocational committment to electronics, radio and television trade.
2. That trainees have a general mechanical and electrical aptitude.
3. That they have had a course in general mathematics or algebra, but need additional instruction in arithmetic, simple algebra, and plane geometry and trigonometry.

NATURE OF TRAINING

1. The duration of training is normally three hours per day, five days per week, thirty-six weeks per year for two years; or, six hours per day, five days per week, thirty-six weeks per year for one year -- a total of 1080 clock hours of training.
2. Related instruction by lecture, demonstration, the use of audiovisuals, etc. immediately precedes application by the trainee in shop practice; instruction and its application are correlated as closely as possible at all times; and the major allotment of time is given to the development of manipulative skills.
3. No instruction directly related to the trade is offered outside the shop.

CONTENT OF THE RELATED INSTRUCTION

1. Detailed coverage of the following areas: radio, black-and-white television, and color television
2. Detailed coverage of soldering; use and care of hand tools; use, care, and adjustment of test instruments and equipment
3. Broad coverage of f-m receivers, recorders, record changers, and antennas
4. A strong enphasis on safety practices and processes and on work hazards
5. An explanation of fundamental information in basic electronics, radio, and television
6. The reading of schematics with emphasis on the use of manufacturer's specifications for the voltage, current and resistant valves, wave-forms, measurement procedures and the interpretations of symbols for the radio and television field
7. The definition and spelling of trade terms applicable to the electronics, radio and television trade
8. Instruction in mathematics, such as arithmetic, simple algebra, plane geometry, and trigonometry, as applicable to the radio and television trade

TYPES AND LEVELS OF SKILLS TO BE DEVELOPED

1. Immediate marketable skills in the troubleshooting of electrical circuits and the repair of radio and television sets
2. Basic manipulative skills in soldering, assembling, and disassembling of electronic components in both hand-wired and printed circuitry

INSTRUCTIONAL BLOCKS

The following blocks are the major areas of instruction. Each has been assigned a number of hours for the purpose of indicating the relative amount of emphasis it is to receive in the total training period. Instructors are urged to plan training carefully, to select, sequence, and assign learning experience, thus making maximum use of available time. It should not be inferred that hour allotments be rigidly adhered to or that students be rotated on a clockwork or calendar basis. On the contrary, the emphasis is on individual proficiency. It is likely that students of lesser ability will require longer periods in certain areas. These students may gain only the minimum proficiencies while more able students will progress more rapidly and engage in many enriching experiences. Consequently, the planning, sequencing, and allotting are not designed to standardize programs, but to assist local teachers in planning more carefully and in conducting their instruction more carefully.

INSTRUCTIONAL BLOCKS

		Contact Hours
I.	FUNDAMENTALS OF ELECTRONICS	390
II.	RADIO	150
III.	BLACK-AND-WHITE TELEVISION	360
IV.	COLOR TELEVISION	180
	Total Hours	1080

ANALYSIS OF OPERATIONS

I. FUNDAMENTALS OF CONSTRUCTION

A. Soldering and splicing

1. File the tip of a soldering gun, pencil, or iron with a single-cut, flat-blade file
2. Tin the tip of a soldering gun, pencil, or iron
3. Tin the end of a strand of solid wire
4. Solder resistor leads with a soldering gun
5. Solder resistor leads with a soldering iron
6. Solder transistor leads with a soldering pencil
7. Splice and solder two pieces of hook-up wire together
8. Disconnect resistors from a chassis, using a soldering pencil, gun, or iron
9. Disconnect resistors from a printed circuit, using a soldering pencil
10. Replace tip on soldering gun
11. Disassemble components, using a soldering gun with solder vacuum attachment
12. Solder components, using a soldering pencil and heat sink
13. Solder heavy wire to the chassis, using a soldering gun and rosin core solder
14. Assemble and disassemble components, using right-angle pliers and a soldering gun
15. Assemble and disassemble components, using right-angle pliers and a soldering gun

B. Hand tools

1. Cut and remove components from a chassis, using diagonal pliers
2. Cut heavy wire with lineman's side-cutting pliers
3. Assemble and disassemble components with a flat-blade screwdriver
4. Assemble and disassemble components with a Phillips screwdriver
5. Cut light stock with a hacksaw
6. Remove and install screw and nuts with a spintite or socket wrench
7. Remove or install nuts and bolts with an adjustable wrench
8. Remove and install set screws with an allen wrench
9. Mark a center with a center punch and a hammer
10. Sharpen a twist drill

11. Drill holes in aluminum stock with a hand drill and twist drill
12. Drill holes in chassis or wood with twist drills and an electric drill
13. Cut a square hole in sheet metal with a square-hole punch
14. Cut a round hole in sheet metal with a round-hole punch
15. Measure the gage of a wire with a wire gage
16. Strip the insulation from wire with wire strippers
17. Sharpen a screwdriver blade with a file or grinder
18. Replace a hacksaw blade

