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Preamble

The Curriculum Development Council (CDC)-Hong Kong Examinations and Assessment Authority (HKEAA) Committees (Senior Secondary) of various subjects have been set up jointly by the CDC and the HKEAA Council to develop the Curriculum and Assessment Guides (C&A Guides) for the new 3-year senior secondary academic structure in Hong Kong. During the first stage of consultation on the new academic structure between October 2004 and January 2005, the document Reforming the Academic Structure for Senior Secondary Education and Higher Education - Actions for Investing in the Future (Education and Manpower Bureau, 2004) was published to seek stakeholders’ views on the design blueprint of the structure, the timetable for implementation and financial arrangements. An accompanying document, Proposed Core and Elective Subject Frameworks for the New Senior Secondary Curriculum, was also produced to solicit views and feedback from schools on the initial curriculum and assessment design of individual subjects to inform the development of the C&A Guides.

The report New Academic Structure for Senior Secondary Education and Higher Education – Action Plan for Investing in the Future of Hong Kong (Education and Manpower Bureau, 2005), an outcome of the first stage of consultation, has just been published to chart the way forward for implementing the new academic structure and to set further directions for the second stage of consultation on curriculum and assessment as part of the interactive and multiple-stage process of developing the C&A Guides. In addition, taking into consideration the feedback collected through various means including the returned questionnaires from key learning area coordinators/panel heads during the first stage of consultation, the curriculum and assessment frameworks of subjects have been revised and elaborated. We would like to solicit further views on the frameworks from stakeholders, in particular the school sector.

To understand the position of each subject in the new academic structure, readers are encouraged to refer to the report. Comments and suggestions on the Proposed New Senior Secondary Information and Communication Technology Curriculum and Assessment Framework are welcome and could be sent to:

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Fax: 27688664 / 21940670
E-mail: teched@emb.gov.hk
Chapter 1  Introduction

Technology Education in Senior Secondary Education

1.1 Technology is ever-changing and ever-improving in nature. In the context of school education in Hong Kong, technology is defined as the purposeful application of knowledge, skills and experiences in using resources to create products or systems to meet human needs. The curriculum of Technology Education (TE) focuses on how human beings solve their daily problems and how the processes involved can be replicated and transferred to solve new problems.

1.2 Technology influences and is influenced by culture and is part of our daily life. To motivate effective student learning, the TE curriculum is so designed to reflect contemporary social, economic and technological changes and developments in both the local and global contexts. In Hong Kong, financial services, producer services, logistics and tourism are the main value-generating sectors of our economy. Creative industries and health care industries have also been identified by the Government as growing and likely to grow further.

1.3 Building on the strengths of the existing TE curriculum and catering for social, economic and technological development, Information and Communication Technology is proposed as one of the five elective subjects under Technology Education Key Learning Area in the New Senior Secondary Curriculum.

Information and Communication Technology

Rationale

1.4 Information and communication technology is the technology required for information processing. It refers to the creation, manipulation, storage, retrieval and communication of information and to the range of technologies, technological devices and systems used to perform these functions.

1.5 Many of the skills of information and communication technologies are important aspects of Information Literacy, which relates to the ability to select, organise, discriminate, analyse and use information effectively. Information is regarded as a valuable asset for all individuals in contemporary society. The ability to construct knowledge from the information gathered has become essential to an individual in an information-based or knowledge-based society like Hong Kong. It is undoubtedly true that a citizen in the 21st century needs to understand the principles and applications of information and communication technologies in order to function efficiently in modern society.
1.6 The importance of information and communication technology is not the technology as such, but its enabling function in access to knowledge, information and communications: increasingly important elements in today’s economic and social interaction. Rapid advances in information and communication technology has continued to drive economic changes, restructure businesses, affect skills and employment, and contribute significantly to growth and wealth creation.

1.7 The Information and Communication Technology (ICT) Curriculum is a course of study that provides students with knowledge, practical skills, and understanding of the processes involved in information and communication technologies. The course emphasises problem solving using these technologies. It encompasses problem identification, solution design, and the applications of ICT knowledge and skills in the processes.

1.8 The ICT Curriculum relates to many aspects of modern life and to diverse fields of study within and beyond senior secondary education. Students will be exposed to a variety of intellectual challenges involving problem solving, communication and a range of associated practical skills and concepts. The study of this course will contribute significantly to the education of students in providing a pathway into the workforce or preparing them for further studies in ICT-related fields. The course also provides opportunities for the development of key generic skills such as critical thinking, communication, creativity and problem solving, in contexts that come naturally from the learning objectives, learning outcomes and learning experiences.

1.9 The course should prove especially relevant to students by equipping them with the knowledge, skills and attitudes necessary to apply and to cope with the rapid changes associated with information and communication technologies, and to appreciate their impact on society.

**Overall Aims**

1.10 The ICT Curriculum aims to

- provide students with a body of essential knowledge, concepts and applications of information, communication and computer systems.
- equip students with problem-solving and communication skills, and encourage them to think critically and creatively.
- develop students into competent, effective, discriminating, ethical and confident users of information and communication technologies, so as to support their life-long learning.
Interface with the Junior Secondary Curriculum

1.11 The linkage of the curriculum with students’ various learning experiences of ICT at school levels and beyond can be depicted in the diagram below:

The Continuum of Learning for Students in ICT

IT Learning Targets at Key Stage 3
Chapter 2    Curriculum Framework

Structure of the ICT Curriculum

2.1 The ICT Curriculum is built upon the S4-5 Computer and Information Technology Curriculum introduced in 2003, and the revision of the two sixth form computer curricula, the Advanced-level Computer Studies and the Advanced Supplementary-level Computer Applications, in 2005. It is recommended for use in Hong Kong secondary schools in the New Senior Secondary Education. It is a three-year course targeted at students with information technology skills at Level 3 of the IT Learning Targets\(^1\) (or S3 Computer Literacy level).

The Curriculum is organised into a compulsory part and an elective part as shown in the diagram on p.6.

2.2 The compulsory part of the curriculum occupies 165 hours and spans approximately one and a half school years. It comprises a number of topics which are the fundamental principles in information and communication technologies and can provide students with a solid foundation as well as a broad area of study in ICT. The compulsory part consists of Information Processing, Computer System Fundamentals, Internet and Its Applications, Basic Programming Concepts and Social Implications. The details of topics and the learning outcomes of the compulsory part are shown on pages 9-24.

2.3 The elective part takes up about 75 hours of curriculum time and spans about one school year. Four options, drawn from distinctive fields of computing and information science as well as their applications, are offered in the elective part. Based on their abilities, interests and needs, students are required to study in depth in a specialised area, an option of their own choice in the elective part. The options in the elective part can be broadly categorised as those illustrating applications of computers in specific areas, and those intended for students who will pursue further studies in ICT as a discipline in tertiary education, but the two are not mutually exclusive. The options are Databases, Data Communications and Networking, Multimedia Production and Web Development and Software Development. Details of the options are covered on pages 25-43.

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\(^1\) The Education Department, Hong Kong (2000). Information Technology Learning Target: a guideline for schools to organize teaching and learning activities to develop our students’ capability in using IT.
Learning Objectives

2.4 Upon completion of this Curriculum, students should

- develop knowledge and understanding of the range and organization of computer systems, and the inter-relationship among hardware, software and data;

- have knowledge and skills in using a range of applications software effectively, ethically and with discrimination to support information processing and problem solving;

- demonstrate an understanding of methods of analysing problems, the planning and implementation of solutions using information and communication technologies, and practice in applying these methods;

- realise the social, ethical and legal issues pertaining to the use of information and communication technologies; and

- develop responsible attitudes towards the use of information technologies and value themselves as productive participants in the development of information and communication technologies.
# Curriculum Framework of ICT

## The Compulsory Part (165 hours)

<table>
<thead>
<tr>
<th>A. Information Processing</th>
<th>(64 hours)</th>
<th>B. Computer System Fundamentals</th>
<th>(25 hours)</th>
</tr>
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<tbody>
<tr>
<td>C. Internet and its Applications</td>
<td>(28 hours)</td>
<td>D. Basic Programming Concepts</td>
<td>(20 hours)</td>
</tr>
<tr>
<td>F. Social Implications</td>
<td>(28 hours)</td>
<td></td>
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</table>

## The Elective Part (75 hours)

(Choose one)

| A. Databases | B. Data Communications and Networking | C. Multimedia Production and Web Development | D. Software Development |

## School-based Assessment (30 hours)
2.5 The number of hours for each module and option is recommended as follows:

<table>
<thead>
<tr>
<th>Module / Option</th>
<th>No. of hours allocated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Compulsory Part</strong></td>
<td><strong>165</strong></td>
</tr>
<tr>
<td>A. Information Processing</td>
<td>64</td>
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<tr>
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<td>E. Social Implications</td>
<td>28</td>
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<tr>
<td><strong>The Elective Part</strong></td>
<td><strong>75</strong></td>
</tr>
<tr>
<td>(Choose one)</td>
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<tr>
<td>A. Databases</td>
<td>75</td>
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<tr>
<td>B. Data Communications and Networking</td>
<td>75</td>
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<tr>
<td>C. Multimedia Production and Web Development</td>
<td>75</td>
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<tr>
<td>D. Software Development</td>
<td>75</td>
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<tr>
<td><strong>School Based Assessment</strong></td>
<td><strong>30</strong></td>
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</table>

**Total Curriculum Time**  **270 hours**

2.6 Details of the curriculum are stipulated in the Curriculum Framework in the pages to follow. The order of the modules and options, however, is arbitrary and immaterial. The organization of individual module or option represents one possible way of organizing the curriculum content. Teachers may structure and design teaching schemes according to their school situations, student needs, interests and abilities.

2.7 The Curriculum Framework serves as a guide for teachers on the contents and the learning objectives which the Curriculum entails. It is presented with the overall aims and major objectives of the Curriculum. In each module or option, the following information is also provided:
- **Introduction** provides the overview and intent of the module or option as it is approached in the curriculum.

- **Learning Objectives** specify what students will learn in the module or option and to what extent/level it will be learned.

- **Topics** are found within each module or option. They are numbered and subtopics are included when necessary. Suggested time allocation for each topic is also given.

- **Remarks** are written in small prints, where appropriate, which serve three purposes. They
  i. provide further information such as the depth and breadth of the learning elements;
  ii. alert teachers to the opportunities for fostering the most dominant generic skills associated with a particular topic/sub-topic; and
  iii. serve as teaching notes.

2.8 Each module or option is written with learning outcomes which use action verbs to indicate the thinking or practical skills that students should exhibit during the course of study:

<table>
<thead>
<tr>
<th>Examples of action verbs</th>
<th>Students need to demonstrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>know, define, record, recall, relate, recognise, state and draw.</td>
<td>the recall and understanding of specific terms or facts and simple concepts.</td>
</tr>
<tr>
<td>discuss, describe, explain, identify, interpret, translate, demonstrate, practise, illustrate, relate, examine, outline, apply, convert and trace.</td>
<td>the application of declarative knowledge and practical skills in contexts.</td>
</tr>
<tr>
<td>distinguish, analyse, differentiate, appraise, compare, contrast, evaluate, organise, debate, prepare, test and set up.</td>
<td>the analysis of materials or systems into their constituent parts and the recognition of relationship between parts.</td>
</tr>
<tr>
<td>compose, plan, devise, propose, design, formulate, construct, deduce, determine, predict and suggest.</td>
<td>the synthesis of concepts and skills from different areas into a plan for solving a problem or reaching a conclusion, and the transfer of learned concepts and skills into new scenarios / situations.</td>
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The Curriculum Framework

The Compulsory Part

2.9 The compulsory part comprises of 5 modules:

A. Information Processing

Introduction

This module provides students with fundamental understanding of what information system and information processing are, and how data are represented inside a computer. Students will learn that different software is used to process different types of data and be given practical tasks to process and present information. Built on the basic knowledge, understanding and skills of word processing, spreadsheet, database and multimedia presentation acquired by students in junior secondary, this module will increase students’ understanding of the terminology, advanced concepts and skills in using integrated software so as to enhance their personal productivity in work or study, and to apply them in problem solving, data analysis and information presentation.

Learning Objectives

Students should

• analyse and describe information system and information processes in real-life contexts;

• understand the difference between information and data;

• understand how data are organised and represented inside a computer;

• be able to integrate the use of office automation software, process and present different types of information appropriately; and

• appreciate how the advancement in information and communication technologies fosters the emergence and development of the Information Age and its impact on the society.

The time allocation for the module is about 64 hours.
Details

This module comprises five topics; namely, “Introduction to Information Processing”, “Data Organization and Data Control”, “Data Representation”, “The Use of Office Automation Software” and “Principles of Effective Presentation of Information”. Further information on the five topics is summarised as follows:

a. **Introduction to Information Processing** (5 hours)

- Describe the basic concepts of Input-Process-Output cycle and the use of a stored program in a processing system.
- Examine the components of an information system, and identify them in a given system.
  
