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MULTICS TECHNICAL BULLETIN MTB- 338

To: MTB Distribution

From: Gary C. Dixon

Subject: Multics Courses to be Taught By Marketing Education

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Attached is the curriculum of courses which Marketing Education, in conjunction with the FSO Multics Education Group in Mc Lean, and with many of the software developers, has developed for Multics. Your comments and suggestions on the overall curriculum or the content of specific courses would be greatly appreciated. Comments on other aspects are welcome as well. Send comments by Multics mail as follows:

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Introduction

In November of 1974, a curriculum was prepared for Multics and many of the courses were developed and taught on a limited scale. The FSO Multics Education Group in McLean is still teaching this curriculum. However, the curriculum has several drawbacks: its courses emphasize the mechanics of system operation, rather than the use of the system; the beginning course sequence concentrates too much information in each course; the operation of the supervisor is analyzed in more detail than most students will need; much of the course material is out-of-date. So in January, Nate Adleman, Bill Silver, and Pat Lyon began defining a new curriculum. Gary Dixon carried on their work in February, with the help of Barnie Ritchie's education group in McLean. The result of this joint effort is the attached curriculum.

The new curriculum is divided into eight types of courses: general courses, language courses, data base courses, word

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processing courses, administration and operation courses, application program courses, operating supervisor courses, and miscellaneous courses. Some course descriptions are tentative because the software is not yet complete (for example, the word processing and data base courses). Others are better defined, with development of course materials already underway for some courses. In particular, the first courses to be developed are: Multics Concepts and Utilization (F01), PL/I Concepts (G15), Commercial PL/I Programming (F15A), Scientific PL/I Programming (F15B), COBOL-74 Specifics (F13), MRDS Utilization within Application Programs (F31), Project Administration (F60A), System Administration (F60B), and Operator Training (F68).

The curriculum will be added to the Marketing Education Planning Guide during third quarter of 1977, and will be formally announced at HLSUA in May of 1977. The first series of courses will be given (hopefully) in the third quarter of 1977.

MULTICS COURSES

1977

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F01 Multics Concepts and Utilization

Duration: Five Days

Intended For: Personnel requiring capability to use the Multics system.

Course Synopsis: This course presents the basic information needed to use the Multics system, including: an overview of the hardware and software facilities; a definition of a Multics process and the environment in which it operates; a discussion of the typing conventions used for Multics terminals; an introduction to commands for writing, compiling and executing programs; a description of the types of errors which can occur, with procedures for recovery; and exposure to other utility commands which provide control of the process' environment, manipulation and control of files, grouping of commands and definition of command abbreviations, and inter-user communication. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to login to and logout from the Multics system.

2. Know how to compile and run simple programs.

3. Know how to create files in the storage system with the qedx editor.

4. Know about other commands available for manipulating files, tailoring the process' environment, and communicating with other users.

Prerequisite: Programming Logic and Flowcharting (G024) or previous data processing experience.

Major Topics:
Hardware/Software Overview
Typing Conventions
Command Language
Useful Commands
Storage System - Overview and Use
qedx Editor
Writing and Executing a Program
Typical User Problems

F02 Multics Features, Functions, and Benefits

Duration: 6 to 8 Hours, Video-Assisted Learning (VAL)

Intended For: Personnel requiring an overview of Multics features, functions, and benefits.

Course Synopsis: This course presents an overview of the concepts and facilities that make Multics a productive, easily used, general-purpose timesharing system.

Objectives: Upon completion of this course, the student should:

1. Understand the advantages of using the Multics system.

2. Understand why programmer productivity is high on Multics.

Prerequisite: None

Major Topics:
Multics Features, Functions, and Benefits
Program Development
Data Security
Virtual Memory
Data Base Manager
Word Processing
Networking
Graphics

G11 APL (Programming Language)

Duration: Three Days

Intended For: Personnel with data processing experience but no previous experience writing APL programs.

Course Synopsis: This course presents standard APL language elements without regard to specific hardware and/or operating systems, and provides basic techniques for writing and executing APL programs.

Objectives: Upon completion of this course, the student should:

1. Know how to use the basic APL language.
2. Know how to define and edit APL functions.
3. Know how to save and reuse APL workspaces.

Prerequisite: High school algebra, and a mathematical background.

Major Topics:
APL Names, Values, Operators and Functions
APL-provided Functions
Function Definition and Editing
APL Typing Conventions

F11 APL (Programming Language) Specifics

Duration: Two Days

Intended For: Personnel with prior knowledge of the APL language who want to write APL programs using the Multics system.

Course Synopsis: This course presents basic information about Multics needed to write and execute APL programs. It outlines the features of the APL language which are specific to the Multics implementation, with emphasis on Multics APL typing conventions, and the APL File Input/Output mechanism. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use the facilities of Multics APL to write and execute APL programs.

2. Know how to establish and reference libraries of APL programs.

3. Know how to use the APL File Input/Output facility and other PL/I subroutines from an APL program.

Prerequisite: APL (G11) or equivalent APL programming experience.

Major Topics:
Multics Specifics of APL
System Functions
APL Typing Conventions
APL File I/O
Sharing Workspaces and Files
Interface to Multics Environment

F12 BASIC (Programming Language) Specifics

Duration: 12 to 16 Hours, Video-Assisted Learning (VAL)

Intended For: Personnel with prior knowledge of the BASIC language who want to write BASIC programs using the FAST subsystem or the full Multics system.

Course Synopsis: This course presents the features of the Multics implementation of BASIC, and describes how to write and execute BASIC programs in the FAST subsystem or the full Multics programming environment.

