



ONTARIO DEPARTMENT OF EDUCATION

CURRICULUM RP-33

# DATA PROCESSING

1966



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OR	
V.2 Unit Record Fundamentals	19

### NOTE:

It is expected that Part I would be offered in Grade 10. Part II would be offered in Grade 11 and Part III in Grade 12. For those schools with equipment devoting double time to Data Processing, Part IV may be offered as the second option in Grade 11 and Part V.1 *or* V.2 in Grade 12. The suggested allotment of time for any one part is one year at five periods per week.

## FIVE-YEAR PROGRAMS

I One-Year Business Option	
Computer Concepts	21
II Business Data Processing	23
(Prerequisite: Computer Concepts)	

## SPECIAL COMMERCIAL DATA PROCESSING 24

A. Introduction to Computer Programming	25
B. Computer Fundamentals	26
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D.1 Business Systems Programming	26
OR	
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### NOTE 1:

Where all four courses are offered, Part A. and Part B. would be semestered. Part C. would be given throughout the year as would Part D.1 *or* Part D.2 depending on the equipment available. The suggested time allotment for any one part is 5 periods per week per year.

### NOTE 2:

It is expected that where three courses (fifteen periods per week per year) are offered that Part A. and Part C. would be semestered. Part B. *or* Part D.2 would continue throughout the year.

## REFERENCES

## INTRODUCTION

In introducing Data Processing courses to the Business and Commerce curriculum it is realized that this subject is relatively new and considerable experimentation will be necessary before entirely satisfactory courses of study emerge. It is also realized that the rapid improvement in technology in the area of Data Processing will make changes in the courses inevitable. The content of these outlines, therefore, is to be considered as a guide and it is hoped that teachers will offer suggestions for improvement.

It is essential to a proper implementation of the courses that special attention be given to the provision of adequately trained teachers. As with all new subject areas, teachers initially may have difficulty in imparting newly-gained information to their students. Gradually, however, as a new repertory of approaches and methods is assembled, a core will be formed around which meaningful instruction may be based.

It should be recognized that the courses have been written with the thought in mind that equipment may not always be available.

Local needs should be considered before any plans are made for the introduction of these courses.

## FOREWORD

Most experts agree that within a few decades more sophisticated methods of processing data will be used by everyone in our society. The more effectively we use these new tools to produce and store information, and the more skillfully we use the resultant knowledge, the greater the benefit to all society.

These new information resources will change our economic production and distribution patterns, our social institutions and the ways in which the individual relates to his environment. More and more business, industrial, and governmental organizations use computers to collect, process, control and store information as feedback from their complicated network of information channels. Management now has the tool of instant information upon which to base decisions and policies, and the ability to test the results of these decisions.

A careful analysis of employment trends in data processing indicates that employment opportunities will expand rapidly during the next decade. Students trained in the basic concepts will have increasing opportunities in jobs ranging from machine operators to system designers.

Experimental classes in Data Processing in Secondary Schools have shown that students enjoy the challenge of automation, and acquire sufficient understanding and skill to gain and maintain employment in a variety of data processing jobs.

Thus, a committee composed of teachers of this subject, outstanding representatives from business firms, professors of the colleges of education, and members of the Department of Education met to develop the following courses.



## FOUR-YEAR PROGRAMS

### I PRINCIPLES OF DATA PROCESSING

#### GRADE 10

#### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

1. Demonstrate man's need of and use of current information
2. Demonstrate an understanding of the basic concepts of Data Processing — manual, electro-mechanical and electronic
3. Demonstrate a knowledge of the evolution of the computer, and an understanding of its function and uses in today's society
4. Demonstrate a sound grasp of the terminology of Data Processing
5. Appreciate that in today's world, education is a continuing process

#### METHODS OF PRESENTATION

1. Assignments such as required reading, oral presentations and programmed texts could be introduced to extend the student's general knowledge
2. Flowcharting techniques should be introduced early in the course. These can then be used as a vehicle in presenting the phases of data processing in Sections 4, 6, 11
3. Students should spend a considerable amount of time gaining practical experience on available equipment. Where the school offers courses in Grades 11 and 12, it is recommended that students will have been taught to keypunch

4. Illustrate topics by using films, slides, T.V., field trips, machine demonstrations, guest speakers

5. As data processing terminology affects all areas of business, it should be stressed throughout the course. It is suggested that the students maintain a glossary of important terms and relative examples

#### TOPICS

*\* Approximate Percentage of Time*

*\* 3%*

1. Man and His Environment  
Adjustment to the environment, adaptation techniques developed through experience, patterns of communication, accumulation of facts, processing and compiling information to assist in making decisions for further adaptation
  - i) Development of survival techniques: accumulation and transfer of knowledge
  - ii) Development of the need to communicate: expressed by symbolic representation of states of being — language, numbers
  - iii) Development of methods of assembling, writing and recording information: records on stone, clay tablets, paper, disk, tape
  - iv) Development of systems to express specialized information: weights, measures, money, maps, accounting
  - v) Development of automation: sail, pump, gear, lever, wheel, tread-mill, pulley, furnace, chute (inclined plane), sluice, water-mill, lightning rod, turbine, thermostat, conveyor belt, elevator, computer

\*6%

## 2 Development of Devices to Improve Information Processing

- A) Abacus, Napier's bones, Pascal's gears, slide rule, manual calculators, electro-mechanical calculators, tabulating equipment, electronic calculators, computer, printing press, typewriter, carbon paper, window envelopes, rubber stamp, writing board, duplicators, charge plate, addressing equipment, postage meters
- B)
  - i) Development of data reservoirs: human memory, books, libraries, film, slides
  - ii) Development of source documents: student enrolment forms, census, driving permits, time cards, sales slips
- C) Development of retrieval and processing techniques: problems presented by volume:
  - i) Physical — effort of collecting and processing volumes of data
  - ii) Cost — expensive, trained personnel required
  - iii) Possibility of error — routine work
  - iv) Need for up-to-date, significant information
  - v) Scientific and mathematical complexities — space program
- D) Simple modern devices for solving problems created by volume:
  - i) Turnstiles, supermarket check-out, registers, traffic counters

\*1%

## 3 Data Processing

- A) Factors of a system:
  - i) Input
  - ii) Storage
  - iii) Manipulation: sorting, collating, tabulating, calculating, summarizing
  - iv) Output: printing and reporting
  - v) Control function

\*20%

## 4 Manual and Mechanical Methods

- A) To illustrate the basic factors of input, storage, manipulation, output and control, choose and expand a topic such as payroll, sales analysis, invoicing. Where equipment is available, have students follow through a writing board, summary strip, edge-punched card, duplicating, bookkeeping machine approach. Flowchart the above procedures
- B) Advantages
- C) Disadvantages

