

PLAN OF INSTRUCTION
(Technical Training)

BUIIC COMPUTER PROGRAMMING



KEESLER TECHNICAL TRAINING CENTER

8 April 1970

VOLUME 2
of 4 VOLUMES

LIST OF EFFECTIVE PAGES

Total Number of Pages in This Publication is 39 Consisting of the Following:

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FOREWORD

1. **PURPOSE.** This volume prescribes the qualitative requirements for Blocks II and III of Course 3AZR27370 D, BUIC Computer Programming, in terms of learning objectives (criterion and enabling) presented in the preferred teaching sequence, and shows their duration, support materials, and guidance. It was developed under the provisions of ATCR 52-7, Plan of Instruction, and ATCR 52-33, Instructional System Development.
2. **COURSE DESCRIPTION.** This course trains Air Force NCOs in the skills and knowledges needed by them to perform as BUIC III computer programmers. The course includes computer principles, computer mathematics, basic programming concepts and techniques, BUIC assembler language programming, and BUIC compiler language programming. It also includes analysis of the BUIC III System functional areas of air surveillance, information transfer, weapons, simulation, recording, control, and ADP/BCDP interface. On-equipment training includes preparation, assembly, and debugging of assembly and compiler language programs, adaptation data, and geography; use of simulation techniques to create an artificial environment for system testing; operation of ADP program for system testing and recording; reduction and analysis of test results; and use of the utility programs to construct, verify, and maintain the ADP master tapes.
3. **COURSE FORM.** Pages iii and iv describe instruction in terms of major subject areas and time allocation as shown in table III of the course chart. The six-hour day (360 minutes) includes 300 minutes for instruction in classroom/laboratory activities and 60 minutes for student administrative activities such as breaks, clean-up, and class change.
4. **EQUIPMENT ALLOWANCES AND AUTHORIZATIONS.** With the exception of the prime training vehicle which is authorized in the PC documents, equipment required to conduct this course is listed in Equipment Authorization Inventory Data Number OZRO124. The following TAs apply:

TA 006 Organizational and Administrative Equipment
TA 014 Individual Training
TA 636 Film Library

OPR: Computer Systems Department
DISTRIBUTION: As directed by ATCR 52-7.

5. REFERENCES. This Plan of Instruction is based on COURSE TRAINING STANDARD 3AZR27370 D, 22 December 1969 and COURSE CHART 3AZR27370 D, 21 February 1970.

FOR THE COMMANDER


ROSS A. BECKHAM, JR., Colonel, USAF
Chief, Operations Division

TABLE III - COURSE CONTENT - COURSE CHART 3AZR27370 D

HOURS PER WEEK	1	2	3	4	5	6
1	<p><u>Course Material - UNCLASSIFIED</u> 90 Hours</p> <p>BLOCK I - Programming Principles</p> <p>Orientation (1 hr); Introduction to computer (5 hrs); Computer mathematics (13 hrs); Boolean logic (5 hrs); Basic problem solving techniques (6 hrs); Flowchart design and analysis (55 hrs); Measurement (5 hrs).</p>					
2						
3						
4	<p><u>Course Material - UNCLASSIFIED</u> 78 Hours</p> <p>BLOCK II - Central Processor Programming I</p> <p>Introduction to AN/GSA-51A System (3 hrs); Basic instruction set (29 hrs); Comparison and logical instructions (10 hrs); Introduction to Compool programming (6 hrs); Shift, complex arithmetic, conditional branch, and repeat instructions (24 hrs); Measurement (6 hrs).</p>					
5						
6	<p><u>Course Material - UNCLASSIFIED</u> 66 Hours</p> <p>BLOCK III - Central Processor Programming II</p> <p>Field and character search instructions (12 hrs); Mini-BUIC system (15 hrs); Floating point instructions (9 hrs); Special system oriented codes (9 hrs); Subroutines (9 hrs); Interrupt system (6 hrs); Measurement (6 hrs).</p>					
7						
8	<p><u>Course Material - UNCLASSIFIED</u> 63 Hours</p> <p>BLOCK IV - Input/Output Programming</p> <p>Introduction (1 hr); Input/output communications (14 hrs); Programming terminal devices (45 hrs); Measurement (3 hrs).</p>					
9						
	<p><u>Course Material - SECRET</u> 33 hrs</p> <p>BLOCK V - BUIC System Analysis I</p>					
10	<p>Introduction (9 hrs)(S); Air surveillance (21 hrs)(S); Measurement (3 hrs)(U).</p>					
11	<p>Above titles are unclassified</p>					