  Components include the purposes, data, information processes, information technologies and personnel.
- Distinguish between various information processes.
  
  Information processes include data collection, organization, analysis, storage, processing, transmission and presentation. Examples from daily life, both computer and non-computer based processes, should be drawn to consolidate and enhance students’ understanding of the activities involved.
- Realise the difference between data and information, and identify different types of data as image, audio, video and text.
- Define Information Age and discuss the importance of information literacy in a knowledge-based society.
  
  How the development of technologies leads to the emergence of the Information Age, and how information can be flexibly and analytically converted into knowledge in modern society should be discussed and focused.

b. **Data Organization and Data Control** (4 hours)

- Identify data, records, fields, files and databases in the hierarchical organization of data.
- Explain how records can be organised, stored and retrieved. State the advantages, disadvantages and applications of the two types of file access; direct access and sequential access.
- Discuss the needs of data control.
- Describe how errors can be detected by using validation and parity checking, and prevented by verification and validation.
c. **Data Representation** (10 hours)

- Distinguish between analog and digital data. State applications or situations where conversion of analog to digital data is required, or vice versa.

- Explain why information technology uses digital data.
  The relationship between the number of bits and number of patterns/combinations available should be mentioned. (eg. 3 bits can be used to represent 8 colours)

- Convert integers from denary numbers to binary numbers or hexadecimal numbers, or vice versa.
  Adopt two’s complement for the representation of negative integers.

- Perform simple calculation (addition and subtraction only) on binary numbers and analyse overflow errors.
  In understanding errors, minimum and maximum numbers an n-bit can hold (maximum 2 bytes) should be considered.

- Know how characters are represented by using common international standards such as ASCII code, the Big-5 code, the GB-code and the Unicode.
  The relationship between the size of the character set and the representation should be explained. Recall of specific codes is not required.

- Know briefly how different multimedia elements are digitised. Convert them into different file formats and compare them for storing the same data.
  Elementary file conversion is required but not the editing of a file. Students should be given the experience to create various file formats such as wav vs mp3, bmp vs jpg, and avi vs mpeg2.

d. **The Use of Office Automation Software** (40 hours)

- Design and create formatted documents or reports effectively and suitably using a word processing tool.
  Through meaningful tasks related to real world such as advertisement flier, newsletter and report, students are expected to apply formatting features such as tables, columns, text frames, graphics with consideration on the use of colour, size and positioning, etc. to present their documents.
  Other features such as table of contents, index, footnote, hyperlink and the checkers (e.g. Spelling checker) should be introduced to students to facilitate the writing of a report and to enhance the readability and accuracy of documents.

- Convert between various document / text formats and justify their usage.
  Examples of text formats are rich text format, hypertext document format, portable document format and word document format.

- Describe and use basic features of spreadsheet to solve problems
  The use of cell references in formulas, standard functions, together with mathematical, logical and relational operators should form part of the contents.
• Demonstrate data manipulation techniques in spreadsheet.
  This includes filtering, searching and sorting data using single or multiple criteria. The manipulation of data dynamically in multiple worksheets should also be introduced.

• Apply spreadsheet as a data analysis tool by using pivot table (and pivot chart), and “what-if” scenarios.
  Through task-based activities, apart from the basic features and functions (sum, sub-total and average) of a pivot table, by varying different fields in a pivot table, students should be led to observe and analyse the inter-dependency of data.
  Together with charting, simulating real-life situations and “what-if” scenarios, students should learn to identify trends, to make informed judgment, and to produce meaningful predictions which are required as critical thinkers throughout their career lifetime.

• Apply the concepts of data organization to create and maintain a simple database using a DBMS tool.

• Create and use a form for data entry.

• Practise data extraction and manipulation by querying a database and create reports.
  This includes the selection, filtering and sorting of data using query. Students should be able to trace and interpret simple SQL. Though sophisticated reports are not required, students should create and format reports for intended user / audience.

• Understand concepts of OLE and its applications.

• Use software suite in an integrated and effective manner.
  Experience on the integrated use of different programs of the software suite (e.g. spreadsheet / database with word documents in mail merging) should be given to students.

**e. Principles of Effective Presentation of Information** (5 hours)

• Construct and design a presentation with the incorporation of multimedia elements.
  The focus is on the planning of the storyboard and presentation, not the means of the presentation. Students may choose a web-based presentation, a slide show, a multimedia document or other means of presentation.
  The presentation should be supplemented with verbal annotation so as to develop students’ communication skills and encourage articulation in ideas/thoughts.
B. Computer System Fundamentals

Introduction

This module provides students with a basic understanding of how the different components of a computer system work together to perform computational tasks. This includes the learning of the functional units of a computer, the system software, and the different types of computer systems for different applications.

Learning Objectives

Students should

- be able to explain the functions and properties of the major components of a computer system and how these components interact together to perform tasks;
- be able to describe the functions and properties of major peripheral devices, select and justify their uses in a specific situation;
- be able to use different utility programs to manage systems and files; and
- describe the capabilities of different operating systems and know the basic concepts of a computer network and its applications.

The time allocation for the module is about 25 hours.
Details

This module comprises three topics; namely, “Basic Machine Organization”, “System Software” and “Computer Systems”. Further information on the three topics is summarised as follows:

a. Basic Machine Organization (15 hours)

- Explain the functions of hardware within a computer system, namely input and output devices, the central processing unit, bus system and storage devices (both primary and secondary).

- Explain the structure and functions of a central processing unit (CPU) and its components.

  Students should know how CPU is measured in terms of frequency. Units such as microsecond, nanosecond and picosecond should also be introduced to students.

- Outline the steps in the fetch-decode-execute cycle and store using a single processor, and describe the roles of and the interdependence among components, registers and buses in the machine cycle.

  Functions of program counter, accumulator, instruction register, memory address register and memory data register should be briefly introduced to students. No assembly language is involved but instructions requiring LOAD, ADD, STORE and STOP may be used to illustrate how data and instructions are processed in the machine cycle.

- Describe the functions and characteristics of RAM, ROM and memory cache. Realise the relationship among the size of the memory, the memory address, wordlength and the performance of the computer.

  Students’ understanding in main memory should be extended to the current version / technologies in RAM and ROM in terms of capacity and data access rate.

  Meanings of units such as terabytes, gigabytes, megabytes and kilobytes should be introduced. Furthermore, the distinction between prefixes used in computer and standard SI notation should also be made (eg. 1KB = 1024 Bytes, not 1000 Bytes).

- Describe the features, advantages, disadvantages and one application of each of the input and output devices. Select and justify the use of appropriate devices for collecting and displaying information in a given context.

  Students should know various hardware devices used for collecting and displaying different types of data such as image, audio, video and text. The technical details concerning how each device operates are not required.
• Describe the functional characteristics of storage devices in terms of random or sequential access, volatile or non-volatile, data transfer rate and storage capacity.

Examples of storage devices are magnetic disk, optical disk, flash memory, magnetic tape and network storage. In understanding the characteristics of storage devices, students should be made aware of the trend to faster and greater storage capacity but smaller in physical size over time.

• Outline the latest developments in computer systems including processor capabilities, primary memory technologies, secondary storage devices and data communications.

Technical details are not required.

b. System Software (4 hours)

• Know the functions of system software and applications software, and the relationship between hardware, system software, applications software and users.

• Outline the basic functions of an operating system and describe some common operating systems, their differences and applications.

• State the functions and needs of utility programs and driver programs.

Examples of the utilities are data compressors, virus checkers, file managers, defragmentation software and system monitoring software. Technical details of these programs are not required but demonstration or practice on the use of the utilities should be given.

c. Computer Systems (6 hours)

• Compare the characteristics of different types of computers.

Types of computers include personal computers, mainframes, supercomputers, and network computers etc. Comparison should be made with respect to physical size, memory size, backing store capacity, input/output devices, processors, number of user supported, cost and applications.

• Distinguish the characteristics and applications of various computer systems.

Computers systems to be considered are batch processing systems, on-line interactive systems and real-time systems, single-user systems and multi-user systems, parallel processing systems and distributed processing systems, and network systems.
C. Internet and Its Applications

Introduction

This module is designed to acquaint students with the Internet fundamentals. It encompasses the concepts of Internet access, services and applications of the Internet and elementary web page design. Students will also be given the opportunity to critically analyse the reliability of the information retrieved from the Web and appreciate the impacts of the Internet on e-commerce, e-government, e-entertainment and e-learning.

Learning Objectives

Students should

- be able to connect to the Internet and know the hardware, software and internet service provider (ISP) involved in accessing the Internet;
- know the personal, social and commercial activities that are available on the Internet;
- be able to participate in various Internet-supported activities such as searching information using search engines, sending and receiving e-mails, uploading and downloading files;
- be aware of the technologies involved in transmitting and displaying multimedia elements on the Internet; and
- be able to design and construct simple web pages for intended audience.

The time allocation for the module is about 28 hours.
Details
This module comprises three topics; namely, “The Networking and Internet Basics”, “Internet Services and Applications” and “Elementary Web Authoring”. Details of the three topics are summarised as follows:

a. The Networking and Internet Basics  (9 hours)
   - Define and compare local area network (LAN) and wide area network (WAN).
   - Discuss the common services available in a networked environment.
     Services include email, internal communications and conferencing.
   - Explain the functions of the hardware devices required for a network.
     This includes communication links (phone line, coaxial cable, fibre optics, microwave, satellite), network interface card, hub, switch and router.
   - Compare various methods for Internet access in terms of speed, cost and bandwidth,
     Methods of connections include using modem, cable modem, ISDN and ADSL etc.
   - Understand the need for communications software and communication protocols.
   - Describe how data is transmitted over the Internet and understand concepts of Internet Protocol (IP), Uniform Resource Locator (URL), Domain Name System (DNS) and Hypertext Transfer Protocol (HTTP).

b. Internet Services and Applications  (7 hours)
   - Formulate an effective strategy for searching specific information on the Web by using search-engines and critically analyse the sources of information.
   - Identify various graphics, audio, video file formats suitable for web pages. Use plug-ins and players for the multimedia elements found on the Internet.
   - Apply various services such as file transfer protocol (FTP), remote logon, online chat, discussion forum, newsgroup and email on the Internet.
     Email protocols such as POP, IMAP, SMTP and their functions should be included.
   - Describe the concepts of streaming technology and its applications on voice mail, videoconferencing, and webcasting etc. on the Internet.
     Technical details of streaming technology are not required.
• Value and appraise the significance of the development of the Internet in e-commerce, e-government, e-learning and e-entertainment.

The benefits and limitations of each type of activities, as compared to the traditional methods, should be discussed. In e-commerce, for instance, this may span from activities such as electronic fund transfer (EFT) to current practices of corporate / organization web portals in digital economy.

The appreciation of technology advancement as a change agent for the betterment of human world should be fostered on students.

c. Elementary Web Authoring (12 hours)

• Practise the basic constructs of Hypertext Markup Language (HTML) which is a means to address cross-platform issues.

• Design and construct web pages, by writing HTML or by using a web authoring tool, for intended audience and upload them onto the World Wide Web.

Students should apply concepts of effective communication acquired in Information Processing. Web page design should consider the organization of information including ease of navigation, appropriate placement of links, tables, frames and multimedia elements, colour combinations, background design, font size and style, for intended audience.

Although students may use a tool or write html codes for the creation of web pages, the understanding and interpretation of html codes are essential.
D. Basic Programming Concepts

Introduction

Students should learn to solve problems analytically and logically, not just to write computer programs. This module is designed to provide students with the basic understanding of the steps and strategies involved in solving a problem systematically. It emphasises the design of a solution, the algorithm, which is essential in computer programming, and with which students should be equipped so as to manage complex problems they may encounter in their lifetime. The realization of the algorithm in a syntactic language will be introduced in Software Development.

Learning Objectives

Students should

- develop skills in the systematic approach to problem solving;
- apply concepts of systematic problem solving to real life problems;
- use pseudocode and/or program flowchart to represent the algorithm;
- be able to identify the objectives of an algorithm, trace the logical flow and examine values of variables during execution; and
- appreciate that there are different ways to solve the same problem, and make comparison among them.