\*22%

## 5 Electro-mechanical Methods

- A) Equipment: need, type of equipment, advantages, demonstration if equipment available
- B) Input:
  - i) The Punched Card:
    - a) History: Hollerith, Powers
    - b) Characteristics: rows, columns, zones, edges
    - c) Card interpretation
    - d) Recording of information onto a card: numeric, alphabetic and special character codes in use; card identification, card preparation and card reading
    - e) Principles of card planning and layout: definition of card fields, planning of card fields, overcoming limitations of card capacity
    - f) Punching of cards: keypunching, summary punching, reproducing, media conversion
  - ii) Punched Paper Tape
  - iii) Mark Sensing
- C) The card as a storage device
- D) Manipulation:
  - i) Sorting:
    - a) Purpose
    - b) Sequential sorting, numeric
    - c) Sequential sorting, alphabetic
    - d) Selective sorting
    - e) Introduce the theory of alphabetic, numeric, and selective sorting through experimental approach and graphic illustration
  - ii) Collating:
    - a) Merging
    - b) Matching
    - c) Sequence checking
    - d) Selecting
    - e) Use practical exercises with electro-mechanical equipment or needlesort
  - iii) Calculating: Principles of operation: addition, subtraction, multiplication and division
- E) Output:
  - i) Printing:
    - a) Principles of operation
    - b) Line printer versus typewriter: speeds and types
    - c) Group printing and detail printing
    - d) Form feed techniques: types, spacing and control
  - ii) Tabulating:
    - a) Principles of operation: control punch, use of registers for accumulating, transferring
    - b) Summary punching



- F) Control function: use of control panel for tabulating, calculating, printing

\*10%

6 Summary, Review and Application

Apply an exercise used in Unit 4A) to unit record methods. (NOTE: Where tabulating equipment is not available, the exercise will enable purposeful work to be carried out in card planning and preparation, sorting requirements, and the design of forms on which output may be printed. Where tabulating equipment is available, a run-through should be undertaken.) Flowchart above procedures.

\*8%

7 Introduction to Electronic Computers

- A) Review fundamental concepts of unit 2C)
- B) Classification of Computers:
- i) Fundamental Uses of Computers: business, scientific, telecommunications — real time
  - ii) Types: digital, analog, hybrid
  - iii) General Comparison of Computers as to:
    - a) Speed
    - b) Size
    - c) Cost
- C) Advantages of the computer: speed, accuracy, storage capacity, random selection capabilities, versatility of application
- D) Limitations of the computer: complete dependence on pre-written instructions (explanation of a program), inability to meet unanticipated situations, need for accurate input (example, GiGo)
- E) Block diagram of computer: explain in terms of input, central processing, output and auxiliary storage. Trace typical path of information processing through a computer using the block diagram as sectionalized above

\*2%

- 8 Coding: Hollerith, binary coded decimal (BCD), alphabetic characters and symbols

\*5%

9 How the Computer Works in its Simplest Form:

Explanation of basic machine language instructions (example, add, subtract, print, etc.) with special emphasis on compare and branch instruction

\*2%

10 Computer Input Media:

Punched cards reviewed, punched paper tape, con-

sole input capabilities, optical reading of machine and manually prepared data, magnetic ink character recognition (MICR), magnetic tape input, concept of compatible machines, development of communications networks in electronic data processing

\*4%

11 Central Processor

Use a simple illustration of the inter-relationship of the components of the steps in process of the Central Processor using an analogy such as 'Baking a Cake.' Flowchart procedure.

- A) Control Unit: compare control panel in unit record equipment with computer control by internally stored program
- B) Arithmetic Unit: electronic version of mechanical calculator by use of specialized electrical circuits
- C) Storage Unit: purpose of storage, many forms of storage

\*5%

12 Storage Devices: advantages and disadvantages

- A) Early devices: electrostatic, delay lines, electronic tubes
- B) Magnetic cores
- C) Magnetic tape
- D) Magnetic drums
- E) Magnetic disks
- F) Magnetic cards
- G) Latest developments

\*3%

13 Manipulation

- A) Sorting: external, internal
- B) Tabulating, calculating, summarizing — internally through interplay of control, arithmetic, and storage units
- C) File maintenance

\*2%

14 Output Media and Data Presentation

- A) Printers: types and speeds, function as printer only (as opposed to tabulator or calculator), report preparation as a function of the control program



- B) Other devices: magnetic tape, paper tape, cards, console, multiple output and communication link

\*5%

#### 15 Number Systems

Binary: need, addition, subtraction, multiplication, division, conversion from decimal to binary, binary to decimal, conversion from binary to octal, octal to binary, hexadecimal

\*1%

#### 16 Important Uses of the Computer in Today's Society

- A) Compilation of information required by managers and owners of corporate enterprises as well by government agencies
- B) Aid to decision making by rapid and accurate assembly of pertinent information and by simulation of alternate courses of action
- C) Determination for a given project or enterprise of the most efficient utilization of available resources of materials, equipment and man-power
- D) Determination of optimum levels of business investment in inventory and most desirable re-order points, scientific forecasting of demand
- E) Air-line and hotel reservation systems
- F) Automation of factory production equipment: for example, oil refineries
- G) Evaluation of engineering designs: for example, bridges, aircraft
- H) Operational control of space-craft

NOTE: Students should be encouraged to present examples of these and other uses.

\*1%

#### 17 Forecast of vocational opportunities in the data processing field

## II BASIC PROGRAMMING GRADE 11 SINGLE OPTION

### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Flowchart and write a program for a computer in a higher level language such as COBOL to perform the following functions:
    - A) Arithmetic
    - B) Branching
    - C) Counting and Looping
    - D) Data Movement
    - E) Address Modification
    - F) Writing a subroutine and creating linkage to and from it
    - G) Input/Output: card, tape, printed
  - 2 Test and produce a running program using a testing system
  - 3 Produce documentation to adequately describe this program
- i) Define Data Processing into five areas: Input, Manipulation, Storage, Output, Control
  - ii) Show variations possible for Data Processing using Card Readers, Punches, Tape Units and Direct Access devices attached to a Central Processing Unit
  - iii) Demonstrate a simple application on the computer to show the speed and versatility of the machine

### METHOD OF PRESENTATION

The teacher should keep clearly in mind that *the object of this course is to teach basic programming*. Only enough of the vehicle language chosen (i.e., COBOL, Fortran, PL/1, Machine Level Language, Autocoder etc.) should be presented to allow the student to write the needed program.

### TOPICS

- 1 Introduction
- A) Review Data Processing concepts covered in Grade 10
- B) Presentation of programming topics:
  - i) Appropriate problems to illustrate each topic
  - ii) Sequence: define operation to be performed by machine, present flowchart symbols and techniques, study language features, assign student problem (flowchart, code)
  - iii) Periodic testing and debugging of selected practice problems using appropriate testing systems.
- C) Charts 1, 2 and 3 give suggested language topics for each of the programming topics, COBOL, Fortran,

PL/1 (Similar charts can be constructed for other programming languages)

### 3 Program Testing Techniques

- A) Before testing sessions, the following topics should be covered:
  - i) Desk checking
  - ii) Error messages on compiling
  - iii) Test data preparation
  - iv) Control cards for testing system
  - v) Test runs
  - vi) Correction and re-run