II. METERS AND TEST EQUIPMENT

A. Volt-ohm-milliammeter (VOM)

1. Zero-adjust an ohmmeter
2. Measure d-c voltage with a VOM
3. Measure a-c voltage with a VOM
4. Measure d-c current with a VOM
5. Measure d-c current with a VOM (10-amp range)
6. Measure d-c current with a VOM (microamps)
7. Measure resistance with a VOM

B. Vacuum tube voltmeter (VTVM)

1. Zero-adjust a VTVM
2. Measure d-c voltage with a VTVM
3. Measure a-c voltage with a VTVM
4. Measure a-c, peak-to-peak voltage with a VTVM
5. Measure resistance with a VTVM

C. Basic measurements and checks with VOM and/or VTVM

1. Measure the plate voltage of a tube with a VOM
2. Measure the plate voltage of a tube with a VTVM
3. Measure the control-grid voltage of a tube with a VOM
4. Measure the control-grid voltage of a tube with a VTVM
5. Measure the screen-grid voltage of a tube with a VOM
6. Measure the screen-grid voltage of a tube with a VTVM
7. Measure the suppressor-grid voltage of a tube with a VOM
8. Measure the suppressor-grid voltage of a tube with a VTVM

9. Measure the forward and reverse resistance of a selenium rectifier with a VOM
10. Measure the forward and reverse resistance of a selenium rectifier with a VTVM
11. Measure the forward and reverse resistance of a diode with a VOM
12. Check capacitor for shorts with VOM or VTVM
13. Check capacitor for leaks with VTVM or VOM
14. Check capacitor for opens with VTVM or VOM
15. Check transformers for open circuit with VTVM or VOM
16. Check a transistor with VOM

D. Wide-band oscilloscope

1. Set up oscilloscope to identify a waveform or trace a signal
2. Set up an oscilloscope to measure voltage
3. Check frequency and phase
   a. Check phase relationships with an oscilloscope
   b. Determine an unknown frequency with an oscilloscope
   c. Check modulation waveform with an oscilloscope
4. Use oscilloscope probes
   a. Trace waveforms with an oscilloscope and demodulator probe
   b. Determine an unknown frequency with an oscilloscope
   c. Trace a signal, using the oscilloscope and low-capacity probe

E. Field-strength meter

1. Locate maximum signal for antenna with aid of field-strength meter
2. Adjust signal booster for maximum signal with aid of field-strength meter
3. Check antenna and lead-in installations with aid of field-strength meter

F. Capacitance checker

1. Check an electrolytic capacitor with a capacitor checker for leaks, shorts, opens
2. Check a ceramic capacitor with a capacitor checker for leaks, shorts, opens
3. Check a paper capacitor with a capacitor checker for leaks, shorts, opens

G. Tube tester

1. Test rectifier tubes
2. Test pentagrid tubes
3. Test tetrode tubes
4. Test pentode tubes
5. Test triode tubes
6. Test multisection tubes

H. Signal generator, r-f

1. Set the generator for rf
2. Set the generator controls for modulated rf
3. Set the generator controls for audio frequency (af)
4. Set the generator controls for sweep rf

I. Transistor checker

1. Check transistors for shorts
2. Check transistors for leaks
3. Check transistors for gain

J. Analyst

1. Check the flyback transformer for shorted turns
2. Substitute signals with an analyst
3. Set the analyst for r-f output signal
4. Set the analyst for video output signal
5. Set the analyst for i-f output signal
6. Set the analyst for audio output signal
7. Set the analyst for f-m (4.5) output signal
8. Set the analyst for color-bar pattern output signal
9. Set the analyst for dot-pattern output signal
10. Set the analyst for crosshatch-pattern output signal
11. Set the analyst for horizontal-pattern output signal
12. Set the analyst for vertical-pattern output signal
13. Set the analyst for sync-pulse output signal
14. Set the analyst for vertical-sweep output signal
15. Set the analyst for horizontal-sweep output signal
16. Check the boost voltage

K. Marker generator

1. Calibrate the marker generator
2. Select proper frequencies for marking a band

L. Sweep generator

1. Select frequency for a band
2. Adjust band width
3. Adjust attenuation

M. Marker adder

1. Produce a waveform for alignment of a broad-band amplifier, using a sweep generator, marker, and marker adder and an oscilloscope
2. Combine two waveforms with a marker adder

N. Color bar/dot/crosshatch generator

1. Use the crosshatch generator to set up linearity and size in the absence of a test pattern
2. Use the crosshatch generator of dot-bar generator to generate the following patterns

    a. Dot
    b. Vertical bars
    c. Horizontal bars
    d. Vertical and horizontal bars simultaneously

O. CRT checker: Check the CRT tube

AN EXPLANATION OF TERMS AS THEY ARE USED IN THE SUGGESTED JOBS

A trainee must possess a thorough understanding of the electrical and electronic fundamentals before he can become a competent repairman in the trade.