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TABLE III - COURSE CONTENT - COURSE CHART 3AZR27370 D

HOURS PER WEEK	1	2	3	4	5	6
11	<p>Course Material - SECRET 36 Hours BLOCK VI - BUIC System Analysis II</p>					
12	<p>Weapons (18 hrs)(S); Information transfer (11 hrs)(S); Simulation (4 hrs)(U); Measurement (3 hrs)(U). Above titles are unclassified</p>			<p>Course Material - UNCLASSIFIED BLOCK VII - Utility Computer Programs 36 Hrs Introduction (1 hr); Initializing UCP (5 hrs); UCP control and service programs (6 hrs); Tape file maintenance (6 hrs); Assemblers (6 hrs); Adaptation (6 hrs); Utility maintenance system (3 hrs); Measurement (3 hrs).</p>		
13						
14						
<p><u>Course Material - UNCLASSIFIED</u> 90 Hours</p>						
15	<p>BLOCK VIII - Program Testing and Analysis</p> <p>Introduction (1 hr); Startover, control, and ADP/BCDP interface (10 hrs); Test planning (11 hrs); BUIC exercise preparation system (BEPS) (16 hrs); Facility system (12 hrs); BUIC analysis and reduction system (BARS) (10 hrs); Master tape generation (6 hrs); Program error correction (12 hrs); Program report processing (6 hrs); Measurement (6 hrs).</p>					
16						
<p><u>Course Material - UNCLASSIFIED</u> 42 Hours</p>						
17	<p>BLOCK IX - Compiler Language Techniques</p> <p>Introduction (3 hrs); Coding conventions and program construction (33 hrs); Measurement (4 hrs); Course critique and graduation (2 hrs).</p>					
18						

ATC FORM 449A PREVIOUS EDITIONS OBSOLETE. SEP 63

PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(1) Basic features, characteristics, and functions of computer modules</p> <p>(2) Basic features, characteristics, and functions of the following primary storage devices:</p> <ul style="list-style-type: none"> (a) Memory module (b) Thin film (c) Magnetic drums <p>(3) Length and format of computer word</p> <p>(4) Basic function of peripheral equipment</p> <p>(5) Data flow within the AN/GSA-51A</p> <p>(6) Basic function of the switching interlock</p> <p>(7) Basic function of the I/O exchange</p> <p>(8) Advantages and disadvantages of modular organization</p> <p>b. Given appropriate references, answer at least 70% of a set of the questions pertaining to: (CTS para 2d,e)</p> <p>(1) Information contained on the AN/GSA-51A Programming Code Card in regard to:</p> <ul style="list-style-type: none"> (a) Instruction names (b) Instruction mnemonics (c) Octal codes of instructions (d) Syllable layouts for instructions (e) Thin film map (f) Special syllables <p>(2) Information contained on the AN/GSA-51A Input/Output Programming Code Card</p> <p>(3) Instruction terminology</p> <p>2. Basic Instruction Set</p>	<p>E</p> <p>E</p> <p>29</p>	<p>the Block II examination. State the purpose of the programming blocks.</p> <p>Give each student a programming card and show them how to use it.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output</p>