Objectives: Upon completion of this course, the student should:

1. Know how to write and execute BASIC programs using the FAST subsystem.

2. Know how to use the commands provided by the FAST environment.

3. Know how to write and execute BASIC programs in the environment provided by the full Multics system.

Prerequisite: BASIC (G537)

Major Topics:
Writing BASIC Programs
Multics Specifics of BASIC
Typing Conventions
Command Language
BASIC I/O Mechanism
FAST Subsystem

F13 COBOL-74 Programming Specifics

Duration: Five Days

Intended For: Personnel with prior knowledge of COBOL who want to design, write, debug, and/or implement COBOL-74 application programs on the Multics system.

Course Synopsis: This course presents basic information about Multics needed to write and run COBOL-74 application programs. It outlines features of COBOL-74 which differentiate it from basic COBOL, and identifies extensions and restrictions of the Multics COBOL implementation. It also describes the interface between COBOL programs and the Multics environment. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use Multics facilities to create, compile, execute, and debug COBOL programs.

2. Know how to execute a group of COBOL programs as a single run-unit.

Prerequisite: Multics Concepts and Utilization (F01), plus COBOL Programming (G434) or equivalent COBOL programming experience.

Major Topics:
Writing COBOL Programs
Features of COBOL-74
Multics Specifics of COBOL-74
COBOL I/O Mechanism
Program Execution
Error Processing and Debugging

F14 FORTRAN-76 Programming Specifics

Duration: Three Days

Intended For: Personnel with prior knowledge of FORTRAN who want to design, write, debug, and/or implement FORTRAN programs on the Multics system.

Course Synopsis: This course presents basic information about Multics needed to write and execute FORTRAN programs using the full Multics system or the FAST subsystem. It outlines the features of Multics FORTRAN which are specific to the Multics implementation, and describes the interface between FORTRAN programs and the Multics programming environment. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course the student should:

1. Know how to use Multics facilities to create, compile, execute, and debug FORTRAN programs in the full Multics programming environment, or in the limited service FAST subsystem.

2. Know how Multics FORTRAN differs from FORTRAN-76 and FORTRAN-66 (FORTRAN IV).

Prerequisite: Multics Concepts and Utilization (F01), plus FORTRAN IV Language (G047) or equivalent FORTRAN programming experience.

Major Topics:
Writing FORTRAN Programs
Multics Specifics of FORTRAN-76
FORTRAN I/O Mechanism
Multics I/O System
External Data Segments
Measuring FORTRAN Program Performance

G15 PL/I Concepts

Duration: Two Days

Intended For: Personnel who need a fundamental knowledge of the PL/I language as a prerequisite to PL/I programming courses, or who need an overview of the language in order to communicate more effectively with their systems and programming staffs.

Course Synopsis: This course presents a generic introduction to the structure and capabilities of the American National Standard PL/I programming language. Topics include: program structure, types of data which can be defined, kinds of statements supported, flow of control through a program, and types of operators which are supported. Workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should know the basic structure and components of a PL/I program, and should be able to read and understand a sample PL/I program.

Prerequisites: Programming Logic and Flowcharting (G024) or equivalent experience.

Major Topics:

PL/I Program Structure
Data Types
Storage Classes
Statement Types and Syntax
Flow of Control
Scope of Names
Operators

F15A Commercial PL/I Programming

Duration: Three Days

Intended For: Personnel with some knowledge of PL/I who require capability to design, write, debug, and/or implement business-oriented PL/I programs for a Multics system.

Course Synopsis: This course presents basic techniques for designing, writing, executing, and debugging business-oriented PL/I application programs. Emphasis is placed on the aspects of PL/I most appropriate to business programming, including: binary integer and decimal arithmetic data, and character and picture data types; automatic, static, and parameter storage classes; array and structure aggregates; arithmetic, concatenation and substring operations; system counter built-in functions; record-oriented input/output for permanent files, with stream-oriented input/output for report generation; and input/output condition handling. It also describes the interface between PL/I programs and the Multics environment. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Be able to write business-oriented PL/I programs.

2. Be able to compile, execute, and debug such programs.

Prerequisites: Multics Concepts and Utilization (F01), plus PL/I Concepts (G15) or equivalent programming experience.

Major Topics:
Review Program Structure and Statement Syntax
Arithmetic, Character, and Picture Data
Automatic, Static, and Parameter Storage Classes
Arithmetic and Character Operators
PL/I Stream I/O
Array and Structure Aggregates
Use of Program Listings
PL/I Record I/O
I/O Condition Handling
Debugging Techniques
Good Programming Techniques

F15B Scientific PL/I Programming

Duration: Three Days

Intended For: Personnel with some knowledge of PL/I who require capability to design, write, debug, and/or implement science-oriented PL/I programs for a Multics system.

Course Synopsis: This course presents basic techniques for designing, writing, executing, and debugging PL/I scientific programs. Emphasis is placed on the aspects of PL/I most appropriate to scientific programming, including: fixed, floating, and complex floating binary data, and character and bit string data; automatic, static, and parameter storage classes; array data aggregates; arithmetic, mathematical, and array operations; stream-oriented input/output for reading and writing data, with record-oriented input/output for permanent storage of large data files; and endfile condition handling. It also describes the interface between PL/I programs and the Multics environment. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Be able to write scientific PL/I programs.

2. Be able to compile, execute, and debug such programs.

Prerequisites: Multics Concepts and Utilization (F01), plus PL/I Concepts (G15) or equivalent programming experience.

Major Topics:
Review Program Structure and Statement Syntax
Arithmetic and Character Data Types
Automatic, Static, and Parameter Storage Classes
Arithmetic and Mathematical Operations
PL/I Stream I/O
Array Aggregates
Use of Program Listings
PL/I Record I/O
Debugging Techniques
Good Programming Techniques

F15C Advanced PL/I Programming Techniques

Duration: Three Days

Intended For: Personnel with prior knowledge of commercial or scientific PL/I programming who want to use the more advanced features of the PL/I language.