All of the jobs listed in Part I may not be of the same type that a trainee would perform in industry. However, performance of these jobs and a strong background in the theory of electrical and electronic fundamentals will enable the trainee to become proficient in the radio-television field.

To avoid needless and meaningless repetition, "jobs" of "check and/or replace components" have been omitted under each heading, except where the component is unique or exceptionally important to that circuit. To avoid the impression that there is a complete omission of service to these components, a typical list is given as the first division of Part II.

A review of the listings of jobs in Parts II, III, and IV reveals that the words "build" or "assemble" and "troubleshoot" are frequently used. A word of explanation will show that this frequent use is justified.

First, building or assembling one or more of the representative types of circuits within radios and televisions acts as a focal point for the trainee. He gains not only basic skills, but also an understanding of the place and function of each component within the circuit. Two types of circuit construction are encouraged: (1) The trainee should construct the circuit by mounting and soldering to develop a high degree of skill; (2) he should use the technique of breadboarding and make use of kits to reduce construction time.

Second, employment within the trade calls for constant troubleshooting, which is a systematic, logical approach to determining any fault in the operation of equipment. Thus, the full troubleshooting procedure will involve four steps:

1. Determine the symptoms through customer complaints and/or observing and listening to the unit.
2. Localize the trouble to a functional block or unit, using test instruments.
3. Isolate the specific circuit within the block or unit.

4. Locate the specific trouble within the circuit by testing each component.

The broad use of the term troubleshooting will be applied when dealing with an entire unit, in which case it will be necessary to include all four steps of procedure, as in each of the following jobs:

a. Troubleshoot a dead a-m receiver.
b. Troubleshoot a distorted a-m receiver.

On the other hand, when dealing with a specific circuit, it will be assumed that steps 1, 2, and 3 above have been performed. In such an instance, troubleshooting would involve only the testing of each component within a specific circuit. For example:

a. Troubleshoot the audio circuit
b. Troubleshoot the r-f circuit.

I. SUGGESTED JOBS IN ELECTRICAL AND ELECTRONIC FUNDAMENTALS

A. Ohm's law

1. Assemble a series circuit
2. Assemble a parallel circuit
3. Assemble a series-parallel circuit

B. Meters

1. Construct a circuit for measuring voltage
2. Construct a circuit for measuring d-c current
3. Construct an ohmmeter

C. Inductance

1. Wind a coil with an air core
2. Wind a coil with a ferrous core
3. Wind two coils and connect them in series
4. Wind two coils and connect them in parallel

D. Transformers

1. Construct a step-up transformer with 2:1 turns ratio
2. Construct a step-down transformer with 2:1 turns ratio

E. Capacitance

1. Construct a series capacitive circuit
2. Construct a parallel capacitive circuit

F. Time constant and resonance

1. Construct a series RC circuit
2. Construct a parallel RC circuit
3. Construct a series RL circuit
4. Construct a parallel RL circuit
5. Construct a series RLC circuit
6. Construct a parallel RLC circuit

G. Vacuum tubes

1. Construct a circuit, using a diode tube to determine the static or dynamic characteristics of the tube
2. Construct a circuit, using a triode tube to determine the grid cutoff

6. Build a voltage doubler power supply
7. Build an a-c/d-c power supply for a portable radio
8. Troubleshoot power supplies
9. Check and/or replace filter circuit components

H. Troubleshooting

1. Troubleshoot a dead a-m receiver
2. Troubleshoot a weak a-m receiver
3. Troubleshoot a distorted a-m receiver
4. Troubleshoot an intermittent a-m receiver
5. Troubleshoot a noisy a-m receiver
6. Troubleshoot a receiver for hum
7. Troubleshoot an a-m receiver that squeals or motorboats

I. F-M radio

1. Signal-trace f-m receiver
2. Install an f-m tuner
3. Align the i-f stages
4. Align the detector stage
5. Troubleshoot an f-m receiver
6. Align a multiplex circuit

J. Auto radio

1. Eliminate automobile electrical system noises in auto radio
2. Check and/or replace vibrator troubles
3. Adjust pushbutton tuning
4. Install and remove auto radios
5. Troubleshoot an auto radio
6. Install and check an auto antenna

K. Record changers

1. Clean and lubricate a record changer
2. Repair and adjust turntables of record changers
3. Troubleshoot and repair record changer
4. Check and/or replace a-c motor in record changer
5. Check the speed of record changer