The time allocation for the module is about 20 hours.
Details

This module comprises three topics; namely, “Problem Solving Procedures”, “Algorithm Design” and “Algorithm Testing”. Further information on the three topics is summarised as follows:

a. **Problem Solving Procedures**  (4 hours)

   - Outline the major stages in problem solving and explain the needs of each stage.
   - Use real life examples to illustrate various stages of problem solving procedures.
   - Explain the importance of formulating and defining the scope of a problem precisely.
   - Solve a problem by decomposing it into sub-problems or modules.
     The sub-problems, for instance, may represent the input, process and output of the solution to the problem.

b. **Algorithm Design**  (13 hours)

   - Define algorithm. Use pseudocode and program flowchart as methods for representing algorithms.
   - Outline and discuss the input and output requirements of the problem, and design appropriate user interface.
   - Recognise the uses and nature of simple data types and data structures to solve a problem
     Examples of simple data types are integer, real, character and Boolean while examples of simple data structures are string and one-dimensional array. Boolean logic (AND, OR, NOT) and truth tables should be introduced.
   - Select appropriate data types for the solution to a particular problem and discuss the merit of the chosen types.
   - Design and construct standard algorithms involving basic control structures.
     Control structures are sequence, selection (binary and multiway) and iteration (pre-test, post-test and for loops).
   - Create and examine algorithms such as to load and print an array, and to add or delete an item from an array.
     When designing a solution to a complex problem, students are encouraged habitually to use the modular approach to structure the algorithm.
   - Describe the advantages of modularity in designing computer solutions.
c. **Algorithm Testing** (3 hours)

- Trace and test the algorithms.
  
  Students need to identify boundary cases and generate appropriate test data.

- Criticise the algorithms by comparing different solutions to the same problem.

  Comparison of different approaches, adopted by peers or from examples, to reach the solution should be encouraged. Comparison can be made simply on the execution counts and simple calculation of statements, or on the efficiency and effectiveness of the algorithm in solving the problem.
E. **Social Implications**

**Introduction**

This module provides students with the understanding of and the ethical analysis on various issues arisen from the use of information and communication technologies. These issues have economic, legal, social, ethical and security consequences. Students should be given the experience to discuss and debate on these issues so as to develop the analytical and interpretive skills required to construct their own normative practices of information and communication technologies. With the pervasiveness of the Internet, students should be made keenly aware of the potential threats associated with its use and the possible measures to safeguard their data and information. This module develops students to act in a socially responsible, ethical and legal way to use the technologies throughout their studies, careers and lifetimes.

Although these issues are taught specifically in this module, they should also be reconsidered and readdressed in various parts of the course as a means to strengthen students’ awareness of the issues, for instance, security measures on network will be touched on again in more detail in Data Communications and Networking.

**Learning Objectives**

Students should

- understand equity issues relating to the access of information and communication technologies;
- understand health hazards and recognise preventive measures in using information and communication technologies;
- understand major issues regarding intellectual property and privacy;
- be aware of the potential threats on the Internet and demonstrate measures to reduce the threats; and
- appreciate the need to use information and communication technologies safely, sensibly, legally and ethically.

The time allocation for the module is about 28 hours.
Details

This module comprises four main areas to be discussed with students. They are issues on “Equity of Access”, “Work Issues”, “Intellectual Property” and “Security on the Internet”. Further information on the issues is summarised as follows:

a. **Equity of Access** (2 hours)

   - Discuss equity issues in terms of gender equity, access for the disabled and the digital divide from local and global perspectives.
     
   In explaining the digital divide, the rising of a knowledge-based society as a result of the development of information and communication technologies should also be discussed.

b. **Work Issues** (2 hours)

   - Discuss the change in nature of work such as work monitoring, telecommuting and retraining etc.
   
   - Identify health hazards associated with the use of computers / IT equipments, and propose good ergonomic practices when using computers.
     
   In ergonomics, consideration includes the reduction of injuries which arise from repetitive strain injuries (RSI) and electromagnetic radiation, the suitable design and placement of the furniture, the design of the software (with user-friendliness features such as ease of use, consistent user interface) and work environment.

c. **Intellectual Property** (9 hours)

   - Define intellectual property and copyright.
   
   - Debate on the benefits of freeware, open source software and licenced software from the perspectives of users and software developers.
   
   - Identify the types of software piracy and internet piracy. Discuss their social, legal and economic implications.
     
   Piracy involves deeds such as copying licensed music or games on a CD-R and internet downloads for illegal uses. The conflict between freedom of information and privacy should also be discussed.

   - Outline cyberlicenced objects such as mp3, online videos and course-notes. Relate acts of possible infringement of copyright especially information retrieved from the Internet.
     
   Students should develop the habit of acknowledging the source of information and be aware of the appropriate use of multimedia materials and possible crimes and consequences of the illegal uses and broadcasting of these materials (e.g. B.T.)
Examine ways to reduce intellectual property theft, particularly on the Internet.

Examples of measures are the use of digital watermark and digital envelopes commonly used on the Internet.

Know some of the legal consequences, especially in education, related to the infringement of copyright in Hong Kong.

d. Security on the Internet (15 hours)

Know, from users’ perspective, possible security threats on networks and the Internet.

Supported by crimes reported on news, students should know the security threats such as viruses, worms and Trojan horse, and cookies from the automatic intrusion via dynamic web pages and peer-to-peer (p2p) or files download.

Demonstrate the control of automatic intrusion using built-in security functions of a browser.

Discuss the possible privacy threats (the leaking of data as well as personal information) on the Internet, and suggest ways to maintain privacy.

Supported by crimes reported on news, the violation of secrecy of data as a result of eavesdropping, hacking, phishing, spamming and junk mails etc. should all be considered and discussed with students. The need to maintain anonymity when participating in public activities such as posting ideas on newsgroups and internet relay chat should also be mentioned.

Realise information encryption technologies so as to prevent eavesdropping and interception.

This includes the basic concepts of data encryption, public and private key encryption systems, the relationship between the size of the key used and the degree of security and Hong Kong PKI.

Explain authentication and authorization as a means to control access of information on the Internet.

Basic concepts include the authentication methods for individuals, types of tokens used in authentication processes, types of digital certificates and procedures involved in obtaining a certificate.

Know security used in electronic transaction.

Concepts of SSL in secured transmission in e-commerce as a result of the development of cryptography and authentication technologies should be mentioned. Other security measures in e-payments such as electronic cash, smart cards, and protocols (e.g. secure electronic transaction SET) should also be introduced.

Be aware of the latest development in security measures.
The Elective Part

2.10 The elective part comprises of 4 options.

A. Databases

Introduction

With the common use of databases in our society, the knowledge and skills in database management have become essential. This option introduces students to the fundamentals of databases and relational database design. It covers the application, management and design aspects of databases. Students will learn how to construct simple data models using entity-relationship diagrams and to appreciate the importance of good database design. They will also learn to use Structured Query Language (SQL) to construct, manipulate and retrieve information from a relational database. In addition, students will be exposed to database security, integrity, data privacy issues and be aware of the impact of database development on society. Through the learning of this option, students will acquire a basic understanding of the concepts, skills and applications of databases, and elementary data modeling concepts.

Learning Objectives

Students should

- explain concepts and applications related to databases and the database management system (DBMS);
- understand the basic concepts of a relational database, and be able to construct, manipulate and extract information from a relational database using Structured Query Language (SQL);
- identify and perform analysis of the data requirements of simple scenarios in different fields;
- construct simple data models using entity-relationship (ER) diagrams methodology;
- appreciate the importance of a good database design as a blueprint for the development of a database system;
- recognise the importance of database security, integrity and data privacy, and identify measures for improvement; and
- be aware of database development and its impact on society

The time allocation for the option is about 75 hours.
Details
The option Databases comprises five topics; namely, “Introduction to Database”, “Relational Database”, “Introduction to Database Design Methodology”, “Database Security, Integrity and Data Privacy” and “Database Applications, Development and Society”. Further information on the five topics is summarised as follows:

a. **Introduction to Database**  (8 hours)
   - Aware of the uses and applications of databases in our everyday life such as database usage in education, public services, business and commerce, etc.
   - Discuss the importance of databases in an organisation and how it improves the operations of an organisation.
   - Know database models, such as relational model and hierarchical model, and list examples of its usage.
   - Describe the purposes and functions of database management systems.
   - Explain the concepts of data definition language, data manipulation language, data dictionary and have experiences in constructing simple data dictionary.
   - Describe and explain the relationship of data, fields, records, tables, files and databases.
   - Describe common data types such as integer, real, character, string, Boolean, date, etc.

b. **Relational Database**  (28 hours)
   - Explain the concept of program-data independence.
   - Describe the basic concepts of relational databases.
     It includes entity, relationship, attribute, domain, index, key such as primary key, foreign key, candidate key and composite key, integrity such as entity integrity, referential integrity and domain integrity, etc. and be able to identify these basic elements in examples taken from everyday applications.
   - Create a simple relational database.
     Students should know how to organise data differently but sensibly in a relational database and be able to establish the required relationships to link up the tables.
   - Use SQL to maintain a simple relational database, manipulate its data or retrieve the required information in at most 3 tables.
     Skills involved include
     - modify the structure of the tables
     - add, delete and modify the data in the tables
     - view, sort and select the contents by filtering
use appropriate operators and expressions such as arithmetic operators and expressions, comparison operators, logical operators and the in, between and like operators, etc. to perform specific operations

use simple built-in functions such as aggregate and string functions, etc.

perform queries on multiple tables including the use of equi-join, natural join and outer join

perform sub-queries (for 1 sub-level only)

export query results to, for example, text, html or spreadsheet format, etc.

c. Introduction to Database Design Methodology  (18 hours)

· Be aware of and appreciate the importance of a good database design in effective database management.

· Be aware of the three levels of data abstraction namely conceptual level, physical level and view level.

· Explain the concept of data independence.

· Be aware of the three types of relationship (one-to-one, one-to-many, many-to-many) among entities in a relational database.

· Analyze simple scenarios in business, education or other fields and create simple entity-relationship (ER) diagrams involving binary relationship only in designing databases.

   The resolution of many-to-many relationship into multiple one-to-many relationships should also be introduced.

· Describe the concepts of instance and schema.

· Explain the meaning and purpose of normalization.

· Explain the concepts of data redundancy and be aware of the methods or measures used to reduce data redundancy.

· Transform the ER diagrams to tables in relational databases and create a database schema for a given set of data to describe the characteristics of the database.

d. Database Security, Integrity and Data Privacy  (13 hours)

· Identify different forms of security threats including unauthorised access, malicious destruction or alteration, etc.

· Identify and describe different security measures in prevention aspect such as measures in physical, human, operating system and database system level, detection aspect such as anomaly detection and misuse detection and recovery aspect such as log-based recovery.
• Compare the effectiveness of different security measures.

• Identify integrity threats such as malicious or accidental introduction of inconsistency.

• Explain the atomicity nature of transactions.

• Explain the need of concurrency control and mechanism such as lock-based method to preserve consistency of transactions.

• Discuss the importance of data privacy and develop proper attitudes to be an ethical user of database to respect data privacy.

e. **Database Applications, Development and Society** (8 hours)

• Be aware of the motivation of data mining.

• Briefly describe technologies to support data mining including massive data collection, data warehouse, powerful multiprocessor computers and data mining method.

• Be aware of the uses and applications of data mining in business field and explain how data mining can further improve the benefit of a business.

• Recognise factors leading to future database development such as massive data, variety of data, variety of users, etc.

• Be aware of database development affected by technologies including mobile/wireless technologies, dynamic webpages, etc.

• Know different database personnel such as database administrators, designers, developers and data entry operator and describe their roles and responsibilities in database development and maintenance.

• Appreciate how efficient retrieval of vast amount of information changes the future life of people.
Symbols used in entity – relationship diagrams

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<thead>
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<th>Meaning</th>
<th>Symbol</th>
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<tr>
<td>Attribute</td>
<td><img src="image" alt="Attribute" /></td>
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<tr>
<td>Key Attribute</td>
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<tr>
<td>Relationship</td>
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<td>One-to-One Relationship</td>
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<td>One-to-Many Relationship</td>
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<td>Many-to-Many Relationship</td>
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<td>Participation constraints:</td>
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B. Data Communications and Networking

Introduction

This option is designed to give students an understanding of the basic principles of data communications and networking, and the knowledge and skills associated with the design, implementation and maintenance of a simple network. Students will also be aware of the common security threats to networks and the measures to improve network security. This option will give students a solid foundation on data communications and networking. Students will find it valuable and extremely practical, no matter whether they continue to pursue the knowledge in this area in tertiary education or migrate to the workforce.

Learning Objectives

Students should

- know the basic concepts and technologies behind data communications and networking;
- be able to identify and describe the functions of components involved in Ethernet and wireless networks;
- be able to describe the uses and applications of a network;
- be able to design and implement a simple network;
- be able to assess the performance of a network and implement measures to improve it;
- know the importance of network security and be able to propose measures to improve it; and
- observe and appreciate the latest developments and the future trends of networking technology.

The time allocation for the option is about 75 hours.
Details

The option Data Communications and Networking comprises three topics; namely, "Data Communications and Networking Basics", "Network Design and Implementation" and "Network Management and Security". Further information on the three topics is summarised as follows:

a. Data Communications and Networking Basics (38 hours)

i. Basic concepts of data communications

- Understand the simple model of communications.
  Components of the model include agent, input device, transmitter, transmission medium, receiver, and output device.