### 4 Documentation

- A) Data (System) Flowchart
- B) Program Flowchart
- C) Operating Instructions

# CHART 1

## COBOL

TOPIC SEQUENCE	1	2	3	4	5	6	7	8	9	10	11
	Basic I/O	Data Movement	Comparing & Branching	Basic Arithmetic	Advanced Arithmetic	Data Formatting	Reading Serial Records	Looping & Counting	Address Modification	File Formats	Subroutines
FLOWCHARTING											
Basic Symbols and Flow	X										
Decision Symbols			X								
Program Modification									X		
Terminal							X				
Connectors			X								
Predefined Process (Subroutine)											X
DATA DIVISION											
File Description		X					X			X	
Record Description							X		X		
Editing Clause or PICTURE	X			X	X	X					
	X			X	X	X					
FILLER		X									
WORKING-STORAGE	X	X									
PROCEDURE DIVISION											
Input/Output Verbs	X						X				
MOVE		X									
Arithmetic Verbs or COMPUTE				X	X						
				X	X						
GO TO			X								
PERFORM											X
STOP			X								
IF (Conditional)			X				X	X			
Literals			X								



## CHART 2 FORTRAN

[illegible]

# CHART 3

## PL/1

TOPIC SEQUENCE	1	2	3	4	5	6	7	8	9	10	11
	Basic I/O	Data Movement	Comparing & Branching	Basic Arithmetic	Advanced Arithmetic	Data Formatting	Reading Serial Records	Looping & Counting	Address Modification	File Formats	Subroutines
FLOWCHARTING											
Basic Symbols and Flow	X										
Decision Symbols			X								
Program Modification									X		
Terminal							X				
Connectors			X								
Predefined Process (Subroutine)											X
DATA SPECIFICATIONS											
Declare	X	X	X	X	X	X	X		X	X	
STATEMENTS											
I/O Statements	X						X				
Assignment		X		X					X		
Arithmetic Expression				X	X				X		
Go To			X					X			
Do								X	X		
If			X					X			
Stop			X								
Procedure	X										
End	X										
Literals			X								
Format						X					
Call											X
Return											X

### III SYSTEMS DESIGN

#### GRADE 12

#### SINGLE OPTION

#### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Design a computer system for given Input/Output and procedure specifications
- 2 Document the design

#### METHODS OF PRESENTATION

- 1 Choose a case study within the experience of the student to introduce and illustrate design concepts
- 2 Develop design of the system from the case study for application using sequential processing. Using similar methods develop a system for application using direct access processing

#### TOPICS

- 1 Systems Design for Sequential Access for example, tape system
- A) Output of System: documents prepared by a Data Processing system containing information supplied by the system or information which the system is held responsible for supplying
  - i) Customer Document:
    - a) Examine document for recorded information, e.g. name and address, amount owing, discount
    - b) Discussion of documents to determine following information: form utilized, information recorded, source of each field of information on document, purpose, frequency of preparation, time period covered by document, method of preparation, number of copies prepared, use made of each copy, checking procedures
  - ii) Company Record:
    - a) Information required to prepare customer document, e.g. name and address, amount of usage, amount owing, payments, due date, date paid, rate of discount
    - b) Discussion of records to determine following information: form utilized, information recorded, source of each entry, purpose of record — what (if any) reports prepared, frequency of postings, method and frequency of summarizing posted data, methods of verifying posted data, frequency of use, retention period
- B) Input to System: Source documents as initial forms on which transaction data is transcribed to introduce new information into the system
  - i) Types of transactions:
    - a) Monthly purchase
    - b) Payments
    - c) Change to customer list, e.g. new customer, service cancelled
  - ii) Discussion of transactions to determine following information: form utilized, information entered on form, source of each field of information, use made of each piece of information, information transcribed (to other reports, records, or forms), volume of usage, responsibility for preparation
- C) Processing required to produce Output from Input:
  - i) Review systems flowcharting symbols; purpose
  - ii) Develop steps of procedure in flowchart form
  - iii) Discussion of processing to determine following information: procedures — mechanical and clerical, computations and other factors involved in them, exception processing, quantity of work performed and time required for each procedural step, Input/Output scheduling — when source



documents available for processing, when reports ready for distribution

- D) Controls: types of controls introduced into a system vary with application
- i) Overall accounting crossfoot control to prove the validity of entire job
  - ii) Validity checks for value, limit, and sequence
  - iii) Control totals, item or record counts, hash totals, dollar totals:
    - a) To verify no information lost from one step to another
    - b) To verify all input received, e.g. batch control
    - c) To record amount of output produced, e.g. record count
  - iv) Retention cycle checks
  - v) Control on origination of source data:
    - a) Use of pre-numbered documents, e.g. receipts, invoices
    - b) Double checking manual operations
    - c) Key punching controls: verification, batch total cards, check digits
  - vi) Auditing consideration: system to contain provisions adequate to allow establishment of an audit trail from origin of transaction to final effect of transaction on Data Processing system

E) Forms Design: examination of forms and discussion of source documents and forms used for Input/Output

- i) Source Documents: initial forms on which transaction data transmitted to introduce new information into system
  - a) Methods for designing easily completed forms:
    - Minimize amount of recording to be done: consolidate forms when possible, preprint where possible to eliminate recording of standardized information, use as much multiple choice as possible to avoid ambiguity or omission of data, make amount of information the respondent fills in as short as possible, consider space required to transcribe data requested
    - Arrange fields on form so respondent works through form straightforwardly: design form to be filled out from left to right or from top to bottom, cluster area in which information to be inserted, sequence fields to follow work flow, arrange information requests in familiar sequences (e.g. street, city, province, month, day, year), arrange fields so those always completed appear on the left of the form, those usually completed appear on the middle, and those seldom completed appear on the right, arrange fields in related documents in same order

- Make instructions for filling out the form meaningful: where possible, combine instructions with questions; where questions and instructions take up more than one side of a sheet of paper, put questions on one side and instructions on the other

b) Filing considerations:

- Standardized form sizes to be selected for filing ease; problems of non-standard binders and filing cabinets
  - Placement of form identification: at top of form if filing in file cabinet, in upper right corner if form bound on left in binder, on bottom if form bound on top
- c) Other considerations:
- If card input for computer to be punched directly from form, design to facilitate keypunch, e.g. place card column numbers under fields on form
  - Handwritten forms to be avoided
  - Typed form to be designed for ease of machine use: form to be all single spaced or all double spaced but not in combinations, margins to be standardized to avoid resetting of margin controls, form to be designed for typing straight across (designs requiring typist to back-up to be avoided, number of skips to be minimized, number of carriage returns to be minimized)

ii) Card Input:

a) Layout:

- Fields to be arranged so keypunch operator punches card by reading source document from left to right or from top to bottom
- Card design to take advantage of features of equipment used: group alpha information and numerical information, group columns not being used at end of card, group duplicated columns together, use intermediate transmittal form (coding sheet) if conflict between designing source document to make it easy to fill out and design card so keypunch utilization optimized
- Fields to be large enough to accommodate maximum number of digits
- Some control on card to enable tracing to source document
- Right-justification in fields to be minimized
- Variability of format among different card types to be minimized
- A card, if possible, to be a single unit — the documentation of *one* transaction; in some cases the necessity for header and trailer cards

iii) Output Forms:

- a) Decision to use pre-printed forms or blank stock:
  - Requirements of recipient may necessitate pre-printed forms