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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>a. Given appropriate references and problem specifications, write at least one program which includes the instructions, control codes, declarative codes, symbolic tags, and RC words identified in the following enabling objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,d,f,h,i,j,k; 2g(1),(4); <u>2g(5)</u>)</p> <p>(1) Format and function of basic instructions: (a) BINARY Add (BAD) (b) Binary Subtract (BSU) (c) Clear (CLA) (d) No Operation (NOP) (e) Halt (HLT)</p> <p>(2) Format and function of program brackets:</p>	<p>(3)</p> <p>C</p> <p>E</p>	<p>Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual TO 31Z3-178-18, Programming Manual (I) TM 2387/102/01, Assembly and Analysis (I)</p> <p><u>Equipment and Training Aids</u> AN/GSA-51A Computer System (9) O26 Card Punch (1) Overhead Projector</p> <p><u>Training Methods</u> Ds-Dm 14 hrs, P 15 hrs(2)</p> <p><u>Instructional Guidance</u></p> <p>Throughout this block of instruction students will be required to write many short programs exercising a basic group of instructions. This group of instructions will initially be quite limited, but will increase as students progress through the course. Encourage them to punch and submit all their programs, time permitting, for computer operation. Assist in analyzing and debugging all assembler outputs of their programs.</p> <p>NOTE: Students should be assigned at least one program a day to be coded and punched for production on the computer. Stress that they are not limited to this number. Any problem</p>
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PLAN OF INSTRUCTION (Continued)

LEARNING OBJECTIVES 1	DURATION (HOURS) 2	SUPPORT MATERIALS AND GUIDANCE 3	
<p>(a) Identity (IDT) (b) End (END)</p> <p>(3) Purpose and structure of data words: (a) Decimal (DEC) (b) Octal (OCT) (c) Hollerith (HOL) (d) Ditto (DIT)</p> <p>(4) Rules governing use of symbolic tags</p> <p>(5) Purpose and structure of RC words</p> <p>b. Given a program, appropriate references, and minimum instructor assistance; assemble at least one program in octal. A grade of at least 70% is required for satisfactory achieve-</p>	<p>E</p> <p>Wk4-Dy2 (4)</p> <p>E E E</p> <p>(2)</p>	<p>they wish to code and punch will be run for them, time and facilities permitting.</p> <p>NOTE: All instructions and programs should be coded on AN/GSA-51A symbolic coding sheets in proper format. Give students sequence of and information for run cards. Explain them at a later time.</p> <p>Give students several problems requiring them to binary add and binary subtract pairs of numbers. These problems should become more complex until the student is able to perform as specified in the criterion objective.</p> <p>Maximum instructor assistance will be required initially. This requirement will ease as students gain knowledge and experience;</p>	
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>ment. (CTS para 2d,f,h,j; 2g(1),(4))</p> <p>(1) Identify various types of syllables on the AN/GSA-51A Programming Code Cards</p> <p>(2) Write octal assembler outputs</p> <p>(3) Identify the advantage of syllable packing</p> <p>(4) Identify the effect of an asterisk on syllable packing</p> <p>c. Given a list of assembler terms and an assembler dump of a program, identify and interpret the items in the dump as required. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,f,h,i,j; 2g(1),(4))</p> <p>(1) Identify terms with definitions</p> <p>(2) Identify steps required to assemble and operate a program</p>	<p>C</p> <p>E</p> <p>E</p> <p>Wk4-Dy3</p> <p>(2)</p> <p>E</p> <p>E</p> <p>(2)</p> <p>C</p> <p>E</p> <p>E</p>	<p>however, all student programs assembled should be checked by an instructor. This is detailed and time consuming work.</p> <p>Give students a problem for homework that will cause them to use most of the instructions covered to date. This program must be submitted for a run during the second student laboratory period (Wk4-Dy5).</p>

PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(3) Select control cards in the sequence required for specified assembler functions</p> <p>(4) Interpret a core dump</p> <p>d. Given a set of specifications and appropriate references, correctly write at least one program in assembler language which will include instructions identified in the following enabling objectives. (CTS para 2c,d,h; 2g(1),(3), (4))</p> <p>(1) Identify advantages of thin film memory over other means of storage</p> <p>(2) Identify thin film registers by name, location, and function</p> <p>(3) Function of the Program Counter Register (PCR) and Program Storage Register (PSR) during instruction execution</p> <p>(4) Operation of the Operand Stack</p> <p>(5) Format and function of instructions used to operate the operand stack: (a) Step Stack Down (SSD) (b) Step Stack Up (SSU) (c) Reverse Stack (RVS)</p>	<p>E</p> <p>E</p> <p>(2)</p> <p>C</p> <p>E</p> <p>E</p> <p>E</p> <p>Wk4-Dy4</p> <p>(5)</p> <p>E</p> <p>E</p>	<p>Give a practice problem from the workbook that will utilize the thin film and instructions covered thus far.</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(6) Format and function of instructions used to access thin film memory: (a) Load Thin Film (LTF) (b) Store Thin Film (STF) (c) Multiple LTF/STF</p> <p>(7) Function of the Real Time Clock (RTC)</p> <p>(8) Write a set of instructions that can be incorporated into a program to time the operation of the program</p> <p>e. Given a set of specifications and appropriate references, correctly write at least one program in assembler language which will include instructions identified in the following enabling objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2c,d,h; 2g(1),(3),(4))</p> <p>(1) Format and function of Transmit (TRS) and Transmit Modified (TRM) instructions</p> <p>(2) Format and function of the Unconditional Transfer (UCT) instruction</p>	<p>E</p> <p>E</p> <p>E</p> <p>(1)</p> <p>C</p> <p>E</p> <p>Wk4-Dy5</p> <p>(2)</p> <p>E</p>	