- Know the basic concepts of data encoding.
  Distinction between data and signals should be known.
  Knowledge on either form of digital and analog data could be encoded into either form of digital and analog signal is required.

- Compare different data transmission media.
  The transmission media include copper wires, glass fibers, radio, microwave, and infrared, etc.
  They are compared in terms of capacity, transfer distance, cost, and security consideration.

- Know that transmission impairments can be caused by attenuation and noise.

- Understand some error detection methods such as parity check, checksum and cyclic redundancy check (CRC), etc.
  Implementation arithmetic of parity check and checksum should be known.

- Identify and describe the three communication modes: simplex, half-duplex, and duplex.

- Compare asynchronous and synchronous transmission in terms of timing and overhead.

- Know the simple concept of multiplexing and its function in sharing the capacity of a data link.

- Explain briefly different multiple access techniques including Carrier Sense Multiple Access (CSMA), Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA).
  Knowledge on both Carrier Sense Multiple Access with Collision Detection (CSMA/CD) and Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) is required.
ii. Networking technologies

- Understand the simple concepts of circuit switching and packet switching.
  
  The basic function of each component of a packet including header, data and trailer should be known.

- Be aware of the need for protocols.

- Know the basic concepts of Internet Protocol (IP) addressing including the scheme and classes of IP addresses.

- Compare TCP/IP protocol suites such as IPv4 and IPv6 in an evolutionary perspective.
  
  Different versions of TCP/IP protocol suites are compared in terms of address size and their support for audio and video.

- Know the use of a subnet and know what a subnet an IP address belongs to from a simple subnet mask.

- Describe the characteristics of the different types of network, including the Local Area Network (LAN), Wide Area Network (WAN), and Personal Area Network (PAN).

- Describe the characteristics of each basic network topology such as star, ring and bus.

- Explain the factors that need to be considered in choosing between a client-server network and a peer-to-peer network.
  
  The factors include the network services required, setup and maintenance cost, workload of the network administrator, etc.

- Compare the common types of communication links for Internet access in terms of capacity, cost, and reliability.
  
  The communication links include modem dialup / cable modem, leased line, broadband, and wireless, etc.

- Explain briefly the basic concepts regarding the design of mobile cellular system including interference, frequency reuse and plan, handoff, etc.
  
  Implementation arithmetic underlying the concepts is not required.
iii. Network components

- Identify and describe the functions of the various hardware components which make up the networks from the Internet to PAN.
  
The hardware components include network interface cards (NICs), cables, hubs, switches, routers, gateways, wireless adapters, wireless access points, wireless routers, mobile phones, personal digital assistants, etc.

- Explain briefly the services provided by a network operating system.

- Identify and describe the functions of the basic infrastructures that compose a cellular system including mobile station, base station, and mobile switching center.

iv. Network applications

- Describe and appreciate the applications of various networks.
  
The applications include resources sharing, web serving, and telecommuting, etc. Simple knowledge on latest mobile computing applications and their role in supporting the mobile business, mobile government services, and mobile life initiatives should be discussed.

- Describe different personnel involved in a networking environment.
  
The types of personnel should include network engineer and network administrator.

b. Network Design and Implementation (26 hours)

- Conduct a simple need analysis on a proposed network and translate the needs identified into requirements and specifications.

- Design a network to meet the requirements generated in the need analysis and represent it in a diagram.

- Justify their design based on technical, cost-effectiveness and other considerations.

- Have the experience of setting up simple Ethernet and wireless networks.

- Have the experience of sharing various resources including files, printers and Internet connection, etc. among the networked computers/stations.

- Have the experience of setting folder/file-sharing permissions including read, write and execute rights, etc.

- Have the experience of validating a network system by testing it according to a simple test plan based on the requirements and specifications.

- Document the user requirements, a schematic diagram for the network and specifications of the network.
  
  Documentation of industry standard is not required.

- Be aware of the importance of adequate end-user support and training on the attainment of the benefits sought.

- Appreciate and value the use of various networking technologies in meeting different user requirements.
c. Network Management and Security  (11 hours)

i. Network management

- Develop the basic skills of monitoring and fine-tuning the performance of a simple network.
- Develop the basic skills of analysing problems associated with the use of a networked environment and performing troubleshooting for it.
- Be aware of the importance of backup in disaster planning and recovery measures.
- Know the common hardware and software components of a network backup solution, such as Redundant Array of Independent Disks (RAID), Uninterruptible Power Supply (UPS), network backup servers, network backup and recovery software, etc.

ii. Network security

- Describe the potential risks caused by the common network security threats including virus, worm and Trojan programs, spyware, unauthorised access, interception, etc.
- Propose effective measures to improve network security for both wired and wireless networks. These include anti-virus programs, authentication, access and user right control, packet filtering, public and private key encryption, Wired Equivalent Privacy (WEP), and IPsec used in Virtual Private Network (VPN), etc.

  Encryption mechanism to guarantee a message is both authentic and private should be known.
  Detailed implementation algorithms of public and private key encryption are not required.
  Technical details on how a VPN is constructed are not required.
C. **Multimedia Production and Web Development**

**Introduction**

This option is designed to equip students with the basic concepts, technologies and tools in developing multimedia products. It will provide students with the useful and practical knowledge related to website design and development. This includes the learning of the incorporation of multimedia in web pages, and the fundamentals of designing, developing and publishing dynamic web pages on the Internet.

**Learning Objectives**

Students should
- describe and examine the benefits of multimedia applications;
- locate, create and process the different kinds of multimedia elements;
- integrate use of multimedia elements into a simple multimedia application;
- analyse design factors for presenting information effectively on the Internet;
- use a web authoring tool together with the associated web authoring skills to develop web pages, and publish web pages on the internet; and
- use client-side scripting to enhance the dynamics and interactive features of web pages.

The time allocation for the option is about 75 hours.
Details

The option Multimedia Production and Web Development comprises three topics; namely, “Multimedia Production”, “Design Factors for Presenting Information on the Internet” and “Web Development”. Further information on the three topics is summarised as follows:

a. Multimedia Production (24 hours)

i. Multimedia Applications

- Describe multimedia applications.
  e.g. advertisement, entertainment, public information, training and education, etc.

- Examine how multimedia elements of a multimedia product function together to produce meaning for an audience.

- Identify the benefits of multimedia applications.

ii. Basic Concepts and Use of Different Multimedia Elements

- Make a distinction among different multimedia elements.
  e.g. between bitmaps and vector graphics, between wave files and midi files, etc.

- Change the attributes of the multimedia elements according to given needs.
  e.g. the font size and typeface of text, the colour scheme of graphics, the amount of details for digital information, etc.

- Convert the same kind of multimedia elements from one file type to another.

- Perform simple editing and processing on multimedia elements.
  e.g. changing the sharpness and brightness of graphical images, applying filters to give special effects, performing simple editing and mixing of wave files, performing simple video editing, etc.

- Capture digital images.
  e.g. use scanners, digital cameras, screen capture, etc.

- Construct simple vector graphics using a graphic utility.

- Use features of a sound card to capture audio information.

- Construct simple animation, such as the animated Graphics Interchange Format (animated GIF) and animations involving characters changing against a static background using appropriate software.

- Understand the meaning of digitisation and compression, and the need to strike a balance between the file size and the resolution in processing multimedia elements.

- Integrate multimedia elements into a cohesive work of multimedia in a given context.
  Required multimedia elements are digital photography, sound/movies clips, frame-by-frame animations, shape/motion tweening, morphing.
b. Design Factors for Presenting Information on the Internet  (6 hours)

- Recognise the essential factors to be considered in their design strategy during the planning stage.

  With the demonstration of some sampled websites, students should understand factors such as audience awareness, content purpose, website structure, viewing environment, bi-lingual with tradition and simplified Chinese version, site map, feedback functions, bandwidth limitation, etc.

- Outline and discuss the various factors to be considered in the construction of web pages.

  By demonstrating some websites, students should discuss success factors such as the use of the workspace available on each page, arrangement of elements on screen, colour scheme, embed graphics/sound/animations appropriately, use of frames and meaningful contextual links, grouping related information into tables/lists, providing channels for feedback, providing details in downloadable files, structuring contents for easy printing, analysing and judging the use of the right resolution and file format for images & photography in order to keep download times low, etc.

- Know that there are guidelines to cater for web accessibility by people with special needs.

c. Web Development  (45 hours)

i. Website Development using Web Authoring Tool

- Construct web pages using Web Authoring Tool.

  Students should be able to use links, anchors, lists, tables, frames, Mailto and Fill-out Forms in constructing the web page. They should also be able to embed multimedia elements in the web page and apply a consistent look and style across a set of web pages with Cascading Style Sheets.

- Publish web pages.

  Students should know the basics of getting a domain name and find free web hosts. They should also be able to transfer web pages from local PC onto website on the Internet using the FTP program and get website listed on the major search engines.

ii. Enhance the Dynamics and Interactive Features of Web Pages - Client-Side Scripting

- Understand the difference between server-side and client-side technologies.

- Describe the characteristics of client-side scripting.

- Control multi-frame navigation.

- Create dynamic menus upon user selection.

  Students should be able to create a 2 level interdependent select list, pull down menu and click-to-expand menu.

- Create and manipulate browser window.
Students should be able to create pop-up window, manipulate window location, window size and allow scrollbars to appear when necessary. They should also be able to embed message in browser window’s status bar such as display current date, time, URL and its description.

- Perform special effects.
  Students should be able to create scroll message and rotating image banners. They should also be able to create mouseover effect to indicate that an option is linked, to show an item is selected and to display related descriptive information.

- Validate and manipulate input data.
  Students should be able to check text data, numeric data, required input, length of input, manipulate radio and check box and valid values for all input data. They should also be able to perform simple computation to create quiz and simple mathematics games.

- Use cookies to save and retrieve visitor information.
D. Software Development

Introduction

The aim of this option is three-fold: to introduce to students the concepts of systems development, further programming concepts and programming languages, to develop in students problem solving skills through a systematic approach to algorithm design and programming, as well as to improve their logical thinking and critical thinking skills. Through the study of this option, students will understand the whole process of software development. They will be able to design and develop computer programs independently for solving problems. Students will also be exposed to various principles and techniques of algorithm design, different programming paradigms and phases of systems development. As such, students will develop their creativity and broaden their views on software development. Besides, this understanding will offer students a wider choice from which to think and select an appropriate approach to solve a specific problem in future.

Learning Objectives

Students should

- define and analyse problems;
- identify the steps involved in writing a program for problem solving;
- realise the importance of good programming skills and develop good programming styles;
- apply structured programming and simple constructs to program writing;
- recognise the importance of algorithms, think and formulate critically appropriate algorithms to solve problems;
- demonstrate creativity in designing and developing computer programs;
- identify and debug the errors, and ensure that the programs are executable as expected;
- prepare program documentation to summarise the design and to improve the readability of a computer program;
- illustrate different programming paradigms with appropriate programming languages;
- discuss the choice of different languages for meeting different needs;
- recognise the importance of a systematic approach to software development;
- apply concepts underlying software development in a systematic way; and
- describe the phases, activities and methodologies involved in systems development.

The time allocation for the option is about 75 hours.
Details

The option Software Development comprises three topics; namely, “Programming”, “Programming Languages” and “Systems Development”. Further information on the three topics is summarised as follows:

a. Programming (47 hours)

i. Problem definition and analysis

- Define problems and identify the tasks involved in a given problem.
- Identify the inputs and outputs involved in solving a problem.
- Plan the solution by choosing an appropriate problem-solving approach.
  - The problem-solving approaches included are the top-down approach and the bottom-up approach.
- Describe the concepts of modularity and stepwise refinement.
- Apply structured programming to program writing.

ii. Design of solution

- Differentiate integer representation and floating-point representation.
  - The integer representation has been introduced in the Compulsory Part.
- Use simple data types, structured data types and user-defined data types.
- Use flowcharts or block diagrams to represent algorithms.
- Apply algorithms of counting, accumulating, swapping, searching, sorting and merging in writing programs.
  - The search algorithms included are linear search and binary search. The sorting algorithms included are bubble sort, insertion sort and merge sort. Merging involves only two arrays of data at one time. Students should realise that there are some other sorting algorithms, say quick sort, other than the three stated above.
- Choose an appropriate algorithm for a task.
  - Students should be aware that a problem may be solved by several algorithms. The selection of algorithms sometimes depends on their complexities and storage requirements as well as their trade-off. Students should evaluate the algorithm with respect to efficiency, correctness and appropriateness for a task.
iii. Implementation

- Use various basic constructs.
  Students should be able to use global variables, local variables, constants, assignment statements, input statements, output statements, arithmetic operators, string operators, Boolean operators and Boolean logic, operations of the operators including precedence and association.

- Apply control structures.
  The control structures included are sequence, selection and iteration.

- Create and manipulate lists, linear linked lists, stacks and queues in terms of arrays.

- Use file handling statements to manipulate text files.
  The manipulation involves file updating statements to delete, insert, append and amend records.