16. Check and/or replace power cord
17. Check and/or replace power plug
18. Check and/or replace batteries

B. R-F section

1. Check and/or replace a gang tuning capacitor
2. Check and/or replace an antenna
3. Check the r-f alignment of a receiver
4. Assemble an r-f amplifier
5. Troubleshoot r-f amplifier

C. Oscillator and converter

1. Assemble an oscillator circuit
2. Troubleshoot an oscillator circuit

D. I-F section

1. Build an i-f amplifier
2. Troubleshoot the i-f circuits

E. Detector

1. Assemble a detector and AVC circuit
2. Troubleshoot the detector and AVC circuit

F. Audio section

1. Assemble and troubleshoot an audio voltage amplifier
2. Assemble and troubleshoot a phase inverter
3. Assemble and troubleshoot an audio power output stage
4. Check and/or replace an output transformer
5. Check the impedance matching of an output transformer
6. Phase a system with two or more speakers
7. Repair speaker cones

G. Power supplies

1. Build a half-wave rectifier power supply
2. Build a full-wave rectifier power supply
3. Build a half-wave rectifier with diode rectifier
4. Build a full-wave rectifier with diode rectifiers
5. Build a full-wave rectifier, using a bridge

3. Construct a circuit, using a pentode tube to determine the dynamic characteristics of the tube

H. Transistors

1. Construct a common base amplifier
2. Construct a common emitter amplifier
3. Construct a common collector amplifier

I. Oscillators

1. Assemble a Hartley oscillator
2. Assemble a Colpitts oscillator
3. Assemble an oscillaotr, using a transistor

J. Amplification

1. Assemble a class "A" amplifier
2. Assemble a push-pull amplifier
3. Couple two amplifier stages together, using RC coupling
4. Couple two amplifier stages together, using capacitive coupling
5. Couple two amplifier stages together, using transformer coupling

II. SUGGESTED JOBS IN RADIO

A. Service to typical components

1. Check and/or replace tubes or transistors
2. Check and/or replace a coil
3. Check and/or replace a ceramic, paper, electrolytic capacitor
4. Check and/or replace a resistor
5. Replace a tube socket
6. Check and/or replace i-f transformer
7. Check and/or replace a power transformer
8. Check and/or replace a selenium rectifier or diode
9. Check and/or replace a volume control
10. Check and/or replace an on-off switch
11. Check and/or replace a tone control
12. Replace a transistor base
13. Check and/or replace speaker
14. Check and/or replace dual cord
15. Check and/or replace dual light

6. Change the needle and/or cartridge of record changer
7. Check and adjust the change cycle of record changer

L. Recorders

1. Troubleshoot and repair tape recorders
2. Check and/or replace a-c motor in tape recorder
3. Check, clean, and demagnetize tape recorder heads
4. Check and adjust the speed of tape recorder
5. Check and troubleshoot erase oscillator

III. SUGGESTED JOBS IN BLACK-AND-WHITE TELEVISION

A. Black-and-white television controls and adjustment

1. Turn on the television set and adjust the operating controls
2. Adjust the service control

B. Cathode-ray tube (CRT)

1. Adjust the ion trap on the CRT
2. Adjust the focus coil
3. Adjust the deflection yoke
4. Remove and/or replace the CRT socket
5. Remove a CRT from the chassis
6. Install a CRT in a chassis
7. Adjust centering devices on CRT
8. Adjust width sleeve
9. Check operating voltage at the CRT

C. Antennas, VHF and UHF

1. Install roof antennas
2. Install ground antennas
3. Check and repair antennas
4. Install lighting arrester
5. Install rotary antenna
6. Check and/or repair rotary motor and control
7. Install signal booster on antenna
8. Check and/or repair signal booster

D. Tuners

1. Install and adjust channel strips
2. Troubleshoot the tuner section
3. Adjust tuner controls
4. Replace and/or repair UHF section of tuner
5. Replace and/or repair VHF section of tuner
6. Check the r-f response of tuner
7. Adjust the r-f oscillator of tuner
8. Adjust and clean loose and dirty contacts of UHF or VHF tuner
9. Troubleshoot the tuners for such defects as direct-drive mechanism
10. Replace wafers on rotary-type tuners

E. Video amplifiers

1. Check video circuits for proper waveforms and voltages
2. Align video i-f transformers
3. Assemble a video stage
4. Check the video-frequency response
5. Adjust the traps
6. Troubleshoot video circuits