- Form may be so complicated that blank stock impractical: too many columns across page, too much information required in captions, public relations considerations, volume and frequency of form
- b) Printer use to be optimized:
  - If possible, print forms two or three up
  - Design the forms to require least number of lines printed per document
  - Standardize left margins on output forms
  - Standardize form widths where possible
  - Use multiple part forms with strip carbons to produce only required selections of original on copies
- c) Storage and filing requirements of form to be considered
- d) Captions to be easily understood; important items or sections to be emphasized
- iv) Colour Coding on Forms and Cards: advantages
- v) Coding Systems:
  - a) Characteristics of a code:
    - Flexibility — a coding structure must provide for expansion of items within categories
    - Scope — to cover all uses to which the code may be put
    - Operation — to be adequate for all operations where used
    - Convenience — to be easy to assign, write, transcribe and check
    - Uniqueness — to distinguish each case from all other cases
    - Classification — to facilitate classification of like terms
    - Identification — to facilitate visual identification of an item
  - b) Types of coding systems:
    - Alphabetical codes
    - Alphanumeric codes
    - Decimal codes
- F) File Consolidation:
  - i) Current master files to be consolidated as much as possible, preferably into one file
  - ii) Advantages of Consolidation:
    - a) Elimination of duplication of information, especially in area of identifying data
    - b) Elimination of duplication of coding and logic problems
    - c) Increased control and lesser maintenance
    - d) Reduction in tape inventory
- G) The Division of Processing into Runs:
  - i) Computer running time and handling time to be minimized:
    - a) Passing of master files to be minimized (blocked/unblocked records)
    - b) Output of one run to be input to next run
    - c) Output forms on printer to be changed as infrequently as possible
    - d) Expand or lengthen records after sorting where possible
  - ii) Runs to be designed so each run performs distinctive functions. Typical systems usually include the following run types:
    - a) Input run, e.g. card-to-tape run
    - b) Sort run
    - c) File maintenance or update run
    - d) Processing run
    - e) Output run, e.g. print run
  - iii) All operations dependent upon a particular file to be confined to the same run
  - iv) Run and job timing methods
- H) Master Record Design: design of record is machine oriented and is a function of the computer characteristics. Design considerations include: necessary basic or identifying information, necessary processing information, kind of record key required (identification), sorting of records, provisions for growth and expansion space, calculations to be performed from information on record
- 2 Systems Design Using Direct Access Devices e.g. Disk or Card
- A) Implementing of System: (Note: Students may use previously designed system)
  - i) Programming: Runs as designed to be programmed for computer
  - ii) Conversion: Master files to be created for new system
  - iii) New System Documentation:
    - a) Preparation of clerical procedures
    - b) Define procedures required to originate data for the system, to investigate and correct errors thrown out by the system, and to handle and distribute reports and records turned out by the system
    - c) Systems flowchart and written descriptions
    - d) Detailed block diagrams of individual runs
    - e) Operating instructions
  - iv) Testing the System:
    - a) Testing the new system to determine whether it performs as it should:
      - Run debugging — testing the individual runs with contrived test cases
      - System checking — testing all runs as a total system with contrived test cases
      - Volume testing — testing the system with “live” data

- Parallel operations – running the new system and the previous system simultaneously and comparing outputs
  - v) Administration: development of a timetable for implementation and assignment of jobs specified
- 3 System Investigation: relate System Design stage back to initial investigation or fact-gathering stage
- A) Information and documents to be gathered:
- i) General background information about the business:
    - a) History of the business: reasons for starting company, founders – when, where, growth history of plant and employees, major milestones in development; sources of information – annual reports, employee orientation handbooks, interviews with top management, copies of management speeches
    - b) Products and/or services and customers: products produced or offered, services offered, recipients of outputs, numbers receiving products and services; sources of information – sales catalogues, publicity releases
    - c) Materials and Suppliers: who, kind of products or services offered, annual dollar value of products and services of various suppliers; sources of information – purchasing departments, accounts payable departments
    - d) Resources of the business: personnel resources, turnover in personnel, inventory resources, physical facilities; sources of information – organization charts, balance sheets, plant layouts and floor plans, inventory reports
    - e) Objectives and goals of the business: planned sale increase, changes in product lines contemplated, branch office expansion; sources of information – personal interviews
  - ii) Operational information about the data processing area:
    - a) Output of the current system (see section 1A)
    - b) Input to the current system (see section 1B)
    - c) Processing required to produce output from input (see section 1C)
    - d) Organization performing the processing: why – guide in interviewing; what – organizational structure; sources – organizational charts
    - e) Policies and regulations under which the system operates: governmental regulations, management policies
    - f) Quality of output produced: degree of error tolerance, areas in which mistakes initial, current controls on output quality, problem areas, *ideal* system
- B) Information gathering methods:
- i) Review of documents:
    - a) Organization charts
    - b) Job descriptions
    - c) Flowcharts
    - d) Decision Tables
  - ii) Interviews:
    - a) Formal
    - b) Informal
- C) Documentation of results of investigation:
- i) Written descriptions
  - ii) Samples of all reports, records and forms
  - iii) Block diagrams of existing procedures
  - iv) Controls in present system
  - v) Documentation on decisions affecting systems design
- 4 System Analysis: relate system design stage back to analysis of investigation phase
- A) Objectives of analysis to pin-point problem areas to improve operations and decrease costs
- i) Analysis in terms of inputs, outputs, procedures:
    - a) Units to be standardized
    - b) Superfluous data to be eliminated
    - c) Inadequate or excessive controls
    - d) Unnecessary duplication of information on reports or records
    - e) Unnecessary forms
    - f) Unnecessary procedures
    - g) Policies to be changed or adjusted
    - h) Number and type of personnel available to implement and operate new system
  - ii) Analysis and definition of future objectives:
    - a) Can system be expanded to handle future growth
    - b) Can expected modifications to system be incorporated
- B) Documentation of results of system analysis:
- i) Proposals presented to be studied
  - ii) Proposals adopted confirmed in writing
  - iii) Proposals rejected with reasons for rejections, confirmed in writing



# IV COMPUTER FUNDAMENTALS

## GRADE 11

### DOUBLE OPTION

#### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Describe these functions of a computer's central processing unit:
  - A) Data Representation (coding methods) and Conversion
  - B) Storage and data handling
  - C) Instruction formats
  - D) Addressing of instruction and data
  - E) Instruction execution and data flow
  - F) Program Switching and Address Modification
  - G) Buffers, channels and interrupt
- 2 Describe the function, operation and characteristics of the following Input/Output devices:
  - A) Card Readers
  - B) Card Punches
  - C) Printers
  - D) Consoles
  - E) Magnetic Tape
  - F) Direct access
- 3 Calculate the operation time:
  - A) Of the individual operations such as add, multiply, for a representative computer
  - B) For the reading or writing of a record using any of the Input/Output devices listed in section 2
- 4 Describe the basic programming systems available for a computer along with the function and use of each

#### METHOD OF PRESENTATION

Each operation of the central processing unit can be illustrated using the console of the accessible lab machine. Small programs in machine language to illustrate these operations should be available to the teacher. The student could then step the operation through on the machine using the single cycle keys.