- Employ parameters passing in manipulating subprograms.
  The subprograms are called by two parameters passing methods: call by value and call by reference.

- Realise the importance of good programming listing.
  Students should develop the habits of using meaningful variable names, comments, annotations, space and indentation.

- Appraise the use of structured programming to design, implement and debugging errors.

iv. Testing and evaluation

- Interpret errors.
  The errors included are rounding errors, truncation errors, overflow errors, underflow errors, syntax errors, logical errors and runtime errors.

- Use both manual methods and software debugging tools to debug programs and revise the programs after analyses.
  The software debugging tools include the use of stubs, flags, break points and program traces.

- Design sets of test data for program testing.

v. Documentation

- Develop the habit of documenting the processes of program development.

- Recognise various documents for documenting a program.
  The documents included are algorithm representation, program listings, the sets of test data and user manuals.
b. **Programming Languages** (12 hours)

i. **Programming paradigms**
   - Realise the evolution of programming languages.
   - Recognise the programming paradigms involved in procedural, logic, object-oriented and query languages.
     One programming language for each paradigm is selected for illustration.
   - Describe the criteria for selecting a programming language for a specific problem.

ii. **Language translators and compilers**
   - Define code generation, linkers and loaders
   - Compare compilers and interpreters.

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c. **Systems Development** (16 hours)

i. **Basic concepts**
   - Define a system and recognise the basic elements of a system.
     The basic elements of a system are environment, inputs, outputs, processes, interfaces and storage.
   - Know the development of a simple computer-based system.
   - Describe the phases involved in systems development using Waterfall Model.
     By using suitable case study, students should experience the processes and activities involved in various phases of systems development.

ii. **Systems analysis**
   - List some common methods and activities to gather information for analysing problems, identifying and documenting users’ requirements.
     The common methods and activities are interviews, surveys, questionnaires, observations and document review.
   - Know the need and use of a feasibility study against a proposed solution.
   - Examine the pros and cons of alternative proposals.
   - Write requirement specifications.
iii. Systems design

- Describe the functions of each part of a computer-based system and the related issues.
  The hardware platform, software, inputs, outputs, user interfaces, database structures, data processing, data control, data security and system security are concerned.
- Design and appraise an effective interface between the user and the system.
  Different types of human-machine interfaces are compared.
- Know system flowcharts, structure charts, data flow diagrams and data dictionaries to design, analyse and document a proposed system.
- Know critical path analysis on project management.

iv. Systems implementation

- Identify the major tasks involved in implementation.
- Design, create and prepare computer-based solutions.
- Explain different types of testing and their uses.
  The types included are unit testing, system testing and acceptance testing.
- Design a simple test plan for functionality of parts of a system.

v. Systems conversion and maintenance

- Compare different strategies of systems conversion.
  The strategies included are pilot conversion, phased conversion, parallel conversion and direct cutover conversion.
- Explain the needs for on-going maintenance, upgrading and trainings.

vi. Systems documentation

- Differentiate different types of documentation and their purposes.
  The types included are system documentation, technical documentation and user manuals.
- Document the processes and specifications.
  The examples of documentation are requirement statements, project plans and design plans.

vii. Alternative approaches

- Explore the limitations and shortcomings of the Waterfall Model.
- Recognise the benefits and limitations of some of the latest approaches.
  Two of the other approaches are Prototyping and Rapid Application Development.

viii. The personnel
• Identify various job titles with different stages of systems development.
Chapter 3     Curriculum Planning

Progression of Study

3.1 The proposed ICT Curriculum is designed in a way that enables students to explore their interests, potential and aspiration for further studies and career. It is built upon students’ prior knowledge and skills in their computer literacy studies from primary up to junior secondary. By including a variety of different topics in the teaching of ICT in SS1, students will have a taster year to make an informed decision in choosing a suitable combination of elective subjects to be studied from SS2 onwards.

3.2 To help students achieve the curriculum aims and objectives, schools may adopt different modes of curriculum implementation through selecting and varying the organization and teaching sequence of learning elements. In practice, most schools will teach the core modules prior to the option. However, some schools may start teaching the option immediately after related core module is covered. Our experiences in handling students in transition from primary 6 to secondary 1 and secondary 3 to secondary 4 with very different backgrounds in information technology knowledge and skills informed us that the transition would not cause major problem if the situation is well aware and curriculum planning has catered for the situation. To this end, students wishing to opt ICT starting SS2 would need to spend some extra time in the subject during the first few months of SS2 to make up the missing major knowledge and skills learned in SS1. In considering curriculum planning of ICT, schools should set priorities based on the benefits of students.

Guiding Principles

3.3 Below are some guiding principles that teachers should take into account in the curriculum planning process.

- Curriculum planning should cater for students with different abilities and inclinations.
- Learning will be made more meaningful by introducing authentic tasks and scenarios; and appropriate life-wide learning experiences.
- Topics are not to be taught in isolation. Appropriate integration of curriculum areas is encouraged.
- Schools should optimise the use of curriculum time to maximise learning effectiveness and, at the same time, address teachers’ operational needs.
Variations of Curriculum Planning

3.4 Among various strategies of curriculum planning, three sample cases on progression of study are provided for teachers’ reference. This is however only some suggestions on how to organise the learning elements and teaching sequence of the Curriculum. Schools should develop their own school-based curriculum planning whenever appropriate and feasible.

Case 1  ICT Curriculum Planning in ABC Secondary School

**Background**
School plans to offer 4 core subjects; namely, Chinese, English, Mathematics and Liberal Studies, and 3 elective subjects including ICT to their senior secondary students. Total curriculum time of ICT is 270 hours. For illustration purpose, 105, 105 and 60 hours will be allocated to the teaching of ICT in SS1, SS2 and SS3 respectively.

**Teaching Sequence & Time Allocation**

<table>
<thead>
<tr>
<th>Curriculum Time</th>
<th>Level</th>
<th>Compulsory Part</th>
<th>Elective Part</th>
<th>SBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>105 hours</td>
<td>SS1</td>
<td>IP (64 hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CSF (25 hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I&amp;A (28 hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>105 hours</td>
<td>SS2</td>
<td></td>
<td>BPC (20 hours)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SI (28 hours)</td>
<td></td>
<td>SBA (30 hours)</td>
</tr>
<tr>
<td>60 hours</td>
<td>SS3</td>
<td></td>
<td>One of the 4 options (75 hours)</td>
<td></td>
</tr>
</tbody>
</table>
Remarks:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP</td>
<td>Information Processing</td>
</tr>
<tr>
<td>CSF</td>
<td>Computer System Fundamentals</td>
</tr>
<tr>
<td>I&amp;A</td>
<td>Internet and its Applications</td>
</tr>
<tr>
<td>BPC</td>
<td>Basic Programming Concept</td>
</tr>
<tr>
<td>SI</td>
<td>Social Implications</td>
</tr>
<tr>
<td>SBA</td>
<td>School-based Assessment</td>
</tr>
</tbody>
</table>

**Rationale**

1) Learning office automation software, web authoring tool and Internet services in “Information Processing” and “Internet and its Applications” modules at an early stage of the Curriculum can equip students with the necessary knowledge and skill sets to complete the project work. Also, these practical skills are essential enabling skills to facilitate students’ self-learning. In addition, the “Computer System Fundamentals” module can provide foundation computer knowledge for students to study the more in-depth topics in the Curriculum.

2) Related modules of the compulsory part are taught in SS1 to let students have more understanding on the nature and contents of the options in the elective part. This will allow students to make an informed decision on choosing one of the options as they progress onto SS2 and SS3.

3) Curriculum time for SBA should be flexibly and appropriately allocated in SS2 and SS3 pertaining to the teaching schedule, to provide continuous feedback to students to enhance learning effectiveness.

4) Since the elective part is taught in the second half of SS2, one shortcoming of this arrangement is that students will have less time to work on the project work.
Case 2  ICT Curriculum Planning in DEF Secondary School

Background
Same as ABC Secondary School in Case 1, DEF Secondary School plans to offer 4 core subjects; namely, Chinese, English, Mathematics and Liberal Studies, and 3 elective subjects including ICT to their senior secondary students. Total curriculum time of ICT is 270 hours. For illustration purpose, 105, 105 and 60 hours will be allocated to the teaching of ICT in SS1, SS2 and SS3 respectively. However, this school introduces a variation on teaching sequence. “Databases” is the option selected and will be taught immediately after related compulsory modules are taught.

Teaching Sequence & Time Allocation

<table>
<thead>
<tr>
<th>Curriculum Time</th>
<th>Level</th>
<th>Compulsory Part</th>
<th>Elective Part</th>
<th>SBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>105 hours</td>
<td>SS1</td>
<td>IP (64 hours)</td>
<td>Databases (75 hours)</td>
<td></td>
</tr>
<tr>
<td>105 hours</td>
<td>SS2</td>
<td>CSF (25 hours)</td>
<td>I&amp;A (28 hours)</td>
<td>SBA (30 hours)</td>
</tr>
<tr>
<td>60 hours</td>
<td>SS3</td>
<td>BPC (20 hours)</td>
<td>SI (28 hours)</td>
<td></td>
</tr>
</tbody>
</table>
Rationale

1) The main advantage of this mode of teaching sequence is that students should learn related knowledge and skills in a sequential and structured manner instead of separated parts to enhance learning and teaching effectiveness. Mapping of related modules in compulsory part and option in the elective part is shown below.

<table>
<thead>
<tr>
<th>Compulsory Modules</th>
<th>Related Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Processing</td>
<td>Databases</td>
</tr>
<tr>
<td>Internet and its Applications</td>
<td>Data Communication and Networking</td>
</tr>
<tr>
<td></td>
<td>Multimedia Production and Web Development</td>
</tr>
<tr>
<td>Basic Programming Concepts</td>
<td>Software Development</td>
</tr>
</tbody>
</table>

2) Since the elective part is taught at an early stage of the Curriculum, students will have more time to work on the project work in SS2 and SS3.

3) Curriculum time for SBA should be flexibly and appropriately allocated in SS2 and SS3 pertaining to the teaching schedule, to provide continuous feedback to students to enhance learning effectiveness.

4) Only a portion of the compulsory part of the Curriculum is delivered to students in SS1. Students may not have a sufficient overview of the whole curriculum in order to choose an option in the elective part appropriately.
Case 3  ICT Curriculum Planning in GHI Secondary School

Background
1) School plans to offer 4 core subjects; namely, Chinese, English, Mathematics and Liberal Studies, and 4 elective subjects including ICT in SS1 to their senior secondary students to let them have a taste of various subjects. Students may choose 3 elective subjects from SS2 onwards.

2) Total curriculum time of ICT is 270 hours. For illustration purpose, 80, 130 and 60 hours will be allocated to the teaching of ICT in SS1, SS2 and SS3 respectively.

3) Students have completed their junior secondary Computer Literacy course and most of them are inclined to further their study in the area of multimedia and web authoring.

Teaching Sequence & Time Allocation

<table>
<thead>
<tr>
<th>Curriculum Time</th>
<th>Level</th>
<th>Compulsory Part</th>
<th>Elective Part</th>
<th>SBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>80 hours</td>
<td>SS1</td>
<td>IP (52 hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>I&amp;A (28 hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>130 hours</td>
<td>SS2</td>
<td>IP (12 hours)</td>
<td>CSF (25 hours)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>BPC (20 hours)</td>
<td>SI (28 hours)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SBA (30 hours)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60 hours</td>
<td>SS3</td>
<td></td>
<td>One of the 4 options (75 hours)</td>
<td></td>
</tr>
</tbody>
</table>
Rationale

1) Topics chosen to be covered in SS1 should be interesting and practical enough to
arouse students’ interest. To this end, topics such as “Introduction to Information
Processing”, “The Use of Office Automation Software” and “Principles of Effective
Presentation of Information” of the “Information Processing” module are chosen to be
taught in SS1. In addition, the “Internet and its Applications” module is also a good
choice to be taught in SS1.

2) Knowledge and skills of ICT taught in SS1 are transferable to other subjects even if
students opt not to study ICT from SS2 onwards.

3) Related modules of the compulsory part are taught in SS1 to let students have more
understanding on the nature and contents of the options in the elective part. This will
allow students to make an informed decision on choosing one of the options as they
progress onto SS2 and SS3.

4) Curriculum time for SBA should be flexibly and appropriately allocated in SS2 and
SS3 pertaining to the teaching schedule, to provide continuous feedback to students to
enhance learning effectiveness.

5) As less topics are covered in SS1, school needs to allocate more curriculum time to
cover the whole curriculum in SS2 and SS3.
Planning the NSS ICT Curriculum

For Students of Different Abilities and Inclinations

3.5 In junior secondary, the emphasis of technology education is on "Exploration, Experiences and Familiarization". After completing the Computer Literacy course, students should become “computer literate” with a broad and balanced knowledge of computer technologies; and have a platform to consider their interests, inclinations, career orientations etc. to make informed decisions on their choice of options in their NSS ICT studies.