Course Synopsis: This course presents advanced techniques for writing PL/I programs, with emphasis on the features of PL/I used in system programming. These features include: area, pointer, offset, and label data types; based, static, and controlled storage classes; array, structure, and structure array aggregates; Multics subroutines for performing stream- and record-oriented input/output; handling of PL/I and Multics conditions; and calling Multics subroutines. Techniques for writing Multics commands and active functions are also described. Interactive workshops are included to reinforce the material presented.

Objectives Upon completion of this course, the student should be able to write PL/I programs which:

1. manage list-structured data.
2. address data directly in the virtual memory (without input/output statements).
3. call supervisor subroutines to create and manipulate segments, and to perform I/O operations.
4. operate as commands and/or as active functions.

Prerequisite: Commercial PL/I Programming (F15A) or Scientific PL/I Programming (F15B) or equivalent programming experience. Also Advanced Program Debugging Techniques (F19) is desirable, but not required.

Major Topics:
Review of Commercial and Scientific PL/I
Locator Variables
Based, Static, and Controlled Storage Classes
Structure Array Aggregates
PL/I and Multics Conditions
Multics I/O System
Commands and Active Functions

F15D Application Subsystem Programming Techniques

Duration: Five Days

Intended For: Personnel who wish to design or write PL/I programs which use the special facilities of Multics.

Course Synopsis: This course describes how to use the special facilities of Multics from PL/I programs. These facilities provide for: use of the virtual memory, the storage system, and the I/O system; interprocess communication and locking; command program argument processing; tailoring of the command environment, and limited service subsystems; subsystem programming and program library management; dialing terminals to an existing process; and writing compilers. Interactive workshops are used to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use special Multics facilities by calling subroutines from a PL/I program.

2. Know how to create a limited service environment tailored to the needs of a particular group of users.

3. Know how Multics object segments are formatted and what conventions compilers should follow when creating object segments.

4. Know about several Multics facilities which aid in writing program subsystems.

Prerequisite: Advanced PL/I Programming Techniques (F15C)

Major Topics:
Virtual Memory and Storage System
Multics I/O System
Interprocess Communication and Locking
Command Argument Processing
Subsystem Programming and Program Library Management
Tailoring the Command Environment
Dialing Terminals to a Process
Writing Compilers and Object Segment Format

F19 Advanced Program Debugging Techniques

Duration: Two Days

Intended For: Personnel writing PL/I, FORTRAN or COBOL programs who require object-level facilities for debugging their programs.

Course Synopsis: This course presents techniques for object-level debugging of PL/I, COBOL, or FORTRAN programs and techniques for measuring program performance. It includes: an overview of the Multics programming environment; a review of source-level debugging tools; an introduction to object-level debugging tools with a discussion of useful debugging techniques; a discussion of unusual conditions which can occur; an introduction to other debugging aids provided by Multics; and a summary of tools and techniques used to measure and optimize program performance. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know about the environment which program operate within on Multics.

2. Know basic techniques for source- and object-level debugging of programs.

3. Know basic techniques for measuring program performance.

Prerequisite: Commercial PL/I Programming (F15A) or Scientific PL/I Programming (F15B) or FORTRAN-76 Specifics (F14) or COBOL-74 Specifics (F13)

Major Topics:
Process Environment and Stack Mechanism
Storage of Program Data
Source-Level Debugging
Object-Level Debugging
Condition Handling
Measuring Program Performance
Useful Debugging Aids

F30 MRDS End-User Utilization

Duration: Five Days

Intended For: Personnel who want to use the Logical INquiry and Update System (LINUS) together with the Report Generator Language (RGL) to retrieve, report on, and update data in a Multics Relational Data Store (MRDS) data base.

Course Synopsis: This course describes how to use the LINUS facility to retrieve or update data in a data base. It describes how to use RGL with LINUS to format retrieved data as a report, how to create a new data base, and how to fill a data base with new data. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use the LINUS facility to selectively retrieve, store, modify, and delete data items (tuples) in a MRDS data base.

2. Know how to use LINUS and RGL to report on selected data in a MRDS data base.

3. Know how to create and fill a new data base.

Prerequisite: Multics Concepts and Utilization (F01)

Major Topics: LINUS Language (LILA)
Report Generator Language (RGL)
Creating/Filling a Data Base

F31 MRDS Utilization within Application Programs

Duration: Five Days

Intended For: Personnel who want to use the Multics Relational Data Store (MRDS) to create a relational data base which can be referenced from a PL/I, FORTRAN, or COBOL program.

Course Synopsis: This course introduces the facilities of the Multics Relational Data Store. It describes how data bases are created, and how programs can retrieve, store, modify, and delete data. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to create a MRDS data base.

2. Know how to retrieve, store, modify, and delete tuples (items) in the data base using a PL/I, COBOL, or FORTRAN program.

Prerequisite: Multics Concepts and Utilization (F01), plus Commercial PL/I Programming (F15A) or Scientific PL/I Programming (F15B) or FORTRAN-76 Specifics (F14) or COBOL-74 Specifics (F13).

Major Topics:
Multics Data Base Manager Overview
MRDS vs. MIDS
Definition of an MRDS Data Base
Definition of MRDS Data Submodels
Display of Data Models and Submodels
Loading a Data Base
Data Retrieval and Update Subroutines
Restructuring a Data Base
Command Interface to the Data SubLanguage
Subroutine Interface for Data Base Creation

F4.. WORDPRO for Basic Terminal Operators

Duration: 6 to 8 Hours, Video-Assisted Learning (VAL)

Intended For: Personnel who enter data for a word processing application using the Multics WORDPRO system.

Course Synopsis: This course presents basic information needed to be able to enter data for a word processing application.

Objectives: Upon completion of this course, the student should:

1. Know how to enter the Multics WORDPRO system.
2. Know the basic Multics typing conventions.
3. Know how to enter data for a word processing application.
4. Know how to leave the Multics WORDPRO system.