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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(2) Given a short routine, add the instructions required to make the routine floatable</p> <p>(3) Format and use of indirect addressing</p> <p>g. Given a set of specifications and appropriate references, correctly write at least one program in both assembler language and octal dump form to accomplish looping and syllable modification. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,d,f,h,i, j,k; 2g(1),(3),(4))</p> <p>(1) Function of Index Registers: (a) Looping (b) Syllable modification</p> <p>(2) Function of Limit Registers</p> <p>(XLC) (3) Purpose of <u>Index, Limit - Compare</u> Instruction</p> <p>(4) Write and debug assigned programs</p>	<p>E</p> <p>E</p> <p>(2)</p> <p>C</p> <p>E</p> <p>E</p> <p>Wk5-Dy1</p> <p>(1)</p> <p>E</p> <p>(1)</p> <p>E</p>	<p>Programming Laboratory</p> <p>Use this time for writing, analyzing and debugging programs as required by the criterion objective.</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE	
<p>3. Comparison and Logical Instructions. Given a set of specifications and appropriate references, correctly write at least one program in assembler language and in octal form which will include the compare and logical instructions identified in the following enabling objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2d,f,h,j; 2g(1),(3),(4))</p> <p>a. Format and use of compare instructions: (1) Alphanumeric Compare Equal (ACE) (2) Alphanumeric Compare Greater (ACG) (3) Alphanumeric Compare Less (ACL) (4) Compare Equal (CEQ) (5) Compare Greater (CGR) (6) Compare Less (CLS)</p> <p>b. Format and use of logical instructions: (1) Logical AND (LAN) (2) Logical OR (LOR) (3) Logical Exclusive OR (LXR) (4) Logical Complement (LCM)</p> <p>c. Write and debug assigned programs</p>	<p align="center">10</p> <p align="center">C</p> <p align="center">(4)</p> <p align="center">E</p> <p align="center">Wk5-Dy2</p> <p align="center">(3)</p> <p align="center">E</p> <p align="center">(3)</p> <p align="center">E</p>	<p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet (4) C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2387/102/01, Assembly and Analysis (I) TM 2780/004/00, General Utility User's Manual (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> AN/GSA-51A Computer System (9) (3) O26 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 5 hrs, P 5 hrs(2)</p> <p><u>Programming Laboratory</u> Use this time for writing, analyzing and debugging programs as required by the criterion objective.</p>	
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>4. Introduction to Compool Programming. Given a set of specifications and appropriate references, correctly write at least one program in assembler language which will use com-pool sensitive data. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,d,f,h,j,k; 2g(1),(3),(4))</p> <p>a. Structure and purpose of COMPOOL and LAYOUT</p> <p>b. Format of compool sensitive data words: (1) Mask (MSK) (2) Complement Mask (CMK) (3) Value (VAL)</p> <p>c. Write and debug assigned programs</p> <p>5. Shift, Complex Arithmetic, Conditional Branch and Repeat Instructions</p>	<p>Wk5-Dy3</p> <p>6</p> <p>(3)</p> <p>C</p> <p>E</p> <p>E</p> <p>E</p> <p>(3)</p> <p>24</p>	<p><u>Instructional Materials</u> C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual TM 2385/203/00, COMDOC TM 2385/204/00, COMPOOL and LAYOUT TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembler and Analysis (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 3 hrs, P 3 hrs(2)</p> <p>(3) <u>Programming Laboratory</u> Use this time for writing, analyzing and debugging programs as required by the criterion objective.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Pro-</p>
<p>PLAN OF INSTRUCTION NO. 3AZR27370 D</p>	<p>DATE 8 April 1970</p>	<p>BLOCK NO. II PAGE NO. 11</p>

PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>a. Given a set of specifications and appropriate reference material, correctly write at least one program in assembler language which will correctly utilize shift instructions. A grade of at least 70% is required for satisfactory achievement. (CIS par 2d,f,h,j,k; 2g(1),(3),(4); 2g(2))</p> <p>(1) Format and function of single shift and single cycle instructions:</p> <ul style="list-style-type: none"> (a) Arithmetic Left Cycle (ALC) (b) Arithmetic Right Cycle (ARC) (c) Arithmetic Left Shift (ALS) (d) Arithmetic Right Shift (ARS) 	<p>Wk5-Dy4 (6) C</p>	<p>programming Code Card C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2387/102/01, Assembly and Analysis (I) TM 2780/004/00, General Utility User's Manual (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 10.5 hrs, P 13.5 hrs(2)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(e) Full Left Cycle (FLC) (f) Full Right Cycle (FRC) (g) Full Left Shift (FLS) (h) Full Right Shift (FRS)</p> <p>(2) Code single class instructions to shift or cycle the contents of a memory location a specified number of bits</p> <p>(3) Format and function of dual shift and dual cycle instruction: (a) Arithmetic Left Cycle Double (ALCD) (b) Arithmetic Right Cycle Double (ARCD) (c) Arithmetic Left Shift Double (ALSD) (d) Arithmetic Right Shift Double (ARSD) (e) Full Left Cycle Double (FLCD) (f) Full Right Cycle Double (FRCD) (g) Full Left Shift Double (FLSD) (h) Full Right Shift Double (FRSD)</p> <p>(4) Code dual class instruction to shift or cycle the contents of a memory location a specified number of bits</p> <p>(5) Function of compool sensitive shift instructions (CYC)</p> <p>(6) Code compool sensitive shift instructions</p> <p>(7) Write and debug assigned programs</p>	<p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>Wk5-Dy5</p>	<p>Programming Laboratory Use this time for writing, analyzing and debugging programs as required by the criterion objective.</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>b. Given a set of specifications and appropriate references, correctly write at least one program in assembler language which will use the complex arithmetic instructions. A grade of at least 70% is required for satisfactory achievement. (CTS para 2d,f,h,j,k; 2g(1),(3),(4))</p> <p>(1) Function and format of complex arithmetic instructions: (a) Binary Multiply (BMU) (b) Binary Divide (BDV)</p> <p>(2) Perform fixed point scaling operations</p> <p>(3) Perform an arithmetic calculation on compool defined, fixed point items</p> <p>(4) Write and debug assigned programs</p> <p>c. Given a set of specification and appropriate references, correctly write at least one program in assembler language which will use the Conditional Branch (BRB) and</p>	<p>(6)</p> <p>C</p> <p>E</p> <p>E</p> <p>Wk6-Dyl</p> <p>(2)</p> <p>E</p> <p>(2)</p> <p>E</p> <p>(2)</p>	<p>Programming Laboratory Use this time for writing, analyzing and debugging programs as required by the criterion objective.</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>Repeat (RPT) instructions. A grade of at least 70% is required for satisfactory achievement. (CTS para 2d,f,h,j,k; 2g(1), (3),(4))</p> <p>(1) Format and function of the Conditional Branch (BRB) instruction</p> <p>(2) Format and function of Repeat (RPT) instruction</p> <p>(3) Write and debug assigned programs</p> <p>6. Measurement</p>	<p>C</p> <p>E</p> <p>Wk6-Dy2</p> <p>(3)</p> <p>E</p> <p>(3)</p> <p>E</p> <p>Wk6-Dy3</p> <p>6</p>	<p><u>Programming Laboratory</u> Use this time for writing, analyzing and debugging programs as required by the criterion objective.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) ATCR 52-3, Measurement (I)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>a. Examination</p> <p>b. Critique</p>	<p>(5)</p> <p>(1)</p>	<p>ATCR 52-29, Student Critique Program (I)</p> <p><u>Equipment and Training Aids</u> Flowcharting Template (1)</p> <p><u>Training Methods</u> TP 5 hrs, Ds 1 hr</p> <p>Administer the examination in accordance with current policies, procedures and regulations.</p> <p>Critique the examination in accordance with applicable policies and procedures.</p>