3.6 In senior secondary, the emphasis of technology education is on "Exploring Orientation for Life-long Learning and Specialization". To cater for the needs of individual students of different learning abilities and inclinations, the ICT curriculum provides four options in the elective part:

- Databases
- Data Communications and Networking
- Multimedia Production and Web Development
- Software Development

3.7 The options in the elective part can broadly be categorised as those illustrating applications of computers in specific areas, and those intended for students who will pursue further studies in ICT as a discipline in tertiary education, though the two are not mutually exclusive. The actual number of option(s) offered by each school is to be determined by the school concerned. Schools should choose to offer the option(s) that best meet(s) their students’ needs, taking into consideration students’ abilities, interests and inclinations.

Making Student Learning More Meaningful

3.8 Knowledge is constructed through rich and authentic learning experiences. The use of authentic situations not only provides meaningful contexts for students to develop their potentials such as creativity and problem solving, but also provide students with opportunities to reflect upon the values they hold, to express and challenge their own views in real contexts. Below are two examples to illustrate how meaningful contexts can be integrated into learning and teaching.
Example 1: Community service project

To make students’ ICT learning more meaningful, schools can involve students in community service such as repairing computers for the elderly and disadvantaged groups. In addition to an authentic task which provides ample opportunities for students to practise the IT skills they have learned, serving others itself is considered an entry point for the development of personal values. Through serving others, students engage in learning how to see the needs of others, experience empathy and sympathy, and take appropriate actions to help to improve the quality of life. Students also develop a sense of responsibility, commitment and sometimes perseverance or resilience when there are barriers to be overcome. Upon completion of a task, students gain a feeling of satisfaction for what they have achieved, and develop confidence for further service and for facing more challenging tasks in the future. In this way, the authentic task fosters value education.

Other authentic tasks may include designing class web pages, setting up a database for alumni association, etc.

Example 2: Reading authentic materials

Everyday authentic materials outside the classroom such as newspapers, magazines and website, can be brought in to make learning of relevant topics more meaningful. For example, students are required to take turns in posting news / journal articles about hot network security issues of the week on bulletin boards or display booths. Students are also required to post their views about the articles and propose improvement measures. To facilitate discussion, teachers may host forums for students. By the end of a school term, students vote for the Top 3 network security threats. This reading to learn activity can make students become sensitive and watchful regarding recent trends and developments in the issue. Furthermore, in the process of evaluating critically various network security risks and their solutions, students' critical thinking skills are nurtured.

Integrating Conceptual Learning with Life-wide Learning Experiences

3.9 Life-wide learning refers to student learning in real contexts and authentic settings. As a subject that emphasises both conceptual and application learning, ICT learning should not be confined to the classroom only. There are many possible experiential learning experiences for students to learn by doing in real contexts and through interactions with people from different sectors.
Example 1: Visits to different IT organizations

When teaching the multimedia-related elements, schools can make arrangements for their students to visit different ICT organizations such as the Cyberport. This kind of activity can help students understand the application of technologies in their daily life and to gain experiences by doing. Alternatively, professionals and experts from ICT fields can also be invited to give talks and conduct activities in schools.

Example 2: Participation in IT-oriented competitions

Schools can encourage students to participate in ICT-oriented competitions such as Hong Kong Olympiad in Informatics. These competitions offer ample opportunities for students to apply knowledge and skills acquired from learning programming and software development-related topics.

Integrating Learning with Assessment

3.10 Assessment is an integral part of the ICT curriculum. Its main aims are to provide feedback to improve learning and teaching as well as to recognise the achievement of students. Thus, the delivery of the ICT curriculum is closely related to and supported by assessment activities.

3.11 The school assessment design should align with curriculum aims, design and learning processes of the subject. The design of assessment practices in the ICT Curriculum will make full use of the assessment occasions available during the three years of study, to provide continuous support and feedback to students. There will be a formative component unveiling needs and attainments during and throughout the process of learning, as well as a summative component marking the achievements of a student at the end of the course.

3.12 A variety of assessment modes including observations, oral quizzes, practical or skill tests, written examinations, progress reports required of project-like work, etc. can be employed. These continuous assessment measures at short and regular intervals can provide feedback for teachers, which help to ensure that students progress smoothly in their learning process with adequate prior knowledge and skills.
3.13 As assessment in the present curriculum has to be linked with the public examination, a number of practical constraints have to be taken into account in planning and designing assessment strategies for the curriculum. Please refer to Chapter 5 for more information on assessment.

**Managing the NSS ICT Curriculum**

3.14 To maximise the use of curriculum time, flexible timetabling is the key to create more room for effective student learning. By strategically arranging double periods or block lessons for the entire school year or in different terms, teachers are enable to utilise a wide range of pedagogies and learning activities to meet students’ learning needs and objectives of the ICT curriculum.

3.15 For school administrators, timetabling should facilitate collaborative teaching, lesson preparation and sharing of experiences among teachers. With support from school, the ICT panel coordinator should take a leadership role to promote collaborative lesson preparation and collaborative teaching among subject teachers. The focus of these meetings should be on teaching and learning related issues rather than on administrative matters.

3.16 By nature of the Curriculum, some topics are more conceptual while some are more practical oriented. Students could be flexibly grouped for topics of different natures to support the appropriate teaching strategies. For example, more students should be grouped in lessons with direct lecturing approach. For tutorial or practical sessions, a smaller group of students is more appropriate so that teachers will have opportunities to closely monitor the progress of individual student’s work.

3.17 Effective resources management including the use of computer rooms and other IT resources is also important for successful implementation of the Curriculum. Schools should coordinate and maximise the use of different computer rooms and/or the multimedia learning centre within and across all subjects. IT resources including hardware, software and network resources should be managed and maintained in a systematic way to support learning and teaching of the ICT curriculum.
Chapter 4  Learning and Teaching

4.1 As the 21st Century unfolds, there is a fundamental need to change strategies used in learning and teaching. The new culture of learning and teaching shifts from transmission of knowledge to learning how to learn, from over-emphasising content study to whole person development, from compartmentalised topics / subjects to integrated learning, and from the dependency on textbooks to diversified teaching and learning materials. All these changes attribute to the fact that citizens in the modern world need to be critical thinkers, problem solvers and good at articulating ideas, and above all active learners who can construct knowledge taken from various sources and from different perspectives in a rapidly changing environment.

4.2 Every student has a capacity to learn. Students learn best if they actively seek information to accomplish a learning task. They learn effectively when they play the role of researchers and navigators rather than spectators; the role of problem solvers and thinkers rather than passive recipients of a static set of facts, for these facts may become obsolete as the rate of computer development accelerates. Students need to construct their own knowledge, learn from different perspectives and be responsible for their own learning. This paradigm of learning comes naturally and effectively if students are intrinsically motivated and engaged in their learning, i.e. they themselves become active learners.

4.3 To engage students actively in learning, as shown in the diagram overleaf, teachers should put students in the center and blend the essential elements (Layer 1) required in effective learning into classroom learning and teaching strategies which are suggested in Layer 2. Consequential to the learning of the Curriculum delivered via various student-centered learning and teaching strategies, apart from knowledge and practical skills associated with computer technologies, students will develop generic skills such as problem solving, critical thinking, creativity and communication, and metacognition and learning to learn capabilities (Layer 3) which are beneficial to students in the complex world of work and study. This system of learning should be supported by the different and active roles played by teachers and supported by the new concept of assessment, assessment for learning, to further facilitate student learning.
Essential elements for active learning

4.4 Learning occurs best

- when students create their knowledge actively using their own learning strategy, and to engage in an active search for understanding of what is being learnt;
- when students make connections among concepts, skill elements and experiences;
- when it is structured in real-world problems or circumstances;
- in the context of relatively challenging tasks or problems;
- in a collaborative context that provides thought-provoking discussion, trust and supportive interaction from peers and teachers; and
- when students receive qualitative feedback, encouragement for self reflection and opportunity for practice and improvement.
Learning and Teaching Approaches

4.5 Learning in Information and Communication Technology is a complex, multi-faceted, active and interactive process. Apart from traditional lecturing approach, active learning elements can be infused into classroom activities for the effective learning and teaching of the Curriculum. The following approaches are suggested for teachers’ reference only. They are by no means the only way to deliver the Curriculum. Teachers may use a repertoire of learning and teaching strategies to achieve the learning objectives of the Curriculum.

4.6 Task-based Learning: Task is a goal-oriented activity with a clear purpose in mind. Teachers may structure learning opportunities that engage students actively in tasks that are related to real-world problems or circumstances. Ask students to perform, create, produce, or do something that invokes real world applications; for instance, the creation of an advertisement flier, the simulation of a tax payment, the creation of a school library database system and the setting up of a home network for shared internet access. The tasks, however, should be moderately challenging and interesting to increase students’ motivation. Teachers need to have very clear teaching objectives. The tasks, however, are tools which serve as instruments to facilitate student acquisition of underpinning concepts and skills, not the learning objectives themselves.

4.7 Life Wide Learning Approach: To enrich students with real-life experiences, activities such as visits to computer or IT companies or institutes help to widen their horizons on the applications of computer systems. Students interact with the environment with the purpose of exploring, learning and observing how problems are solved in a computer-based system. By giving students authentic experiences outside the school setting in the form of observation or problem-solving, which they may inevitably encounter in their own workplaces or study, it will facilitate deep learning in students. The inclusion of reflection on experience after the visit can certainly maximise learning.

If visits or field experiences of this kind cannot be provided, case studies of real-life examples regarding how computers are employed in various contexts can be used to bring out the concepts and methodologies behind and to further consolidate students’ concepts, knowledge and skills.
4.8 **Problem-based Learning and Project-based Learning:** Most students retain and use little of what they memorise in classroom. Students learn best when they are actively and purposely seeking information.

"Tell me, and I will forget. Show me, and I may remember. Involve me, and I will understand." (Confucius around 450 BC)

By engaging students in structuring solutions to real life and contextualised problems, problem-based learning or project-based learning helps to orient students towards knowledge-making over fact-collecting. Through searching and finding solutions to problems, students develop higher levels of comprehension and cognitive strategies to research, gain more learning and knowledge-forming skills and more social skills (collaboration and handling group dynamics) if group work is involved. This kind of approach emphasises long-term, integrated and student-centered practices. Because of the reduction in direct teaching, students assume greater responsibility for their own learning.

4.9 As a result of their rich learning outcomes, problem-based learning and project work should be integrated throughout the Curriculum and embedded in learning and teaching activities, and the assessments. This kind of methodology is commonly used throughout the computer industry and students will emulate these approaches. The importance of this kind of learning is also reflected on the mandatory Project Assignment in School-based Assessment. However, problem-based or project-based learning should not be restricted to a Project Assignment only. If problem-based or project-based learning is structured and guided carefully with built-in mechanisms on self-reflection, learning in both knowledge and skills will certainly be maximised.

4.10 **Making Connections and Integrated Approach:** The Curriculum should not be viewed as a collection of discrete and disconnected modules. Concepts, skill elements and experiences can be linked and integrated to make them more meaningful and achieve lasting cognitive connections. In helping students to make connections, students can then see the interrelationships between concepts within or beyond the Curriculum. This can facilitate flexible thinking, critical thinking and transferring of knowledge from one context to another.
4.11 **Approach to Sustain Fluency in Computer:** Faced with the rapid advancement of computer technologies, students should be encouraged to read computer journals and magazines, to update their computer knowledge and skills through knowledge networks such as educational newsgroups and websites available on the Internet, and to participate in various workshops or contests in order to enrich their learning experiences. All of these help to stretch the students’ potential in computer knowledge and nurture them into lifelong learners, similar to personnel working in IT industries, who continually keep abreast of new developments in the field.

4.12 **Collaborative Approach:** Effective learning is social and interactive. In the learning of computer and related technologies, students are often required to do group work. It is recommended that students at various ability levels should be grouped together in small groups toward solving a problem or accomplishing a project or a task. This will enhance the active exchange of ideas and multiple feedback within the small groups. This not only increases interest and retains information longer among students, but also promotes critical thinking, enhances communication skills and immediate feedback from the peers. The shared learning gives students an opportunity to engage in discussion and take responsibility for their own learning.

4.13 **Feedback and Reflection:** Feedback from peers and teachers throughout the learning process or activity, be it a project, a task or a problem to solve, is essential for effective learning and should be integrated into learning and teaching. Structured opportunity for practice should be given, for without opportunity for practice, even well-learned abilities will diminish.

Reflection is necessary to reach the point of deeper learning required for knowledge and skills to be used in future. Reflection enhances students’ self-assessment skills. Through reflection students use critical thinking to examine their understanding of the concepts, application of certain computer skills and presentation of work. They take control of their own learning. In doing so, students develop their learning to learn capabilities and metacognition. Without reflection, deep learning will not occur.