Prerequisite: None

Major Topics: Data Entry
Typing Conventions

F4.. WORDPRO for Advanced Terminal Operators

Duration: Five Days

Intended For: Personnel who want to write reports, manuals, and other documents using the Multics WORDPRO system.

Course Synopsis: This course introduces the Multics WORDPRO System, and presents basic techniques for writing documents using WORDPRO. The course outlines how to login to Multics and issue commands, describes text editors used to create files, presents basic features of the runoff command used to format files, and introduces several other commands used to manipulate files. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use an editor to create a document, and the facilities of WORDPRO to format the document, and aid in its typing.

2. Know how to use a few Multics commands to print files, obtain lists of documents, and perform similar functions.

Prerequisite: WORDPRO for Basic Terminal Operators (F4..)

Major Topics:
Typing Conventions
Cursor Editing
Context Editing
Text Formatting
Use of Online Dictionaries

F4.. WORDPRO for Document Administrators

Duration: Ten Days

Intended For: Personnel who want to define the form of letters, reports, or manuals created with the Multics WORDPRO system, or personnel who supervise the work of terminal operators writing documents using WORDPRO.

Course Synopsis: This course presents basic techniques needed to design forms used in form letters, or to define the layout of a document. It also describes the tools and facilities available for managing a tailored word processing environment used by terminal operators. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use the more advanced facilities of the qedx context editor.

2. Know how to write simple text formatting macros which define the format of a document.

3. Know how to create a form letter to be sent to a list of people.

4. Know how to manage a set of online dictionaries which can be used to find misspelled words, to allow abbreviations in typed input, and to hyphenate words in formatted output.

Prerequisite: WORDPRO for Advanced Terminal Operators (F4..)

Major Topics:
Intermediate Context Editing
Intermediate Text Formatting
Document Layout
Dictionary Maintenance
Command Language
Managing WORDPRO Environments

F4.. WORDPRO for Programmers

Duration: Five Days

Intended for: Personnel with a programming background who wish to write documents using the Multics system.

Course Synopsis: This course introduces the Multics WORDPRO System, which can be used to write and format documents of all types. The course emphasizes formatting of text, use of context editors, and use of online dictionaries.

Objectives: Upon completion of this course, the student should:

1. Know how to create and format simple documents (e.g., letters, theses, journal articles, or program documentation).

2. Know how to automatically find misspelled words, use abbreviations in typed input, and hyphenate words in formatted output under the control of an online dictionary.

3. Know how to create a series of documents which have a specific format (such as program descriptions) more easily with WORDPRO.

Prerequisite: Multics Concepts and Utilization (F01), plus experience writing programs on a large-scale operating system.

Major Topics:
Intermediate Context Editing
Text Formatting
Document Layout
Use of Dictionaries
Dictionary Maintenance

F4.. Advanced WORDPRO Techniques

Duration: Five Days

Intended For: Personnel who want to define standardized text formats used for a manual or similar document, or who want to know more about word processing tools.

Course Synopsis: This course presents advanced techniques for defining document formats, and discusses more specialized word processing facilities, including runoff macros, diagramming and photocomposition, and qedx macros. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how to use runoff macros to format an entire manual.

2. Know how to use the diagramming and photocomposition facilities of runoff.

3. Know how to write editing macros for the qedx context editor.

4. Know how to use the full facilities available for producing form letters or formatted documentation.

Prerequisite: WORDPRO for Document Administrators (F4..) or WORDPRO for Programmers (F4..).

Major Topics: Advanced Context Editing
Advanced Text Formatting
Advanced Document Layout

F60A Project Administration

Duration: 8 to 10 Hours, Video-Assisted Learning (VAL)

Intended For: Personnel who want to control the programming environment and resources used by users of a Multics project.

Course Synopsis: This course presents an overview of Multics administration and describes the functions performed by the administrator of a Multics project. The course shows how an administrator identifies the users of his project, controls the resources available to these users, and optionally limits the programming environment these users operate in.

Objectives: Upon completion of this course, the student should:

1. Know the responsibilities of a project administrator.

2. Know how to register users in the Project Master File (PMF), and to set resource limits for these users.

3. Know how to limit project users to a specially-tailored programming environment.

Prerequisite: Multics Concepts and Utilization (F01)

Major Topics:
Administration Overview
Responsibilities of a Project Administrator
Project Master File
CPU Time Limits
Charge Limits
Disk Storage Limits
Logical Volumes
Tailored User Environments

F60B System Administration

Duration: Five Days

Intended For: Personnel who must register Multics users, and who must account for the resources consumed by these users.

Course Synopsis: This course presents an overview the Multics administration and accounting facilities. It describes the mechanisms used to control, account for and bill Multics usage. It also outlines the responsibilities of the system administrator, and defines how administrative data bases are used and maintained. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know the responsibilities of a system administrator.

2. Know how to register users and projects, and how to allocate resources to registered projects.

3. Know how to control the resources used by project users, or to delegate this control to a project administrator.

4. Know how to account for and bill out the charges for Multics usage to each project.

Prerequisite: Multics Concepts and Utilization (F01)

Major Topics:
User and Project Registration
Project Administration
Load Control
Quota Manipulation
Accounting, Billing, and Usage Reports
Administrative Data Bases
Limited Service Systems

F68 Operator Training

Duration: Five Days

Intended For: Personnel responsible for operation or operation management of a Multics system, or who require an understanding of Multics operational procedures.

Course Synopsis: This course presents the information necessary to initialize a Multics system, reconfigure Multics hardware or software, communicate with Multics via the system consoles, operate I/O Daemons which control system peripherals, handle I/O media, recover from system failures, and perform storage system maintenance functions. Extensive, hands-on training in a live environment reinforces the material presented in classroom lectures and workshops.