#### TOPICS

- 1 Introduction
  - A) Review of computer topics covered in Grade 10
  - B) History of computers
- 2 Basic functions and components of a computer system
  - A) Input units
  - B) Output units
  - C) Central processing unit
- 3 Data representation
  - A) Discussion of need for data representation (human language vs machine language)
  - B) Coding systems:
    - i) Hollerith
    - ii) BCD
    - iii) Byte
    - iv) ASC II
    - v) 4 bit BCD
    - vi) Bi-Quinary
    - vii) Qui-Binary
    - viii) Binary

- c) Binary Arithmetic
  - d) Numbering systems:
    - i) Binary
    - ii) Octal
    - iii) Decimal
    - iv) Hexadecimal
  - e) Fundamental method of converting for any numbering system
- 4 Storage and data handling
- A) Storage:
    - i) Coding methods for card, tape, direct access and memory
    - ii) Core characteristics
  - B) Data handling:
    - i) Ways of moving, grouping and referring to information using Input/Output devices and main memory
- 5 Instruction formats and addressing
- A) Types of addresses:
    - i) Direct addresses
    - ii) Indirect addresses
    - iii) Implied addresses
  - B) Types of formats of addresses:
    - i) Data addresses
    - ii) Instruction addresses:
      - a) Instructions addressed sequentially
      - b) Instructions addressed non-sequentially
    - iii) One, two, and three address machines
    - iv) Variable length instructions
- 6 Instructions execution and data flow for various types of instructions. For topics A), B), C) a particular computer should be chosen to illustrate these points. This can be a real or hypothetical machine.
- A) Basic registers:
    - i) Instruction counters
    - ii) Data address
    - iii) Operation code
  - B) Method of instruction pickup and interpretation
  - C) Data flow through machine registers
  - D) Input/Output commands
    - i) Card reading
    - ii) Punching and printing
    - iii) Tape
    - iv) Direct access
    - v) Typewriter
- E) Arithmetic units and commands:
    - i) Representation of negative numbers
    - ii) Algebraic addition and subtraction
    - iii) Re complementing
    - iv) Serial and parallel adders
    - v) Multiplication and division
    - vi) Fixed Point instructions
    - vii) Floating Point instructions
  - F) Data movement commands:
    - i) Fixed word, single address
    - ii) Variable word, single address
    - iii) Variable word, two addresses
  - G) Logic and control commands:
    - i) Unconditional branch
    - ii) Conditional branch
    - iii) Logical compare
    - iv) Algebraic comparisons
    - v) And/or logic (optional)
- 7 Program Switches
- i) Devices built into hardware for switching
  - ii) Other methods that can be used
- 8 Address Modification
- i) Changing the actual instruction
  - ii) Indirect addresses
  - iii) Index registers
  - iv) Subroutine linkage
- 9 Special commands (optional)
- i) Table search
  - ii) Data formatting for printing
- 10 Input/Output Devices
- A) Readers:
    - i) Serial
    - ii) Parallel
    - iii) Timing
  - B) Punches:
    - i) Separate units
    - ii) Associated with readers
    - iii) Timing
  - C) Printers:
    - i) Wheel
    - ii) Chain
    - iii) Bar
    - iv) Timing
  - D) Consoles:
    - i) Control functions
    - ii) Data entering



- E) Magnetic Tape:
  - i) Coding
  - ii) Operation
  - iii) Checking
  - iv) Timing
- F) Direct Access Devices:
  - i) Physical structure
  - ii) Coding of data
  - iii) Access methods (organization)
  - iv) Timing

## 11 Buffers, Channels and Interrupt

- A) Buffers:
  - i) Function
  - ii) Data Flow
  - iii) Timing
- B) Channels:
  - i) Function
  - ii) Data Flow
  - iii) Timing
- C) Interrupt:
  - i) Function of special hardware
  - ii) Programming necessary
  - iii) Timing (optional)

## 12 Programming systems

- A) Monitors:
  - i) Purpose
  - ii) Organization
- B) Utilities routines:
  - i) Loading
  - ii) Input/Output
  - iii) Memory print
  - iv) Testing
  - v) Sorting
- C) Subroutine libraries:
  - i) Types available
  - ii) Methods of using
- D) Program Compilers:
  - i) Types available
  - ii) Method of using

# V.1 BUSINESS SYSTEMS PROGRAMMING GRADE 12 DOUBLE OPTION

## OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Write programs in the programming language chosen to accomplish the following operations on a computer equipped with either card, tape, or direct access Input/Output devices as the file medium
  - A) File maintenance
  - B) Data editing
  - C) Report preparation
- 2 Test and debug any of the above programs using a testing system
- 3 Describe the components and functions of a monitor system
- 4 Describe the basic methods used for sorting on tape and direct access systems
- 5 Describe and demonstrate the methods of data validation and system control

## METHODS OF PRESENTATION

- 1 If a computer equipped with tape or card is available, stress parts i-xii of suggested sequences
- 2 If a computer equipped with direct-access is available, stress parts i-iii and xiii-xxiii
- 3 Use case studies to present sections iv to xii, xiii to xxiii. Depth of detail to be determined by case study used, and taught when information required to proceed to next phase

## SUGGESTED SEQUENCE OF PRESENTATION

- 1 Each of the items in this sequence will be covered in detail in the TOPICS section.
- 2 Suggested sequence:
  - i) General Concepts of File Processing (needed to give student an overview of the course)
  - ii) Programming Language features to allow reading and writing of serial files
  - iii) Present a case study of a system to be programmed showing:
    - a) How it is done manually
    - b) The data flow charts, inputs and outputs for all the runs in the new system
  - iv) Program logic structure for above program using a pre-defined technique
  - v) Students to flow chart and code the basic file maintenance program for the case study
  - vi) Input data editing for batch processed jobs: students to add these features to their program (flowchart and code)
  - vii) Overall system controls for batch processed jobs: students to make the necessary additions to their programs as well as write up the procedures necessary
  - viii) Compile and test file maintenance program
  - ix) Monitors in preparation for student use in testing session
  - x) Tape-sorting techniques: students prepare control cards for the sorting of Input records
  - xi) Preparation of reports: students to flowchart and code an Output report
  - xii) Compile and test report program (optional, if time available)
  - xiii) Data flow for case study using direct access equipment for immediate processing

- xiv) Language features to allow reading and writing on direct access files
- xv) Basic methods of file organization on direct access devices
- xvi) Program logic structure for immediate processing applications
- xvii) File maintenance: students to flowchart and code a program to perform this function
- xviii) Input data editing and validating techniques for immediate processing application: students to add these features to their programs
- xix) Total system controls for immediate processed jobs: students to make any additions to the program as well as write procedures necessary to ensure processing accuracy
- xx) Compile and test the program
- xxi) Sorting methods used for direct access files
- xxii) Report preparation from direct access files: students to flowchart and code a program to produce a report
- xxiii) Compile and test the above program (optional, if time available)