4.14 Effective learning can be achieved with the active involvement of teachers who can direct and orchestrate learning and teaching activities for students, and with a clear vision of assessments (especially assessment for learning) within and beyond the classrooms.
Teacher’s roles

4.15 New concepts of learning demands new concepts of teaching and different roles expected of teachers. To foster active learning, teachers must not only be knowledgeable about computer technologies, they also need to have the pedagogical skills and knowledge to deliver the Curriculum. First and foremost the teacher becomes a facilitator who may become the consultants or instructors of computer knowledge, resource guides or developers, assessors and learners in the learning community.

(i) Teachers are the *consultants or instructors* of computer knowledge, for they

- have a thorough understanding of the theories, principles and concepts of computer technologies deeply and flexibly so that they can help students to create useful cognitive maps, construct knowledge, apply to real-world settings, relate one idea to another and address misconceptions;
- serve as role models when they fulfil their roles as teachers, to inspire students with their computer knowledge and insights, approaches to problem solving, flexible and critical thinking, values and excellence to be pursued and upheld; and
- employ a repertoire of strategies to provide students with multiple ways to acquire knowledge, concepts and skills which the Curriculum encompasses.

(ii) Teachers are *knowledge facilitators*, for they

- are facilitators of students’ learning, not dispensers of facts and information in a student-centered teaching approach. The introduction of problem-based or project-based learning highlights the need for such a role.

(iii) Teachers are *resource consultants*, for they

- lead students to the art of self-learning by locating and securing tools, pools of resources and support to facilitate students’ learning anywhere and anytime.

(iv) Teachers are *assessors*, for they

- assess individual student as well as the class as a whole by using multiple assessments and multiple dimensions of learning, both formatively and summatively;
- know how to move from assessment to decisions about teaching strategies and about where each student is in the continuum of learning so as to help him/her to improve, thus increasing the prospects for successful learning; and
evaluate and reflect systematically and critically about their practice in light of student progress and pedagogical trends, and learn from experience.

(v) Teachers are learners, for they

act as a role model for life-long learning through continuous self-updating and self-improvement in both computer and pedagogical knowledge and skills.

While each of the five teachers’ roles has been described briefly and separately in the system of active learning, they are often interconnected and closely related. A teacher may indeed take on several roles simultaneously.

4.16 Teachers undoubtedly play a significant role in directing student learning in a dynamic flow of classroom activities. Assessment, on the other hand, helps students to understand curriculum expectations and can be a tool to improve their own learning. In fact, the kind of assessment used significantly influences what is learned and the degree of meaningful engagement by students in the learning process throughout the course.
Chapter 5  Assessment

Introduction

5.1  Assessment is the practice of collecting evidence of student learning. The aims are to improve learning and teaching as well as to recognise student achievements. In this curriculum, a variety of assessment modes in formative and summative ways are contrived and compiled to evaluate the different aspects of student performance. It should delineate the reflection of the curriculum objectives and contents upon the completion of the course.

Assessment for Learning

5.2  Conventional written examination is assessment for accountability purposes, to determine the products of learning at a certain point in time. It has been widely used in the past for assessing students' attainment in the knowledge domain, in particular for comparison purposes. However, it provides little feedback to students and teachers for improving learning and teaching processes as it is conducted in a summative manner. Moreover, practical computer skills and learning experiences are better reflected in the processes of learning rather than in written examinations. Curriculum change will not succeed without corresponding changes in assessment.

5.3  Assessment for learning provides a beneficial impact on teaching and learning. Teachers can plan and implement, with appropriate strategies, formative assessment to

- focus on how and what students learn;
- integrate it into learning and teaching;
- advocate a shared understanding of learning objectives and the criteria by which students are assessed;
- develop student's capacity for self-assessment and reflection;
- provide students with constructive guidance, feedback on work and opportunity to improve on their work; and
- recognise the full range of student achievements.
5.4 During the course of three years, teachers can build in many opportunities to assess how well students can learn. The assessment should provide feedback not only to students for improving learning, but also to teachers for better teaching. Indubitably, it can widen students’ horizon in acquiring computer knowledge as well as generic skills such as problem-solving and communication. It also renders the efficacious development of higher-order thinking skills through various authentic tasks including problem-based or project-based learning tasks arising from the learning and teaching approaches developed by teachers in collaboration with students.

**Internal Assessment**

5.5 Internal assessment refers to the assessment practices that schools employ as part of the learning and teaching strategies during the three-year study in ICT. During the three years of study, schools should be assessing the performance of students regularly, or helping students evaluate what they have attained themselves on a regular basis. Both approaches are considered essential as the former provides more objective information, while the latter strengthens students’ ownership of the learning process. A variety of assessment modes including observations, oral quizzes, practical or skill tests, written examinations, progress reports required of project-like work, etc. can be employed. As certain skills in ICT (e.g. the use of word processing software to create and edit documents, the use of email to send mails as well as attachments, etc.) have now become everyday life-skills, schools can also consider adopting assessment practices that aim only at evaluating whether students can or cannot perform required tasks, sometimes irrespective of how long it might take them or how they achieve them, for certain areas of the ICT Curriculum. In these cases, students are only required to demonstrate their competence. The performance of each student is compared against one or more defined standards instead of against other individuals.

**Public Assessment**

5.6 Public assessment of ICT leads to a qualification in the subject to be offered by the Hong Kong Examinations and Assessment Authority. In the public assessment of the ICT Curriculum, a standards-referenced approach will be adopted for grading and reporting student performance. The purpose of this approach is to recognise what each student can do in the subject at the end of the three-year senior secondary education. Each student’s performance will be matched against a set of performance standards, rather than compared to the performance of other students. It makes the implicit standards explicit by providing specific indication of student performance. Descriptors will be provided for the set of standards at a later stage.
5.7 Though a standards-referenced approach is adopted, the public assessment of the ICT Curriculum is not meant to include a summative component only. There will be a written examination conducted at the end of the third year and a School-based Assessment (SBA) component conducted predominantly and preferably during the second and third years of study. The allocation of marks is as follows:

- Paper 1 (Compulsory Part) 50%
- Paper 2 (Elective Part) 25%
- School-based assessment
  - core skills assessment 10%
  - project work 15%

School-based Assessment

5.8 Students’ learning outcomes cannot be comprehensively assessed and recognised in the conventional paper-and-pencil public examination. Students should be offered alternative opportunities to demonstrate their achievements. School-based assessment is a mode of assessment to primarily assess students’ learning outcomes that cannot be easily measured in the conventional examination. It aims to assess core practical skills of computer and integrated application of curriculum contents. In addition, it can alleviate the pressure from one-off examinations, as it is a continuous assessment of diversified modes. In view of these, school-based assessment is taken into account in the public examination to improve the validity and reliability of the public examination. It consists of the core skills assessment and one piece of project work. As teachers can well understand their students' learning and make professional judgments to student performance, they should administer the school-based assessment throughout the course in school.

5.9 Teachers can either use the assessment tasks provided by the HKEAA or set questions by themselves for the core skills assessment. For promoting the acquisition of the core skills, teachers can flexibly adjust their teaching schedule to arrange repeated assessments for students who fail in their attempt to demonstrate the learning of core skills.

5.10 Students are required to complete a project from a list issued by the HKEAA according to their chosen elective option. The context of a project to be assessed is pertinent to the core modules as well as the elective option taken by individual students. Teachers are encouraged to inform students the assessment criteria/guideline before starting the project and continuously provide feedback to students to improve their learning.
5.11 Projects will be assessed continuously and marked internally by teachers. In order to ensure the consistency in marking across schools, teachers should primarily rank their own students accurately according to student performance in the school-based assessment. The school-based assessment results will be statistically moderated by, but not limited to, the public written examination results. Professional judgments by examiners will also be involved.

5.12 30 hours of curriculum time has been allocated for the school-based assessment. The time reserved is for teachers to give advice and guidance to students regarding their pieces of work. It is essential that each piece of work is the demonstrated effort of individual students. The role of the teacher is essentially that of a facilitator. Further elaboration on the school-based assessment can be found on the documents and handbooks issued by the HKEAA. Students should note that the school-based assessment is a mandatory requirement of the public examination and the amount of effort spent on the school-based assessment need not be limited to 30 hours only.

**Learning Outcome Framework**

5.13 To address the curriculum aims and serve as the foundation of assessment activities, a learning outcome framework for ICT has been proposed. It includes three dimensions:

- Knowledge and concepts
- Practical and generic skills
- Values and attitudes

The relationship between the framework and modes of assessment can be depicted in the table below:

<table>
<thead>
<tr>
<th>Dimension of Learning Outcome</th>
<th>Example of Learning Objective</th>
<th>Assessment Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge and concepts</td>
<td>Understand how data are organised and represented inside a computer</td>
<td>Conventional paper and pencil tests</td>
</tr>
<tr>
<td>Practical and generic skills</td>
<td>Integrate the use of office automation software, process and present different types of information appropriately</td>
<td>Core skills assessment, project work</td>
</tr>
<tr>
<td>Values and attitudes</td>
<td>Appreciate how the advances in information and communication technologies foster the emergence and development of the Information Age and its impact on our society</td>
<td>Attempts should be made to assess skills and performance of students relevant to the learning of the subject instead of assessing attitude as a separate criteria. In fact, positive attitude is often implied and conducive to performance of skills during the learning process. Assessment of values and attitudes could be done through internal assessment as reflected in the student report card of the “Student Learning Profile”.</td>
</tr>
</tbody>
</table>

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5.14 This proposed framework justifies the assessment modes and activities such as conventional paper and pencil tests to assess knowledge and concepts which are more abstract; core skills assessment to evaluate students' performance in applications software; project work to assess generic and integration of practical skills, etc.

**Modes of Assessment**

5.15 A number of assessment modes can be used in the learning and teaching of Information and Communication Technology. Teachers should integrate assessment into learning and teaching and students can be well informed of how they will be assessed.

**Paper-and-pencil Tests**

5.16 Paper-and-pencil tests have been widely used as a mode of assessment. Teachers should focus on designing test items to assess the understanding of concepts, creativity and higher-order thinking skills rather than factual recall. Incorporation of open-ended questions in tests and examinations could help evaluating students' higher-order skills such as creative and critical thinking skills.
Example 1

Module : Information Processing

Topic : The Use of Office Automation Software

Knowledge / generic skills to be assessed :

i) Word processing – ‘search and replace’ function

ii) Problem solving skill

Part of Alan’s passage describing John Lee and John Woo is shown in the following box:

Mr Lee and John are working in ABC University. Mr Lee is a professor while John is a research assistant. They have been working together for more than two years.

Now Alan wants to make some changes in the passage:
• change ‘Mr Lee’ into ‘John Lee’
• change ‘John’ into ‘John Woo’

Describe briefly how Alan can do it by only using the ‘search and replace’ function.

(2004 ASCA Paper Q. 2(c))

Annotated Note

1 In this question, students should understand the operation of ‘search and replace’ function. The word processing tool will simply find the pattern of word(s) being searched and replace it with other word(s). It will not consider the content. So, students should predict the result after changes to avoid unexpected mistakes.

2 To complete the task, students should notice that there exists priority between the two operations of ‘search and replace’ function. Students who simply execute the ‘search and replace’ functions following the order described in the question will generate a wrong result. Instead, it should be done in reverse order. In this way, students’ problem solving skill is evaluated.
**Example 2**

**Module**: Social Implications

**Topic**: Security on the Internet

**Knowledge / generic skills to be assessed**:

1. **Knowledge on data privacy**
2. **Critical thinking skill**

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The Internet Fashion Design (IFD) is a web-based fashion retail company. It has accumulated a large number of customers during the past two years. Last month, the whole business of IFD was sold to a property development company. The development company screens the customers' profiles of IFD to select likely property-buyers and mails its property catalogue to these selected customers.

(a) Is it legal for IFD to sell its whole business including its customer information to another company? Explain your answer.

(b) Is it legal for the development company to use the customer information of IFD for the screening of likely property-buyers? Explain your answer.

(2001 ASCA Paper Q. 5)

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**Annotated Note**

1. In this question, students should have knowledge on data privacy.

2. This kind of question requires students’ critical thinking skill. Students have to support their point of view with convincing argument. To a certain extent, students’ value and attitude towards the controversial issues can also be evaluated.
Core Skills Assessment

5.17 The Curriculum encompasses essential knowledge, concepts and applications of information, communication and computer systems. Obviously, practical use of a computer cannot be excluded from the learning process. The acquisition of some core computer practical skills is paramount to students as the higher level of practical skills and the understanding of concepts in different curriculum contents are originated among the core skills to a certain extent. It is subsumed into the learning of the topics:

- The Use of Office Automation Software
- Principles of Effective Presentation of Information
- System Software
- Internet Services and Applications
- Elementary Web Authoring

5.18 Teachers should plan the core skills assessment pertaining to the teaching schedule. Teachers may assign an authentic task, which comprises the demonstration of different core skills, to students right after the teaching and learning of those core skills. Students should complete their work under teacher supervision.