Objectives: Upon completion of this course, the student should:

1. Know how to run the Bootload Operating System (BOS).
2. Know how to start up the Multics system.
3. Know how to communicate with Multics via the system consoles, and how to operate the Initializer (system control) process.
4. Know how to handle system peripherals, and how to operate the I/O Daemon processes which control these peripherals.
5. Know how to make backup copies of user storage, and to retrieve backup copies.
6. Know how to recover from a system failure.

Prerequisite: Experience operating a large-scale computer system.

Major Topics:
Hardware Configuration
BOS Operation
Initializer Operation
Dynamic Reconfiguration
Storage System, I/O Daemon and Backup Operation
Recovery from System Failures and Errors

F70 Graphics Programming

Duration: Three Days

Intended For: Personnel who want to use the Multics Graphics System to generate static or animated graphics displays.

Course Synopsis: This course introduces the facilities of the Multics Graphics System, and describes how graphics displays can be generated using the graphics_editor or the subroutine interfaces to the Graphics System.

Objectives: Upon completion of this course, the student should:

1. Know about the features provided by the Multics Graphics System.
2. Know how to create a graphic display using the graphics_editor.
3. Know how to create graphic control structures from a program.
4. Know how to write a graphic definition table and graphic support procedure.

Prerequisite: Advanced PL/I Programming Techniques (F15C)

Major Topics:
Overview of Graphics
Multics Graphics System Concepts
High-Level Graphics Programs
Low-Level Graphics Facilities
Graphic Definition Tables

F80 Multics Process Management Analysis

Duration: Five Days

Intended For: Personnel requiring knowledge of how Multics manages the environment in which a process operates.

Course Synopsis: This course outlines the functions performed by each component of the Multics supervisor, and describes the control data used to multiplex these functions among all processes. The supervisor functions provide the basic environment in which all Multics processes operate. Knowledge of supervisor operation gives students an insight into tuning of the system. Workshops are included to reinforce the material presented.

Objectives: Upon completion of the course, the student should:

1. Know what functions the supervisor performs, and how the supervisor is structured to perform these functions.
2. Know what control data each supervisor component uses.
3. Know more about how to tune the system.

Prerequisite: System Administration (F60B), and Application Subsystem Programming Techniques (F15D)

Major Topics:
Segment Control
Page Control
Directory Control
Traffic Control
Interprocess Communication
Fault and Interrupt Processing
Input/Output Processing
Address Space Control
Name Space Control
Initializer Operation
Answering Service Operation
Resource and Logical Volume Control

F81 Multics Failure Analysis and Recovery

Duration: Five Days

Intended For: Personnel who must analyze and recover from Multics system failures.

Course Synopsis: This course discusses the procedures and facilities available for analyzing and recovering from total failure of the Multics system, or from the failure of isolated hardware or software subsystems.

Objectives: Upon completion of this course, the student should:

1. Know procedures for recovering from system failures or subsystem failures.
2. Know how to analyze the dumps taken when the Multics system or subsystem fails (crashes).
3. Know how to use Multics tools to help analyze and trap system failures.
4. Know what tools can be used to correct or bypass failures.

Prerequisite: Multics Process Management Analysis (F80), plus Operator Training (F68)

Major Topics: Procedures for Failure Recovery
Crash Analysis
Analysis and Recovery Tools

F86 Multics Communication System (MCS) Concepts and Implementation

Duration: Five Days

Intended For: Personnel who must understand the communication capabilities of the Multics system in order to implement an MCS configuration.

Course Synopsis: This course presents an overview of the Multics Communications System (MCS). It describes what kinds of terminals, modems, and communications protocols MCS supports, what equipment options are required, and how MCS can be configured to optimize its communications capabilities.

Objectives: Upon completion of this course, the student should:

1. Know how Multics uses the Front-End Network Processor (FNP).

2. Know what kinds of communications equipment and communications protocols MCS supports.

3. Know how to define a communications configuration to be used on Multics.

4. Know how to configure the FNP to support a given communications configuration.

5. Know how to tailor the MCS software to optimize MCS performance.

6. Know how to set the terminal control tables used by a given process to optimize the performance of a given terminal.

7. Know how an intermediate I/O module can be written to provide interim support for terminals not officially supported by Multics.

Prerequisite: Communication Concepts (G60) and Multics Concepts and Utilization (F01)

Major Topics:
MCS Operation
Terminals, Modems and Protocols
Channel Master File
FNP Configuration
MCS Configuration
Terminal Control Tables
Intermediate I/O Modules

F90 GCOS Environment Simulator Utilization

Duration: Three Days

Intended For: Personnel who want to execute GCOS applications using the Multics system.

Course Synopsis: This course presents an overview of the GCOS Environment Simulator subsystem, describes how to use the simulator, and outlines the way in which the simulator maps the GCOS environment onto the Multics environment. Interactive workshops are included to reinforce the material presented.

Objectives: Upon completion of this course, the student should:

1. Know how the GCOS Environment Simulator simulates the GCOS environment on Multics.

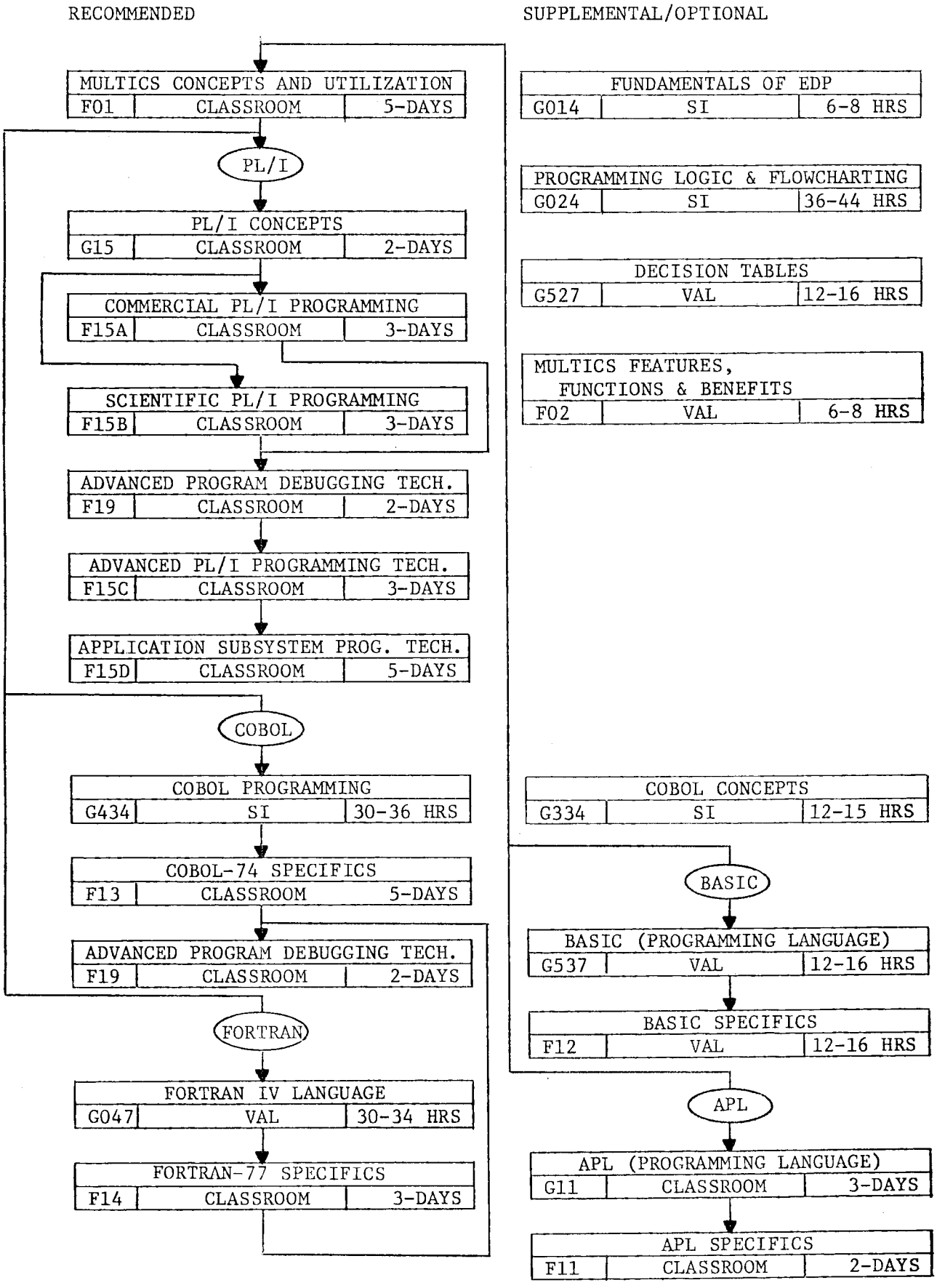
2. Know how to login to Multics and execute GCOS applications programs.

Prerequisite: Multics Concepts and Utilization (F01)

Major Topics:
Overview of the Simulator
Simulator Operation
GCOS Utilities
Mapping of GCOS onto Multics
GCOS Daemon