F. Audio circuits

1. Assemble audio circuits for television receiver
2. Troubleshoot audio circuit in television receiver

G. Power supply

1. Assemble a low-voltage television power supply
2. Troubleshoot a television power supply

H. Sound i-f circuits

1. Assemble i-f section
2. Check and/or align sound i-f section
3. Troubleshoot i-f section

I. Sound detector

1. Assemble sound-detector circuits
2. Align detector circuits
3. Troubleshoot the sound-detector circuits

J. Horizontal oscillator

1. Assemble a horizontal oscillator
2. Check and align to proper frequency
3. Troubleshoot horizontal oscillator circuit

K. Horizontal output and high-voltage circuits

1. Assemble a horizontal output circuit
2. Check circuit for correct waveforms
3. Check and/or replace the horizontal output transformer
4. Replace filament winding for high-voltage rectifier
5. Change high-voltage rectifier tube socket
6. Troubleshoot high-voltage and horizontal output circuits

L. Vertical oscillator and output circuit

1. Assemble a vertical oscillator and output stage circuit
2. Check for proper waveforms
3. Check for correct frequency of vertical oscillator
4. Troubleshoot vertical oscillator and output circuit

M. Detector

1. Assemble a detector circuit
2. Troubleshoot the detector circuit

N. I-F stages

1. Assemble the i-f circuits
2. Check and/or replace i-f transformer
3. Check and align i-f transformers
4. Troubleshoot the i-f circuits

O. Sync circuits and AGC

1. Assemble sync and AGC circuits
2. Troubleshoot sync and AGC circuits

P. Cabinet and chassis

1. Clean and repair cabinets
2. Clean picture tube
3. Clean the front glass or shield of television cabinet

4. Clean a television chassis

IV. SUGGESTED JOBS IN COLOR TELEVISION

A. Operating controls

1. Adjust hue control
2. Properly adjust fine tuner
3. Properly adjust horizontal oscillator
4. Adjust color saturation control

B. Service controls

1. Adjust high-voltage control
2. Adjust focus control
3. Adjust bias control
4. Adjust color-killer control
5. Adjust screen controls
6. Make conve-gence adjustment - (using dot-and-bar generator, and degaussing coil)

C. Chrominance circuits

1. Troubleshoot chrominance circuit
2. Align chrominance circuit

D. Color-demodulator circuits

1. Check waveform of demodulator circuits
2. Align color-demodulator circuits
3. Troubleshoot demodulator circuits

E. Band pass amplifier

1. Check for proper waveforms and alignment

F. Oscillator, 3.58 MH_z

1. Check crystal
2. Tune oscillator circuit

G. Burst amplifier

1. Check and/or align burst amplifier
2. Troubleshoot the burst amplifier

H. Killer amplifier

1. Check waveform of killer amplifier
2. Troubleshoot the killer amplifier

I. Color amplifiers

1. Check waveform of color amplifier
2. Troubleshoot the color amplifier

J. Color AFC circuits

1. Check waveforms and voltages in color AFC circuit
2. Align color AFC circuit
3. Troubleshoot the color AFC circuit

K. Reactance circuit

1. Align reactance circuit
2. Check waveform of reactance circuit
3. Troubleshoot the reactance circuit

L. Color bar generator

1. Check the color sections of the television receiver, using the color bar generator
2. Adjust the color phasing control, using the color bar generator

RELATED SUBJECTS

for

RADIO & TELEVISION

I. CONSTRUCTION FUNDAMENTALS

A. Soldering and splicing
B. Care and use of hand tools

II. PRINCIPLES OF ELECTRICITY

A. Basic electron theory
B. Electron movement
C. Basic physics
D. Radio symbols
E. Identification of electronic components
F. Color code
G. Electrical energy
H. Measurement of electrical energy
I. Laws of electrical charges

III. MAGNETISM

A. Permanent magnets and magnetic fields
B. Electromagnetism
C. Characteristics of electromagnets

IV. OHM'S LAW

A. Ohm's law in series circuits
B. Ohm's law in parallel circuits
C. Ohm's law in series-parallel circuits

V. INDUCTANCE

A. Induced voltages

B. Alternating and direct currents

C. Phase relationship of voltage and current

VI. TRANSFORMERS

A. Theory of transformer action

B. Turns ratio

C. Impedance matching

D. Transformer losses

E. Transformer rating

F. Power transformers

G. R-F transformers

H. Isolation transformers

I. Instrument transformers

VII. CAPACITANCE

A. Capacitance values

B. Color code of capacitors

C. Capacitance in a-c circuits

D. Testing capacitors

VIII. TIME CONSTANTS AND RESONANCE

A. Capacitors and time constants

B. Inductance and time constants

C. Time constants of RC circuit

D. Time constants of RL circuit

E. Time constants of RLC circuit

F. Resonant frequencies in RLC circuits

IX. VACUUM TUBES

A. Emission in vacuum tubes

B. Electron action in diode tubes

C. Rectifiers

D. Rectifiers and filters
E. Diode tube as detector
F. Triode tube
G. Biasing of triode tube
H. Tetrode tubes
I. Pentode tubes
J. Cathode-ray tube
K. Special-purpose tubes