5.19 The core skills assessment can inform students of their strengths and weaknesses. Since the core skills are essential for students to develop their potential level of learning of curriculum contents, teachers can repeatedly carry out an assessment to evaluate student performance on a particular core skill upon failure and make beneficial changes in instruction. However, the core skills assessment cannot be unduly and perpetually done throughout the course. The practice of repeated assessments without appropriate learning and teaching strategies is untenable. Teachers should avoid asserting the core skills assessment to be the sole driving force to teaching and learning.
Example 1

Module: Information Processing

Topic: Integrated Use of Office Automation Software

Core skills to be assessed: Concepts of OLE – mail merge

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ABC Secondary School
ICT Core Skills Assessment

Class: ______ Date: ___________ Time allowed: ______

Topic:
Integrated Use of Office Automation Software

Scenario:
XXX College Alumni Association was established since 1985 with around 1000 members. A reunion party will be held on 1st August 2005 to celebrate the 20th Anniversary. Details of the party can be found in the invitation letter template in file “Letter.doc”. Members’ correspondence is stored in file “Member.xls”.

Task:
Suppose you are the secretary of the Alumni Association. You are requested to prepare all invitation letters to be sent to members. Please make use of the files “Letter.doc” and “Member.xls” to generate invitation letters to different members.

Note:
Upon completion of the task, you should show the result on screen to your teacher. Please note that no printout of invitation letters is required.
Example 2

Module: Internet and its Applications

Topic: Internet Services and Applications

Core skills to be assessed: Application of internet services - email

<table>
<thead>
<tr>
<th>ABC Secondary School</th>
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<tbody>
<tr>
<td>ICT Core Skills Assessment</td>
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</table>

Class: ______  Date: ___________  Time allowed: ______

Topic: Internet Services and Applications

Scenario:
XXX College Computer Club will organise a “Video Editing Course” next month. Students interested are required to send an email to Mr. Ng at “ngsir@xxx.edu.hk” to apply. Since enrolment quota is limited, students have to provide reasons for studying the course.

Task:
Suppose you are interested in attending the course. You are required to send an email to Mr. Ng for the application with the following format.

To: ngsir@xxx.edu.hk
Cc: <your own email address>
Subject: Application of “Video Editing Course” (<Your Name>)

Message: Dear Mr. Ng,
I would like to apply to join the “Video Editing Course”.
Please consider the reasons provided in attached file.
Regards,
<Your Name>
<Your Class and Number>

Attached File: <A word file with reasons for applying the course>

Annotated Notes:

i) Skills that cannot be assessed in written form are suitable for school-based assessment.

ii) Assessments are recommended to be conducted during lesson time to minimise the workload of teachers and students.

iii) Successful completion of the tasks indicates that students are already acquainted with the skills.
**Project Work**

5.20 Project work aims to assess students' integrated application of nearly all dimensions of learning in the curriculum: knowledge and concepts, technical and generic skills, values and attitudes. It can enhance the qualities of independent learning including reflective thinking and self-improvement. Project work should be done in a continuous and prolonged way which is integrated into on-going learning and teaching activities with the guidance from teachers. Teachers may help students to divide project work into stages:

- Pre-training on report writing skills
- Interpretation and selection of project questions
- Data collection
- Further discussion on the project question based on the data collected
- Implementation of the project product, and submission of interim product and report
- Writing up of final report

(Note: Teachers can refer to the "Resource Package on Coursework Assessment of the S4-5 Computer and Information Technology Curriculum" published by EMB.)

**Oral questioning**

5.21 Oral questioning is a mode of assessment that is often employed in classroom teaching. It can serve as a complementary way by which teachers may coalesce oral questioning into core skills assessment and project work to have a better collection of evidence of student achievements. Questions from fact finding, problem posing, reason seeking, to those that promote higher levels of thinking or information which is unfamiliar to the students, can be set. Students’ responses are also valuable feedback to teachers to inform learning needs.
Chapter 6
Effective Use of Learning and Teaching Resources

6.1 Curriculum material for learning and teaching can be obtained from various sources: textbooks, reference books, newspaper, journals, periodicals and learning resources on the Internet. With appropriate selection of these learning and teaching resources, the pedagogies mentioned in Chapter 4 can be realised in classroom teaching to achieve the curriculum aims.

6.2 Students taking Information and Communication Technology can use textbooks (for the compulsory part) to provide them with foundational knowledge. There are three steps for teachers to advise students on the effective use of textbooks. Firstly, ask students to go through the required parts in the textbooks to get a quick overview of the material. Students should not take notes at first sight but rather focus on understanding the material. Otherwise, they are likely to take down too much information and simply copy without understanding. Secondly, ask students to review the material, locate the main ideas and important points after the first reading. Thirdly, students can try to paraphrase the ideas and points as their notes so that they can become more actively involved with the material. Students can then arrange information and series of facts from the textbooks so as to understand the material more thoroughly, thus creating a context for comparing and understanding material from other sources. As such, students can develop their “reading to learn” skills, too.

6.3 As some information from textbooks may be too academic, lacking real-life experiences and experimentation, or there are no textbooks for the options mentioned in this curriculum, students may need to seek more information from sources other than textbooks. Additional reading on reference books and alternative sources of information, say news, journals and periodicals, can assist students to create a richer understanding. Learning is by no means creative if there is too much dependence on the textbooks. Much material on Information and Communication Technology comes from reference books and those alternative sources of information.

6.4 Teachers may advise students on the choice of articles relevant to their studies. Students can acquire more information and perspective, interact or engage with facts and circumstances of the material. They can also practise and familiarise themselves with new vocabulary, concepts and technological advancement. In the meantime, students can further develop their “reading to learn” skills by reading these printed matters. Their self-learning skills are also enhanced and they become more sensitive and watchful regarding recent trends and developments in the computer field.
6.5 Conflicting information from different sources can impede students’ learning. Therefore, students should analyse it for commonalities and biases. After that, they should evaluate the conflicts: what to keep and what to kick. Finally, they should filter it with the context presented in the basic text. All these processes can then enhance students’ critical thinking. Learning will not be impeded but impelled.

6.6 As a facilitator, teachers should encourage their students to discuss with others on issues related to Information and Communication Technology. Students can present their own ideas and findings, exchange and challenge views of others in quest for consistency and conclusion. Through these classroom activities, students will have ample chances to develop their communication skills in the context of Information and Communication Technology.

6.7 Besides printed materials, the on-line resources also provide students and teachers with an open access to a vast amount of knowledge. The Internet is ubiquitous and pervasive to teachers and students. It can be both a regulated and an unregulated medium. Both teachers and students should be aware of the authenticity of the information from on-line channels. They should pay attention to the authority, currency, coverage, objectivity and accuracy of the on-line materials.

6.8 To acquaint teachers with useful and relevant learning and teaching resources, lists on reference books and sites on curriculum planning, learning and teaching, and curriculum materials are updated incessantly and can be found in the following EMB Technology Education Key Learning Area website:

Chapter 7  Supporting Measures

7.1 This Chapter outlines the strategies to support teachers and schools to be fully prepared for the implementation of the elective subject ICT in the new senior secondary curriculum.

7.2 At the end of the consultation, a Curriculum and Assessment Guide will be published to support schools in implementing the ICT curriculum. The Guide will provide information on the curriculum aims, framework and contents. Further details to facilitate planning and delivery of the curriculum, including the framework on school-based assessment will also be provided. Teachers may refer to relevant chapters in this consultation document for more details on these important topics.

7.3 To ensure smooth implementation of the ICT curriculum, teachers must have a firm grasp of the curriculum intention, and be fully equipped to deliver the curriculum contents confidently. As stated in Chapter 9 of the Report on the New Academic Structure for Senior Secondary Education and Higher Education, EMB will collaborate with various institutions in providing these professional development programmes. There are four components in the programmes:

- Understanding and interpreting the ICT curriculum (6 hours)
- Assessment (15 hours)
- Learning and teaching strategies (12 hours)
- Knowledge enhancement (18 hours)

The first two are core provisions to ALL teachers with the intention to teach ICT while the other two are optional. Hours in brackets are the proposed number of training hours per teacher.

7.4 The programmes will generally commence in the 2005/06 school year and will be provided progressively before the year of implementation. It is intended that the component on understanding and interpreting the ICT curriculum will be completed in 2005/06 so that all prospective teachers going to teach the subject would be able to understand the requirement and theoretical underpinnings in relation to curriculum design as soon as possible. The courses will be repeated for new teachers.

7.5 Different modes (e.g. seminars, workshops, e-courses, reflective practice, sharing of experience and best practices) will be used in the professional development programmes to allow flexible engagement to suit teachers’ needs.
7.6 Besides professional development programmes, an e-learning platform for the curriculum will also be developed to provide teachers with up-to-date knowledge and, more importantly, learning and teaching resources to enrich students’ learning process. To cope with the rapid and ever-changing nature of ICT, an e-learning platform is essential and considered more effective in providing just-in-time support to teachers and schools.

7.7 Furthermore, EMB will strengthen collaboration with leading ICT industry partners to support teachers and schools in terms of training provisions and curriculum resources. EMB will continue to develop learning and teaching resources and acquaint teachers with ways to access useful resources for the curriculum from various sources. For more details on effective use of learning and teaching resources, please refer to Chapter 6 of this document.
## Appendix

### I. Curriculum Planning

<table>
<thead>
<tr>
<th></th>
<th>Title</th>
<th>Author</th>
<th>Publisher</th>
<th>Year of Publication</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>A Broader View for Computing Education</td>
<td>Rich Halstead-Nussloch, Mike Mruphy and Bob Harbort</td>
<td>ASEE/IEEE Frontiers in Education Conference</td>
<td>1999</td>
</tr>
<tr>
<td>2</td>
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<td>Curriculum Development Council</td>
<td>Hong Kong Special Administrative Region</td>
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<tr>
<td>3</td>
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<td>Hong Kong Special Administrative Region</td>
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<tr>
<td>4</td>
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<td>Board of Studies N.S.W</td>
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<tr>
<td>6</td>
<td>Computing GCE Advanced Level</td>
<td>Edexcel</td>
<td>Edexcel Foundation</td>
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</tr>
<tr>
<td>7</td>
<td>Diploma Programme, Computer Science</td>
<td>International Baccalaureate Organization</td>
<td>International Baccalaureate Organization</td>
<td>2000 (2\textsuperscript{nd} Edition)</td>
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<tr>
<td>8</td>
<td>Edexcel GCSE in Applied Information and Communication Technology (Double Award)</td>
<td>Edexcel</td>
<td>Edexcel Foundation</td>
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<tr>
<td>9</td>
<td>Information Processes and Technology, Stage 6 Syllabus</td>
<td>Board of Studies N.S.W</td>
<td>N. S. W, Australia</td>
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<td>Information Processing &amp; Technology Senior Syllabus</td>
<td>Queensland Studies Authority</td>
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<td>2004</td>
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<td>11</td>
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<td>2002</td>
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II. Learning and Teaching

Reference Books

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<th>Title</th>
<th>Author</th>
<th>Publisher</th>
<th>Year of Publication</th>
</tr>
</thead>
<tbody>
<tr>
<td>3. Infusing higher-order thinking and learning to learn into content</td>
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<td>2000</td>
</tr>
<tr>
<td>instruction: a case study of secondary computing studies in Scotland</td>
<td></td>
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Websites

<table>
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<tr>
<th>Title</th>
<th>URL</th>
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<tbody>
<tr>
<td>1. Approaches to Learning</td>
<td><a href="http://www.ncrel.org/tandl/build2.htm">http://www.ncrel.org/tandl/build2.htm</a></td>
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<tr>
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<tr>
<td>4</td>
<td>Literature Review in Thinking Skills, Technology and Learning</td>
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### III. Curriculum Content

#### A. The Compulsory Part

**Reference Books**

<table>
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<th>Year of Publication</th>
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<tr>
<td>3</td>
<td>Computer Systems</td>
<td>Bryant, Randal E., O’Hallaron, David R.</td>
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<tr>
<td>5</td>
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</tbody>
</table>
| 2 | Electronic Payments and the Future of Electronic Commerce            | http://crec.bus.utexas.edu/works/articles/cy
berpayments.html                          |                            |                     |
| 3 | How E-Commerce Works                                                 | http://money.howstuffworks.com/ecommerce2.htm |                            |                     |
| 5 | RSA Laboratories on Cryptography                                     | http://www.rsasecurity.com/rsalabs/node.as
p?id=2157                                   |                            |                     |
| 6 | The Internet Guide To Popular Resources on Computer Security         | http://www.sans.org/resources/popular.php   |                            |                     |

**B. The Elective Options**

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ware                                        | McGraw-Hill Osborne Media       | 2004                |

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