LANGUAGES

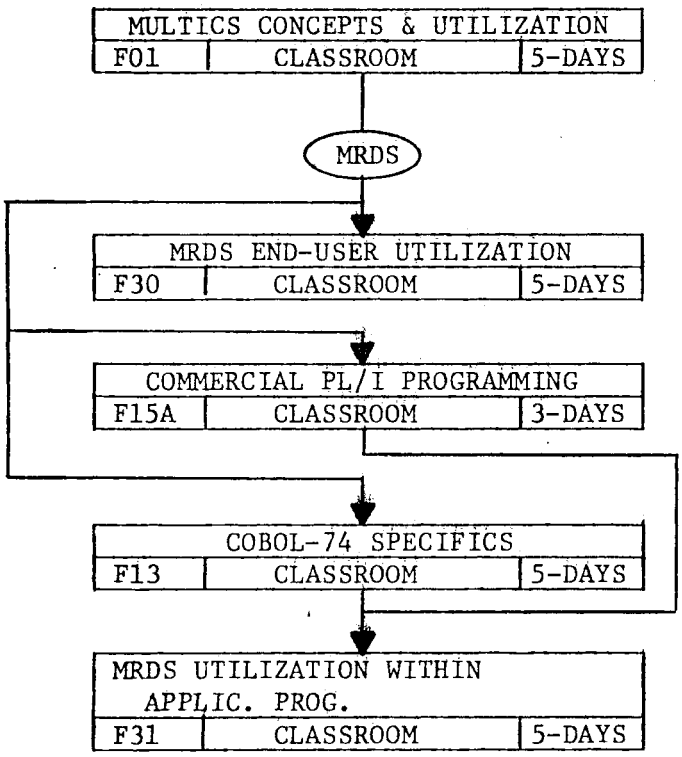
COURSE SELECTION GUIDE



DATA BASE

COURSE SELECTION GUIDE

RECOMMENDED



SUPPLEMENTAL/OPTIONAL

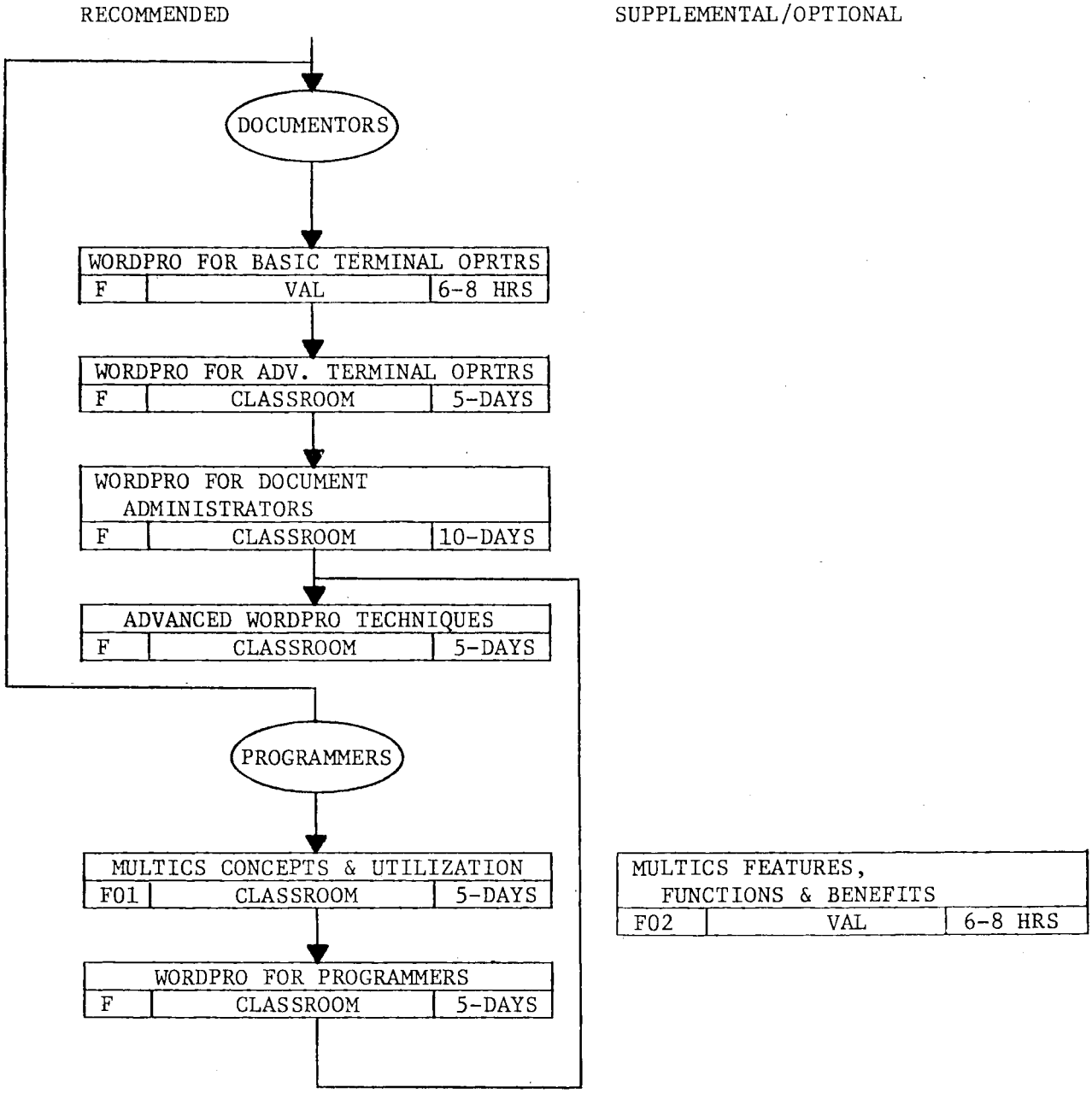
FUNDAMENTALS OF EDP		
G014	CLASSROOM	6-8 HRS