X. TRANSISTOR

A. Semiconductor theory
B. Diodes
C. Junction transistor NPN
D. Junction transistor PNP
E. Field effect transistor
F. Types of transistors
G. Servicing transistor circuits
H. Test equipment for transistors

XI. AMPLIFICATION

A. Class "A" amplifier
B. Class "B" amplifier
C. Class "C" amplifier
D. Class "A-B" amplifiers
E. Push-pull amplifiers
F. Coupling to amplifiers

XII. OSCILLATION

A. Oscillations
B. Hartley oscillator
C. Colpitts oscillator
D. UHF oscillators
E. Multivibrators

F. Blocking oscillator

G. Transistor oscillators

XIII. RADIO RECEIVERS

A. R-F detectors

B. R-F amplifiers

C. Automatic volume control

D. Frequency modulation

E. Receiver alignment

F. Portable radio receivers

G. Transistor circuits in radio

H. Troubleshooting transistor radios

I. Servicing transistor radios

J. Alignment of transistor radios

K. Superheterodyne receiver

XIV. RADIO TROUBLESHOOTING

A. Signal tracing

B. Printed circuits and etched wiring

C. Power supply

D. I-F stage

E. Local oscillator

F. R-F stage

G. Audio stage

XV. HIGH FIDELITY

A. High fidelity

B. Impedance matching

C. Loudspeakers

D. High-fidelity speaker enclosure

E. Electrical cross-over networks

F. Record players

G. Tape recording and playback

XVI. ADVANCED TEST EQUIPMENT

A. Oscilloscope
B. Sweep and marker generator
C. Crosshatch generator
D. Marker adder
E. Field strength meter
F. Analyst

XVII. TELEVISION

A. Television transmission and reception

1. Transmitting and receiving picture information
2. Transmitting and receiving sound information
3. Scanning
4. Vertical and horizontal scanning frequencies
5. Television channels
6. Standard of transmission

B. Scanning and synchronizing

1. Sawtooth waveform
2. Standard scanning pattern
3. Blanking
4. Interlacing
5. Waveforms encountered in TV
6. Synchronizing pulses

C. Picture carrier signal

1. Negative transmission
2. Vestigal side-band transmission
3. Line-of-sight transmission
4. Television broadcasting

D. Television receivers

1. TV receiver block diagrams
2. Receiver circuits
3. Sound take-off circuits

4. Localizing troubles to a receiver section

E. Picture tubes

1. Deflection, focusing, and centering
2. Types of picture tubes
3. Electron beam
4. Focusing the electron beam
5. Magnetic deflection
6. Picture-tube precautions
7. Picture-tube troubles

F. Power supplies

1. Full-wave rectifier
2. Half-wave rectifier
3. Heater circuits
4. Voltage doublers
5. Transformerless low-voltage power supply
6. Stacked B+ circuits
7. Rectifier ratings
8. High-voltage power supplies
9. High-voltage safety precautions
10. High-voltage troubles
11. Low-voltage power supply troubles

G. Video amplification

1. Video signal
2. Picture reproduction
3. Amplification of video signal
4. Manual contrast control
5. Video frequencies
6. Frequency and phase distortion
7. Video amplifier circuit
8. Transistorized video amplifier
9. Trouble in the video section

H. Brightness control and d-c clamping

1. Brightness control

2. D-C component and average value of the video signal
3. Clamping action of grid-leak bias and diode clamping circuit
4. Trouble in the brightness control and d-c clamping circuits

I. Video detector

1. Detection
2. Video detectors load resistance and filters
3. Detector diodes
4. Video detector diodes
5. Troubles in video detector circuits

J. Automatic gain control

1. Requirements of the AGC circuit
2. How the AGC bias controls gain
3. Advantages of AGC for picture signal
4. Keyed AGC circuit
5. AGC level adjustment
6. AGC troubles
7. AGC bias for transistor amplifiers

K. Sync separation

1. Vertical synchronization of the picture
2. Horizontal synchronization of the picture
3. Separating the sync from the video signal
4. Integration of the vertical sync
5. Noise in the sync
6. Sync separator circuits
7. Sync and blanking bars on the kinescope screen
8. Sync troubles

L. Deflection oscillators

1. The sawtooth deflection waveform
2. Producing sawtooth voltage
3. Blocking oscillator and discharge tube
4. Analysis of blocking oscillator circuit
5. Deflection generators with blocking oscillator and discharge tube
6. Deflection oscillator controls

7. Synchronizing the blocking oscillator
8. Multivibrators
9. Plate-coupled multivibrator
10. Cathode-coupled multivibrator
11. Multivibrator sawtooth generator
12. Synchronizing the multivibrator
13. Frequency dividers
14. Trapezoidal voltage waveshape
15. Incorrect oscillator frequency