## TOPICS

- 1 Programming
  - A) Review of Basic Programming
  - B) Language features to read and write serial files:
    - i) Input/Output commands
    - ii) End of file procedures
    - iii) File formatting
    - iv) Areas used in reading and writing
  - C) Language features used to read and write immediate access files:
    - i) Locating and reading records
    - ii) Writing records
    - iii) File formatting
    - iv) Utility routines used
- 2 File processing techniques
  - A) General concepts:
    - i) Most business applications are built around data files
    - ii) Types of files: master files, transaction files, report files
    - iii) Start with file cabinet and develop through batch processing to immediate processing
  - B) Batch processing:
    - i) Files organized sequentially
    - ii) Need for sorting
    - iii) Program organization techniques for batch processing

- C) Immediate processing:
  - i) Methods of file organization
  - ii) Data flow considerations
  - iii) Program organization, i.e. modular techniques

### 3 Sorting methods

- A) Methods used on tape computers:
  - i) Internal sorting
  - ii) Multipass operations
- B) Methods used on machines equipped with direct access devices:
  - i) Tag sorting
  - ii) Physical relocation

- C) Timing considerations of sorting

### 4 Input data editing and validating

- A) Completeness checks:
  - i) Control totals
  - ii) Hash totals
- B) Validity of individual records:
  - i) Alphanumeric tests
  - ii) Range
  - iii) Self-checking number
  - iv) Date
  - v) Batch numbering
- C) Use of pre-edit runs
  - i) Limitations
  - ii) Where needed

### 5 Overall system control

- A) Use of control sheets:
  - i) Where kept
  - ii) How each field of master output validated
- B) Audit trails
- C) Re-run and error correction procedures
- D) Emergency procedures

### 6 Report preparation

- A) Detailed reports, i.e. invoices, statements etc.
- B) Statistical reports

### 7 Monitors

- A) Functions of a computer using a monitor:
  - i) Translation
  - ii) Execution
- B) Features of a basic monitor
- C) Present and use a monitor



## V.2 UNIT RECORD FUNDAMENTALS GRADE 12

### DOUBLE OPTION

Some schools may wish to continue teaching the principles of unit record punched-card data processing, especially in those areas where employment may depend on a unit record background. This course is available for such areas.

#### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Understand and apply the basic programming principles to installation applications
- 2 Make adequate use of installation reference manuals
- 3 Develop procedures, card designs, and reports for basic business routines

#### METHODS OF PRESENTATION

- 1 The operation of each machine, installation routines, standards and volume card handling can be taught using standard Data Processing procedures with or without the aid of a *Fictitious Company*
- 2 Sufficient functional wiring and programming principles and procedure flowcharting should next be given to enable the student to program and prepare basic company reports
- 3 Procedure development, and form and card design could then be developed by case studies and/or the use of a *Fictitious Company*
- 4 Where desirable, the concepts of Report Program Generators (RPG) could be introduced using the case study method

5 Visits to installations may be undertaken

6 Suggested time allotment is shown in the margin opposite the **topic**

#### TOPICS

##### *\*Approximate Percentage of Time*

*\*2%*

- 1 Review of Unit Record topics covered in Grade 10

*\*5%*

- 2 Functions

- A) Machine functions and operating features for *each* of the following:
  - i) Key punch (review)
  - ii) Sorter (review)
  - iii) Reproducing punch
  - iv) Interpreter
  - v) Collator (optional)
  - vi) Accounting machine
  - vii) Calculator (optional)

- B) Introduction to Procedure Flow Charting

*\*16%*

- 3 Functional wiring principles

- A) Card reading by machines: brushes, contact roll, timing, path of card
- B) Control panels: purpose and make-up
- C) Printing: typebars, control panel wiring
- D) Punching: component parts, methods, 514 type reproducing panel, 602 serial calculator type punching



- E) Comparing: verification (manual and machine), 514 type comparing with reproducing, 085 type comparing and sequence checking, 402 and 407 type comparing, control panel wiring
- F) Column splits: X punch, needs, control panel wiring for 514, 402, 407, 085 and 602 machines
- G) Selection: 514 type selectors, pilot selectors, co-selectors, control panel wiring
- H) Storage: 407 accounting machine, 602 calculator

\*35%

#### 4 Programming

Installation problems should be chosen to illustrate these points:

- A) Accounting Machine:
  - i) Detail printing: numeric, alphabetic, zero
  - ii) Addition
  - iii) Subtraction
  - iv) Program control: meaning, the comparing unit, program start, total program, numerical and alphabetic programming
  - v) Group printing
  - vi) Selection: X and digit
  - vii) Use of co-selectors
  - viii) Group indication
  - ix) Heading and detail printing
  - x) Carriage control
  - xi) Storage
  - xii) Summary punching
  - xiii) Multiple line reading
  - xiv) Special operating features: negative balances, crossfooting, spacing control
  - xv) Timing chart

\*7%

- B) Collator (optional):
  - i) Card selection
  - ii) Sequence checking
  - iii) Merging without selection
  - iv) Merging with selection
  - v) Matching with selection
  - vi) Timing chart

\*5%

- C) Calculator (optional) — basic Arithmetic operations for:
  - i) Addition
  - ii) Subtraction
  - iii) Multiplication
  - iv) Division
  - v) Timing chart

\*10%

#### 5 Procedure development

- A) Introduction: three basic steps in procedures:

- i) Recording of data to machine processible document
- ii) Arranging data into reporting sequence
- iii) Preparation of reports

- B) Preparation of reporting requirements (output of system):

- i) Define type of reports required and function of report
- ii) Areas of reporting: accounting, statistical, operating, control
- iii) Develop format of reports: standards, factors influencing design, steps in design
- iv) Development through case studies

- C) Development of card design (input to system):

- i) Types of cards
- ii) Coding requirements and design of coding structure
- iii) Design of card format
- iv) Case studies

\*20%

#### 6 Report Program Generator

- A) Introduction:

- i) Reason for RPG in Unit Record Course
- ii) Configuration of equipment necessary

- B) Input/Output

- i) Method of presentation using cards
- ii) Formatting data necessary
- iii) Correlating coding sheets
- iv) Practice problems

- C) Arithmetic:

- i) Addition, subtraction, multiplication and division
- ii) Preparation of coding sheets
- iii) Practice problem: compile and run

- D) Condition Codes:

- i) Unconditional branch
- ii) Comparison
- iii) Conditional branches
- iv) Preparation of coding sheets
- v) Practice problem: compile and run

- E) Advanced Input/Output:

- i) Input and Output using Magnetic Tape
- ii) Formatting necessary
- iii) Preparation of coding sheets
- iv) Practice problems
- v) Input/Output using direct access device
- vi) Formatting necessary
- vii) Preparation of coding sheets
- viii) Practice problems

- F) Case studies and review problems

## FIVE-YEAR PROGRAMS

### I ONE-YEAR BUSINESS OPTION COMPUTER CONCEPTS

This basic course is to be offered as a single Business option to five-year students. It is intended to be a comprehensive *appreciation* course. Although the student is expected to master some topics in considerable detail, a general understanding of data processing and the ability to write simple programs should be the major considerations.

#### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Outline the evolution of electronic data processing and its importance today
- 2 Describe the physical characteristics of a computer and the functions of its components
  - A) Central Processor
  - B) Input/Output Devices
- 3 Write a program in a higher level language to comply with given Input/Output and procedure specifications
  - A) Operational Flowchart
  - B) Coding
  - C) Compilation and Diagnostics
  - D) Run and Test
  - E) Documentation

#### METHOD OF PRESENTATION

- 1 Assignments such as required reading, programmed texts, and essays should be included to supplement the student's general knowledge

- 2 Flowcharting techniques should be introduced early in the course. These can then be used as a vehicle in presenting the phases of data processing
- 3 Such skills as keypunching and machine operation, while beneficial, are incidental and should not occupy a great deal of class time
- 4 Programming concepts should be presented by topic, with pertinent exercises and frequent machine tests. A suggested topic list includes:
  - A) Input/Output operations and formatting
  - B) Data Movement
  - C) Arithmetic Instructions
  - D) Comparing and Branching
  - E) Looping and Counting
  - F) Address Modification
  - G) Subroutines

#### TOPICS

*\* Approximate Percentage of Time*

*\* 12%*

- 1 Manual Data Processing Methods
  - A) Early manual and mechanical techniques: abacus, Babbage's folly
  - B) Early coding techniques: languages, numbering systems, concept of communications

- c) Flowcharting: basic concepts developed through simple applications and practice problems
- d) Applications of Coding:
  - i) Common types of documents
  - ii) Manual filing methods
  - iii) Coding techniques used
  - iv) Manual operations: listing, sorting, merging, collating, calculating, etc.
- e) Output:
  - i) Types
  - ii) Source and destination
  - iii) Use
  - iv) Feasibility: timeliness, accuracy, complexity

\*15%

## 2 Evolution of the Electronic Computer

- A) Advanced technology in modern society:
  - i) Need: volume, speed, accuracy
  - ii) Effect: automation, examples of mechanical devices used in data processing
- B) Electro-mechanical equipment:
  - i) Role of the punched card, examples
  - ii) Filing concepts
  - iii) Punched card code
  - iv) Concept of fields in the card
  - v) Printed output
  - vi) Processing: listing, sorting, merging, collating, calculating, etc.
  - vii) Limitations of electro-mechanical equipment
- c) The electronic computer:
  - i) Early computers:
    - a) Advantages over electro-mechanical equipment
    - b) Disadvantages
  - ii) Modern computers:
    - a) Advantages
    - b) Limitations
  - iii) Classifications of computers:
    - a) Digital vs. analog
    - b) Business vs. scientific
    - c) Speed, size, cost
- d) Review: role of the computer in today's society

\*12%

## 3 Physical Characteristics of the Computer

- A) Central processor:
  - i) Components
  - ii) Coding (machine language): brief introduction to numbering systems may be necessary
  - iii) Storing and manipulating instructions and data

- B) Input/Output devices: general introduction:
  - i) Variety of devices for serial and direct access
  - ii) Processing
  - iii) Uses
  - iv) Advantages and disadvantages
  - v) Concept of different codes for these devices

\*55%

## 4 Programming the Computer

- A) Need for and functions of a programmer
- B) Programming concepts:
  - i) Topical presentation of programming techniques, introducing necessary information on instructions, data flow, hardware considerations, and control cards
  - ii) Practice problems in increasing complexity as further topics are presented:
    - Flowchart and code
    - As frequently as possible, follow up with compilation, testing, and documentation

\*6%

## 5 Computer Growth

- A) Uses, advantages, limitations
- B) Development of programming languages: characteristics and functions
- C) The future of data processing
- D) Vocational opportunities in data processing



## II BUSINESS DATA PROCESSING GRADE 12

NOTE: This course is to be offered as an option at the Grade 12 level (*Prerequisite*: Grade 11, Computer Concepts)

### OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Write a file maintenance program of *production* quality
- 2 Design and document a computer system

### SUGGESTED METHOD AND SEQUENCE OF PRESENTATION

- 1 All topics should be covered at the time needed during the development of the case study
- 2 Suggested Sequence:
  - i) Review of computer concepts covered in Grade 11: review problems applicable to the machine to run concurrently with introduction of new work, to be completed before commencing section xiii
  - ii) System concept: examples
  - iii) Apply system concept to new business: capital, income, personnel, specialized knowledge, company's functions (processing) products (goods and services)
  - iv) Case study: discussion approach to develop the total view of the company
  - v) Segment one function of the company's operations and develop a computer system for it, e.g. billing, accounts receivable

- vi) Output: students to discuss and develop the output requirements i.e. customer documents, company records.
- vii) Input: students to determine the input requirements: documents and data content
- viii) Processing required to produce output from input: students to flowchart the data flow
- ix) Controls: students to develop the necessary controls of the system to check the input, output, processing
- x) Specifications, of equipment available: students to determine general approach within equipment limitations, e.g. batch processing vs. immediate processing
- xi) Runs on the machine: students to break down system into computer runs
- xii) Forms design: students to design the Input/Output documents
- xiii) Logic design of file maintenance program
- xiv) Additional features of programming language required for the file maintenance program
- xv) Code the file maintenance program
- xvi) Study of data validating and editing techniques: students to add data editing to file maintenance program
- xvii) Controls: examples, students to add controls to file maintenance program
- xviii) Students to key punch, desk check
- xix) Discuss test system: students to prepare test data
- xx) Compile
- xxi) Test and debug
- xxii) Implementation procedures
- xxiii) Documentation
- xxiv) System performance evaluation: follow-up procedures



# SPECIAL COMMERCIAL DATA PROCESSING

## OBJECTIVES

Upon satisfactory completion of this course, the student should be able to:

- 1 Demonstrate an understanding of the basic concepts of Data Processing — manual, electro-mechanical and electronic
- 2 Be able to demonstrate man's need and use of information
- 3 Flowchart and write a program for a computer in a higher level language such as COBOL, Fortran or PL/1 to perform the following functions:
  - A) Arithmetic
  - B) Branching
  - C) Counting and Looping
  - D) Data Movement
  - E) Address Modification
  - F) Writing a subroutine and creating linkage to and from it
  - G) Input/Output: card, tape, printed
- 4 Test and produce a running program using a testing system
- 5 Produce documentation to adequately describe this program
- Refer to section on OBJECTIVES in Grade 11 course in Computer Fundamentals

- Refer to section on OBJECTIVES in Grade 12 course in System Design
- Refer to section on OBJECTIVES in Grade 12 course in Business Systems Programming

OR

- Refer to section on OBJECTIVES in Grade 12 course in Unit Records Fundamentals

## METHODS OF PRESENTATION

### A. INTRODUCTION TO COMPUTER PROGRAMMING

- 1 Sufficient training and practical experience should be given on the keypunch to allow the students to: prepare the decks of cards and program cards required throughout the remainder of the course, re-make damaged cards, change ribbons, etc.
- 2 Run through a topic such as payroll to illustrate the five basic processing factors
- 3 Teach enough of the language chosen to allow students to write the required programs

### B. COMPUTER FUNDAMENTALS

- 1 For details, teachers will refer to the related sections of the Grade 11 course in Computer Fundamentals

### C. SYSTEMS DESIGN

- 1 Use a local application to introduce concepts, examples — wholesale company, retail company
- 2 For details, teachers will refer to the related sections of the Grade 12 course in Systems Design

### D.1 BUSINESS SYSTEMS PROGRAMMING

- 1 For details, teachers will refer to the related sections of the Grade 12 course in Business Systems Programming