MULTICS FEATURES, FUNCTIONS & BENEFITS		
F02	VAL	6-8 HRS

DATA BASE CONCEPTS		
G078	1BR	1-HR

WORD PROCESSING

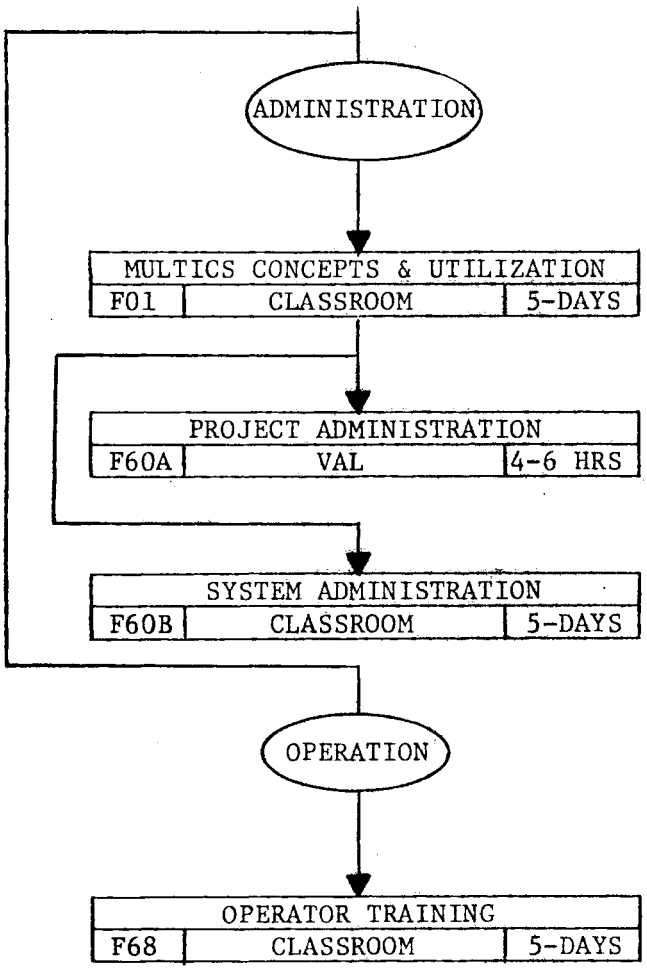
COURSE SELECTION GUIDE



ADMINISTRATION AND OPERATION

COURSE SELECTION GUIDE

RECOMMENDED



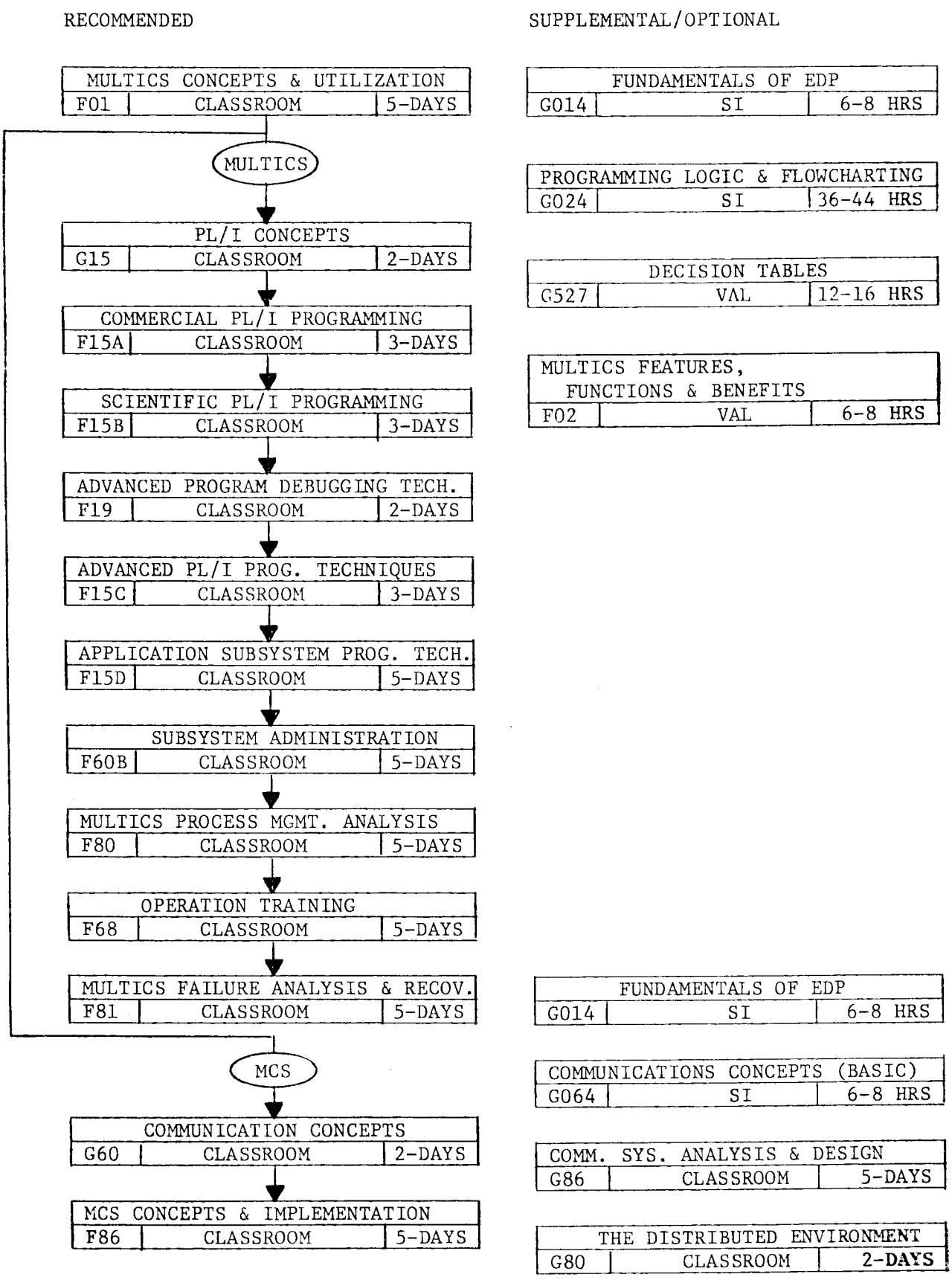
SUPPLEMENTAL/OPTIONAL

FUNDAMENTALS OF EDP		
G014	SI	6-8 HRS

MULTICS FEATURES, FUNCTIONS & BENEFITS		
F02	VAL	6-8 HRS

OPERATING SUPERVISOR & COMMUNICATIONS

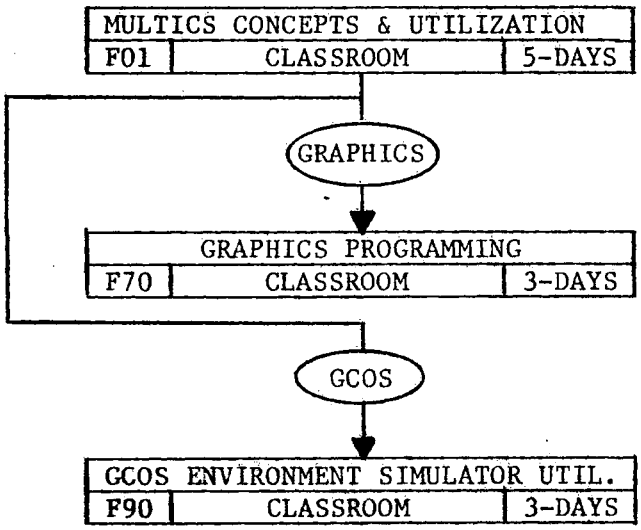
COURSE SELECTION GUIDE



APPLICATIONS AND MISCELLANEOUS

COURSE SELECTION GUIDE

RECOMMENDED



SUPPLEMENTAL/OPTIONAL

MULTICS FEATURES, FUNCTIONS & BENEFITS		
F02	VAL	6-8 HRS