M. Horizontal AFC circuits

1. AFC requirements
2. Push-pull sync discriminator
3. Circuit of multivibrator controlled by sync discriminator
4. Single-ended sync discriminator
5. D-C control tube (synchro-guide)
6. Sine wave oscillator with reactance tube (synchro-lock)
7. Hold-in range and pull-in range
8. Filtering the d-c control voltage
9. Phasing between horizontal blanking and flyback

N. Vertical deflection circuits

1. Triode vertical output stage
2. Vertical output transformers
3. Vertical linearity
4. Internal vertical blanking
5. Vertical deflection circuit with blocking oscillator
6. Combined vertical oscillator and output circuit
7. Transistorized vertical deflection circuit
8. Vertical deflection troubles

O. Horizontal deflection circuits

1. Functions of the horizontal output circuit
2. Horizontal amplifier circuit
3. Damping in the horizontal output circuit
4. Horizontal scanning and damping
5. Boosted B+ voltage

6. Flyback high voltage
7. Horizontal deflection controls
8. Deflection yokes
9. Horizontal output transformers
10. Analysis of horizontal output circuit
11. Typical horizontal deflection circuit
12. Transistorized horizontal deflection
13. Troubles in the horizontal deflection circuits

P. Picture i-f amplifiers

1. Picture i-f response
2. The intermediate frequency
3. I-F amplification
4. Double-tuned i-f amplifiers
5. Single-tuned i-f amplifiers
6. Stagger-tuned stages
7. Wave traps
8. Picture i-f alignment
9. Picture i-f amplifier circuits
10. Transistorized i-f stage
11. Troubles in the picture i-f amplifier

Q. The r-f

1. Operation of the r-f tuner
2. The r-f amplifier stage
3. R-F amplifier circuits
4. The mixer stage
5. The local oscillator
6. R-F alignment
7. Conversion methods for UHF channels
8. Types of r-f tuner circuits
9. UHF tuner circuit
10. Receiver noise

R. Antennas and transmission lines

1. Resonant length of an antenna
2. Definition of antenna terms

3. Ghosts
4. Straight dipole
5. Folded dipole
6. Broad-band dipoles
7. Long-wire antennas
8. Parasitic arrays
9. Multiband antennas
10. Stacked arrays
11. Transmission lines
12. Characteristic impedance
13. Transmission-line sections as resonant circuits
14. Impedance matching
15. Antenna installation
16. Multiple installations
17. Troubles in the antenna system

S. The f-m sound signal

1. Frequency changes in a f-m signal
2. Audio modulation in an f-m signal
3. Definition of f-m terms
4. Reactance-tube modulator
5. Advantages and disadvantages of AM
6. Receiver requirements for an f-m
7. Triple-tuned discriminator
8. Center-tuned discriminator
9. The limiter
10. Ratio detector
11. Quadrature-grid f-m detector
12. Complete sound i-f circuit
13. Sound i-f alignment
14. Intercarrier sound
15. Intercarrier buzz

T. Receiver servicing

1. Receiver adjustments
2. Types of ghosts
3. R-F interference

4. External noise interference in the picture
5. Sound in the picture
6. Localizing Hum troubles
7. Testing scanning linearity with bar patterns
8. Signal injection
9. Localizing receiver troubles
10. D-C voltage measurements
11. Oscilloscope measurements
12. Alignment precautions
13. Typical receiver circuit

U. Color television system

1. Color signals
2. Color addition
3. Definition of color television terms
4. Y signal
5. Types of color video signals
6. Q signal
7. I signal
8. R - Y signal
9. B - Y signal
10. G - Y signal
11. Desaturated colors
12. The transmitted chrominance signal
13. Matrix circuits
14. Color subcarrier frequency
15. Color synchronization
16. Colorplexed composite video signal waveforms
17. Vector addition of color signals
18. Chrominance section
19. Chrominance amplifier circuits
20. Burst amplifier circuits
21. Color AFC circuits
22. Automatic color control (ACC) bias
23, Color-killer circuit
24. Color-demodulator circuits

25. Color picture tubes
26. Kinescope setup adjustments
27. Convergence procedure
28. Color controls and adjustments
29. Schematic of color section of receiver
30. Color troubles

XVIII. MATHEMATICS

1. Arithmetic
2. Decimals
3. Fractions
4. Percentages
5. Powers and roots
6. Graphs
7. Algebraic addition and subtraction
8. Algebraic division and multiplication
9. Simple equations
10. Ratio and proportion
11. Powers of ten
12. Special products and factoring
13. Equation containing fractions
14. Graphs and sets of linear equations
15. Exponents and radicals
16. Logarithms
17. Basic trigonometry
18. Tables of trigonometric functions
19. Vectors