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BLOCK NO. II

PAGE NO. 16

PLAN OF INSTRUCTION		COURSE TITLE BUIC Computer Programming	
BLOCK TITLE Central Processor Programming II			
LEARNING OBJECTIVES		DURATION (HOURS)	SUPPORT MATERIALS AND GUIDANCE
1. Field and Character Search Instructions (Part I)		Wk6-Dy4 9	<u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C181-BUIC-WB, Mini-BUIC System C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)
<u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)		<u>Training Methods</u> Ds-Dm 7 hrs, P 2 hrs(2)	
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>fied in the following enabling objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,f,h,j,k; 2g(1))</p> <p>(1) Function and use of field instructions:</p> <p>(a) Group 1:</p> <ol style="list-style-type: none"> 1 Binary Add Field (BAF) 2 Binary Subtract Field (BSF) 3 Logical OR Field (LOF) 4 Logical AND Field (LAF) 5 Logical Complement Field (LCF) 6 Logical Exclusive OR Field (LXF) <p>(b) Group 2:</p> <ol style="list-style-type: none"> 1 Compare Equal Field (CEF) 2 Compare Greater Field (CLF) <p>(c) Group 3: Strip and Adjust Field (SAF)</p> <p>(d) Group 4: Adjust and Insert Field (AIF)</p> <p>(2) Structure and use of field syllable</p> <p>(3) Code field instructions</p> <p>(4) Function and use of the operand stack in conjunction with the field instructions</p> <p>(5) Calculate and analyze assembler output for given field instructions</p> <p>(6) Using a given compool, code compool sensitive field instructions</p>	<p>C</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>Wk6-Dy5</p> <p>(3)</p> <p>E</p>	
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(7) Write and debug assigned programs</p> <p>2. Mini-BUIC System (Part I). Given appropriate references and the specifications for a radar processing program, prepare a program to meet the specifications. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,d,e,h,i,j,k; 2f; 2g(1); 2g(3),(4))</p> <p>a. List the steps require to assemble and operate the radar processing program</p> <p>b. Identify the SID displays that should be generated by the radar processing program</p> <p>c. Use computer listings to locate given compool tables and items</p> <p>d. Analyze the requirements for the radar processing program</p>	<p>E</p> <p>3</p> <p>C</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p>	<p><u>Programming Laboratory</u> During this period students will prepare and debug programs to satisfy the requirements of the criterion objective.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C181-BUIC-WB, Mini-BUIC System C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) 026 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> P 3 hrs(3)</p> <p><u>Instructional Guidance</u> Preparation of the radar processing program will require both in-class and out-of-class work by the students. In-class work will be accomplished in five 3-hour periods during</p>