OR

## D.2 UNIT RECORD FUNDAMENTALS

- 1 For details, teachers will refer to the related sections of the Grade 12 course in Unit Record Fundamentals

## TOPICS

### A. INTRODUCTION TO COMPUTER PROGRAMMING

- 1 Man and his environment:
  - A) Adjustment to the environment, adaptation techniques developed through experience, patterns of communication, accumulation of facts, processing and compiling information to assist in making decisions for further adaptation
  - B) Development of survival techniques: accumulation of knowledge
  - C) Development of the need to communicate: expressed by symbolic representation of states of being – language, numbers
  - D) Development of methods of assembling, writing, and recording information: records on stone, clay tablets, paper, disk, tape
  - E) Development of systems to express specialized information: weights, measures, money, maps, accounting
  - F) Development of automation: sail, pump, gear, lever, wheel, tread-mill, pulley, furnace, chute (inclined plane), sluice, water-mill, lightning rod, turbine, thermostat, conveyor belt, elevator, computer
- 2 Development of devices to improve data processing: abacus, Napier's Bones, Pascal's gears, slide rule, manual calculators, electro-mechanical calculators, tabulating equipment, electronic calculators

### 3 Business Data Processing:

- A) Definition: Manipulation of input to produce the desired output
- B) Factors of Data Processing
  - i) Input (creation)
  - ii) Storing
  - iii) Manipulation (sorting and collating, tabulating, calculating and summarizing)
  - iv) Output (printing and reporting)
  - v) Control

### 4 Manual System of Processing Data

To illustrate the basic factors in a Manual System, choose a topic such as payroll and have students follow through the procedure using the manual or writing board approach

### 5 Electro-Mechanical System of Processing Data

- A) Need
- B) The Punched Card:
  - i) History (Hollerith, Powers)
  - ii) Characteristics: rows, columns, zones, edges
  - iii) Card interpretation
  - iv) Recording information into a card: numeric, alphabetic, special character codes
  - v) Card identification (Codes)
  - vi) Card Fields: definition
  - vii) Card preparation exercises: (Key Punch)
  - viii) Card reading exercises
  - ix) Card planning and card layout: planning of card fields, methods of overcoming limitations of card capacity
- C) Methods of Creating Input Data
  - i) Direct punching: Key punch
  - ii) Indirect punching: Summary punching, reproducing, (media conversion)
  - iii) Mark Sensing
- D) Manipulation of Input Data
  - i) Sorting: purpose, sequential (numeric and alphabetic) selective
  - ii) Collating: matching, merging, sequence checking and selection, practical exercises
  - iii) Calculating
- E) Output: listing
- F) Limitations of Electro-Mechanical System (Punched-Card) Processing Data
- G) Illustration of the basic factors of every Data Processing System

### 6 Introduction to Basic Programming

- A) Show variations possible for Data Processing using card readers, card punches, tape units and direct access devices attached to a central processing unit
- B) Demonstrate a simple application on the computer to show the speed and versatility of the machine

### 7 Programming Topics

The teacher should keep in mind that *the object of this course is to teach basic programming*. Only

enough of the vehicle language chosen should be presented to allow students to write the required program

A) The following topics should be covered in the language chosen:

- i) Basic Input/Output
- ii) Data Movement
- iii) Comparing and Branching
- iv) Basic Arithmetic
- v) Advanced Arithmetic (Algebraic calculations, multiplication and division)
- vi) Data formatting (print edit)
- vii) Reading serial records (Tape, card, etc.)

B. COMPUTER FUNDAMENTALS

- 1 Evolution of computers
- 2 Basic functions and components of a computer system
- 3 Data representation
- 4 Storage and Data handling
- 5 Instruction Formats and Addressing
- 6 Instruction execution and Data Flow for various types of instructions
- 7 Program Switches
- 8 Address Modification
- 9 Special commands
- 10 Input/Output devices
- 11 Buffers, Channels and Interrupts
- 12 Programming systems

C. SYSTEMS DESIGN

- 1 Systems Design for Sequential Access e.g. Tape system
- 2 Systems Design for Direct Sequential Access e.g. Disk or Card
- 3 System investigation
- 4 System analysis

D.1 BUSINESS SYSTEMS PROGRAMMING

- 1 Programming considerations
- 2 File processing techniques
- 3 Sorting methods
- 4 Input Data Editing and Validating
- 5 Overall systems control
- 6 Report preparation
- 7 Monitors

OR

D.2 UNIT RECORD FUNDAMENTALS

- 1 Machine functions and operating features
- 2 Functional wiring principles
- 3 Programming
- 4 Procedures development
- 5 Report Program Generator



## REFERENCES

The following list of publications is intended as suggested material for teaching of the various courses in Data Processing. It is necessarily limited, including only a few of the volumes in the broad field covered by these courses.

In organizing the courses the Committee has been acutely aware of the scarcity of instructional materials and textbooks suitable for Secondary School use. Most of the references suggested are recommended primarily for teacher use. Teachers must be especially resourceful in selecting classroom materials that are appropriate for student use.

It is recommended that descriptive literature from all available sources (computer manufacturers, service bureaus, data processing associations etc.) be used.

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VAN NESS, *Principles of Punched Card Data Processing*, Business Press 1964

WANOUS, S. J. and E. E., *Automation Office Practice*, South Western Publishing,

Various manufacturer's equipment publications

## FILMS AND FILMSTRIPS

<i>Automatic Computers</i> , Motion Picture, sound, colour, 16 min.	IBM
<i>Automation in To-Day's Modern Office</i> , Filmstrip, 35 mm., colour, 20 min.	FRIDEN
<i>Basic Data Processing</i> , Filmstrip, 35 mm., sound, colour, 20 min.	FRIDEN
<i>Cards that Count</i> , Motion Picture, 16 mm., sound, colour, 15 min.	IBM
<i>Computer Programming</i> , Motion Picture, 16 mm., sound, black & white, 26 min.	SYSTEMS DEVELOPMENT CORP.
<i>Electronic Computer Occupations</i> , Filmstrip, colour	NATIONAL FILM BOARD
<i>Introduction to Digital Computers</i> , Motion Picture, 16 mm., sound, colour, 25 min.	UNIVAC
<i>Introduction to Feedback</i> , Motion Picture, 16 mm., colour, 11 min.	IBM
<i>Magic Window</i> , Filmstrip, sound, colour	IBM
<i>Principles of Electronic Data Processing</i> , Filmstrip, 35 mm., sound, colour	IBM
<i>The Control Revolution</i> , Motion Picture, black & white, 29 min. Service Charge \$5.00	CANADIAN FILM INSTITUTE
<i>The Information Machine</i> , Motion Picture, 16 mm., colour, 10 min.	IBM
<i>This Business of Numbers</i> , Filmstrip, 35 mm., sound, colour, 20 min.	DATA PROCESSING MANAGEMENT ASSOC.
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## PERIODICALS

*Journal of Data Management*, DATA PROCESSING MANAGEMENT ASSOC.

*Journal of Educational Data Processing*, P.O. Box 607, Malibu, Calif., 90265

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Don Mills, Ontario.

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