NOTE: All of the above topics should be taught with applications as applied to the Radio, Television, and Electronics trade

XIX. SAFETY

1. Personal
2. Hand tools and materials
3. Working with high voltages

4. Electrical shock treatment
5. Administering first aid

RADIO-TV EQUIPMENT LIST

ITEM NO.	QUANTITY	DESCRIPTION
1.	1	Electronics Lecture Demonstration Unit (To include console)
2.	1	Electronics Fundamentals Unit (Accessory to Item #1)
3.	1	Transistor Lecture Demonstration Unit
4.	1	Voltage Regulator Demonstration Unit
5.	1	Frequency Modulation Demonstration Unit
6.	1	Accessories Storage Drawer
7.	1	Oscilloscope, wide-band (Dual Trace)
8.	1	Square-wave Generator
9.	1	Vacuum-Tube Voltmeter (Lab Type)
10.	1	Audio Oscillator (Lab Type)
11.	1	R-F Signal Generator
12.	1	Master Antenna Distribution System (To include antenna)
13.	1	Power Line Monitor

STUDENT EQUIPMENT

14.	8	Fundamentals Units (Breadboarding)
15.	8	Regulated Power Supply
16.	8	Volt-ohm-milliameters
17.	8	Vacuum Tube Voltmeters
18.	8	Oscilloscope (Wide-band)
19.	8	R-F Signal Generator
20.	8	Audio Oscillator (Sine-Square Wave)
21.	8	Isolation Transformer
22.	8	Demodulator Probes (Brand to be same as VTVM)
23.	8	Bench Lamps (Fluorescent)
24,	2	Sweep Generator
25.	2	Marker Generator
26.	2	Marker Adder
27.	2	Color Bar/Dot/Crosshatch Generator
28.	2	Pattern Generators
29.	2	Yoke Substitution Unit (Universal)

ITEM NO.	QUANTITY	DESCRIPTION
30.	2	Substitution Box (Resistor, Capacitor, Rectifier)
31.	2	Capacitor Analyzer
32.	2	High-Voltage Probes (25KV) (Brand to be same as VOM)
33.	2	High-Voltage Probes (50KV) (Brand to be same as VOM)
34.	8 lots	Test Harness
		SPECIAL EQUIPMENT
35.	2	Transistor Radio Analyzer
36.	2	Tube Checkers
37.	1	Multiplex Generator
38.	1	CRT Checker
39.	1	Field-Strength Meter
40.	1	Degaussing Coil
41.	2	Power Supply, DC (0-5V @ 10A; 0-16V @ 6A)
42.	1	Microphone (Dynamic)
43.	1	Microphone (Crystal)
		SHOP EQUIPMENT AND HAND TOOLS
44.	8	Soldering Guns, 145-210W
45.	8	Pliers, Long nose, 6"
46.	8	Pliers, Diagonal, 5"
47.	8	Pliers, Combination, 6"
48.	8	Screwdrivers, 2" x 1/8"
49.	8	Screwdrivers, 6" x 1/4"
50.	8	Screwdrivers, 3" x 3/32"
51.	8	Screwdrivers, Phillips #1
52.	8 sets	Nut Drivers
53.	8	Alignment Kits
54.	1	Vise, Machinist (4" Jaw, 6" Opening)
55.	1	Drill Press, Bench model, 1/2", Jacobs Chuck
56.	1 set	Chassis Punch, Round
57.	1 set	Chassis Punch, Square
58.	1	Circle Cutter

ITEM NO.	QUANTITY	DESCRIPTION
59.	1 pr.	Tin Snips (Aviation, 10")
60.	2	Wire Strippers
61.	1	Square, Combination
62.	1	Wrench Set, Open-end, 1/4" to 13/16" by 16ths
63.	1	Adjustable Wrench, 8"
64.	1	Hammer, Ball-peen, 8 oz.
65.	1 set	Punches (Center, Pin, Prick)
66.	1	Hacksaw, 12", Adjustable
67.	2	File Sets, Mill (6", 8", 10")
68.	1	Drill, Electric, 1/4", Heavy duty
69.	1	Tap and Die set, Electrician's
70.	1	Reamer, 1/8" Tip, 5-1/2" long
71.	1	Twist Drill Set, 1/16" through 1/2" by 32nds

OTHER SPECIAL EQUIPMENT

72.	Analyst
73.	Impedance bridge

BIBLIOGRAPHY

RECOMMENDED TEXTS:

A definite text has not been selected at this time. Some of the reasons for this are the rate at which new electronic devices are being employed in the electronic field and their effect upon different types of circuitry. The trainee must receiver training in the fundamentals of electricity and electronics, radio, black-and-white television and color television; therefore, several texts are necessary to cover the complete field. Some of the texts being used by the radio and television instructors are listed below.

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