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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE	
<p>3. Field and Character Search Instructions (Part II). Given appropriate references and a set of specifications, write at least one program in assembler language which will correctly utilize the character search instruction (CSE). A grade of at least 70% is required for satisfactory achievement. (CTS para 2c,d,f)</p> <p>a. Function and use of the character search instruction (CSE)</p> <p>b. Code the character search instruction (CSE)</p> <p>c. Trace the flow of action in a program using the CSE instruction</p> <p>d. Calculate and analyze the contents of the character count register (CCR) after a given CSE instruction</p>	<p>Wk7-Dy1</p> <p>3</p> <p>C</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p>	<p>the last half of Wk6-Dy5 (today), Wk7-Dy2, Wk7-Dy4, Wk8-Dy1, and Wk8-Dy3. A group of enabling objectives are listed in each of these in-class periods. Work will be started on these objectives during the in-class period and continued into out-of-class time if required.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C181-BUIC-WB, Mini-BUIC System C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)</p>	
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>4. Floating-Point Instructions (Part I). Given a set of specifications and appropriate references, write at least one program in assembler language which will correctly utilize the floating-point instructions identified in the following objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,d,f,h,j,k; 2g(1))</p> <p>a. Identify the advantages of floating-point arithmetic over fixed-point arithmetic</p> <p>b. Structure of floating-point data words</p> <p>c. Function and use of:</p> <ol style="list-style-type: none"> (1) Floating Add (FAD) instruction (2) Floating Subtract (FSU) instruction (3) Floating Multiply (FMU) instruction (4) Floating Divide (FDV) instruction (5) Convert Binary to Floating-Point (CBF) instruction (6) FLT declarative data word <p>d. Code floating-point instructions and the FLT declarative data word</p> <p>e. Calculate the floating-point value from a given programmer's value</p>	<p>6</p> <p>C</p> <p>(3)</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>Wk7-Dy2</p>	<p><u>Training Methods</u> Ds-Dm 2 hrs, P 1 hr(2)</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 3123-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 4 hrs, P 2 hrs(2)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE	
<p>b. Code the control codes</p> <p>c. Calculate the assembler output for a given program that uses control codes</p> <p>d. Function and use of address declarative codes: (1) ADR (2) ADRA (3) ADRP</p> <p>e. Code the address control codes</p> <p>f. Calculate the assembler output for a given program that uses address declarative codes</p> <p>8. Mini-BUIC System (Part III). Code the radar processing program on AN/GSA-51A Coding Sheets</p>	<p>E</p> <p>E</p> <p>Wk7-Dy4</p> <p>(3)</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>3</p> <p>E</p>	<p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 4 hrs, P 2 hrs(3)</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Sheet C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C181-BUIC-WB, Mini-BUIC System C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p>	
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>9. Special System Oriented Codes (Part II). Write and debug programs using special system oriented codes</p>	<p>Wk7-Dy5 3 E</p>	<p><u>Equipment and Training Aids</u> Flowcharting Template (1)</p> <p><u>Training Methods</u> P 3 hrs(3)</p> <p><u>Instructional Guidance</u> The students should be working at their own speed and they should be using their flowcharts as they code. Three instructors should be available to check the student's coding and to help those students having difficulties.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Sheet C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> AN/GSA-51A Computer System (9)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>10. Subroutines (Part I). Given a set of specifications and appropriate references, write at least one program in assembler language which will correctly utilize the subroutine instructions identified in the following enabling objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,d,f,h,j,k; 2g(1))</p> <p>a. Function and use of subroutine instructions: (1) Subroutine Jump (SRJ) (2) Subroutine Return (SRR)</p> <p>b. Code subroutine instructions</p> <p>c. Advantages of external subroutines and internal subroutines</p> <p>d. Trace the flow of action resulting from a given PCR subroutine</p>	<p>6</p> <p>C</p> <p>(3)</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p>	<p>026 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 1 hr, P 2 hrs(3)</p> <p><u>Programming Laboratory</u> Have students work on the requirements of the criterion objective for special system oriented codes.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) 026 Card Punch (2) Flowcharting Template (1)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>e. Trace the flow of action resulting from a given SRJ subroutine</p> <p>f. Function and structure of the subroutine address register (SAR) and the subroutine storage register (SSR)</p> <p>11. Mini-BUIC System (Part IV). Punch the radar processing program on cards</p>	<p>Wk8-Dy1 (3)</p> <p>E</p> <p>E</p> <p>E 3</p>	<p><u>Training Methods</u> Ds-Dm 6 hrs</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C181-BUIC-WB, Mini-BUIC System C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> AN/GSA-51A Computer System (9) 026 Card Punch (2) Flowcharting Template (1)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>12. Subroutines (Part II). Write and debug programs using subroutine instructions</p>	<p>Wk8-Dy2 E 3</p>	<p><u>Training Methods</u> P 3 hrs(3)</p> <p><u>Instructional Guidance</u> Two instructors should assist those students who have not completed the project through this objective. A third instructor should assemble the programs of the students who have finished punching their programs.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> AN/GSA-51A Computer System (9) 026 Card Punch (2) Flowcharting Template (1)</p>

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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>13. Interrupt System. Given a set of specifications and appropriate references, write at least one program in assembler language which will correctly utilize the interrupt instructions identified in the following enabling objectives. A grade of at least 70% is required for satisfactory achievement. (CTS para 2b,c,d,f,h,j,k; 2g(1))</p> <p>a. Function and use of the interrupt system</p> <p>b. Identify the modes of control associated with the interrupt system</p> <p>c. Identify the twelve interrupts</p> <p>d. Identify the causes of and the responses to the twelve interrupts</p> <p>e. Function and purpose of the twelve interrupts</p> <p>f. Function and use of special registers and the table associated with the interrupt system</p> <p>g. Function and use of the interrupt instructions: (1) Load Special Register (LSR)</p>	<p>6</p> <p>C</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p> <p>E</p>	<p><u>Training Methods</u> Ds-Dm 1 hr, P 2 hrs(3)</p> <p><u>Programming Laboratory</u> Review all subroutine instructions and have students work on the requirements of the criterion objective for subroutines.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet (3) C184-BUIC-WB, AN/GSA-51A Central Processor Programming C185-BUIC-ST, AN/GSA-51A Programming Manual TO 31Z3-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> Overhead Projector AN/GSA-51A Computer System (9) O26 Card Punch (2) Flowcharting Template (1)</p> <p><u>Training Methods</u> Ds-Dm 4 hrs, P 2 hrs(3)</p> <p><u>Instructional Guidance</u> Show the transparency of the interrupt jump (IRJ) routine.</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
<p>(2) Interrupt Return (IRR) (3) Store External Request (SER)</p> <p>h. Code interrupt instructions</p> <p>i. Write and debug programs using interrupt instructions</p> <p>14. Mini-BUIC System (Part V)</p> <p>a. Assemble and cycle the radar processing program</p> <p>b. Debug the radar processing program</p>	<p>E</p> <p>E</p> <p>Wk8-Dy3</p> <p>(3)</p> <p>E</p> <p>3</p> <p>E</p> <p>E</p>	<p><u>Programming Laboratory</u> Complete enabling objectives from the previous day. Have students work on the requirements of the criterion objective for the interrupt system. If time permits, have them complete programs assigned in previous units.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C181-BUIC-WB, Mini-BUIC System C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I) TM 2387/102/01, Assembly and Analysis (I) TO 3123-178-18, Programming Manual (I)</p> <p><u>Equipment and Training Aids</u> AN/GSA-51A Computer System (9) O26 Card Punch (2)</p>

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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE
15. Measurement	Wk8-Dy4 6	<p>Flowcharting Template (1)</p> <p><u>Training Methods</u> P 3 hrs(3)</p> <p><u>Instructional Guidance</u> Take students to the computer and assemble and operate their programs. Assist those students who are having difficulty with cycling their program. At least one instructor is required in the classroom to help analyze and debug student programs which have already been assembled, a second instructor is required to operate the computer, and a third instructor is required in the computer room to analyze listings and dumps. Those students having major problems should be returned to the classroom for assistance; those with minor problems should be encouraged to find the errors and submit corrections immediately.</p> <p><u>Instructional Materials</u> C175-BUIC-HO, AN/GSA-51A Programming Code Card C176-BUIC-HO, AN/GSA-51A Input/Output Programming Code Card C178-BUIC-HO, AN/GSA-51A Symbolic Coding Sheet C185-BUIC-ST, AN/GSA-51A Programming Manual C193-416M-SU, Register Reference Sheet TM 2780/004/00, General Utility User's Manual (I)</p>
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PLAN OF INSTRUCTION (Continued)

1 LEARNING OBJECTIVES	2 DURATION (HOURS)	3 SUPPORT MATERIALS AND GUIDANCE	
<p>a. Examination</p> <p>b. Critique</p>	<p>(4½)</p> <p>(1½)</p>	<p>ATCR 52-3, Measurement (I) ATCR 52-29, Student Critique Program (I)</p> <p><u>Equipment and Training Aids</u> Flowcharting Template (1)</p> <p><u>Training Methods</u> TP 4½ hrs, Ds 1½ hrs</p> <p><u>Instructional Guidance</u></p> <p>Administer the examination in accordance with current policies, procedures, and regulations.</p> <p>Critique the examination in accordance with applicable policies and procedures.</p>	
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