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Diploma Programme

Information technology in a global society guide

First examinations 2012

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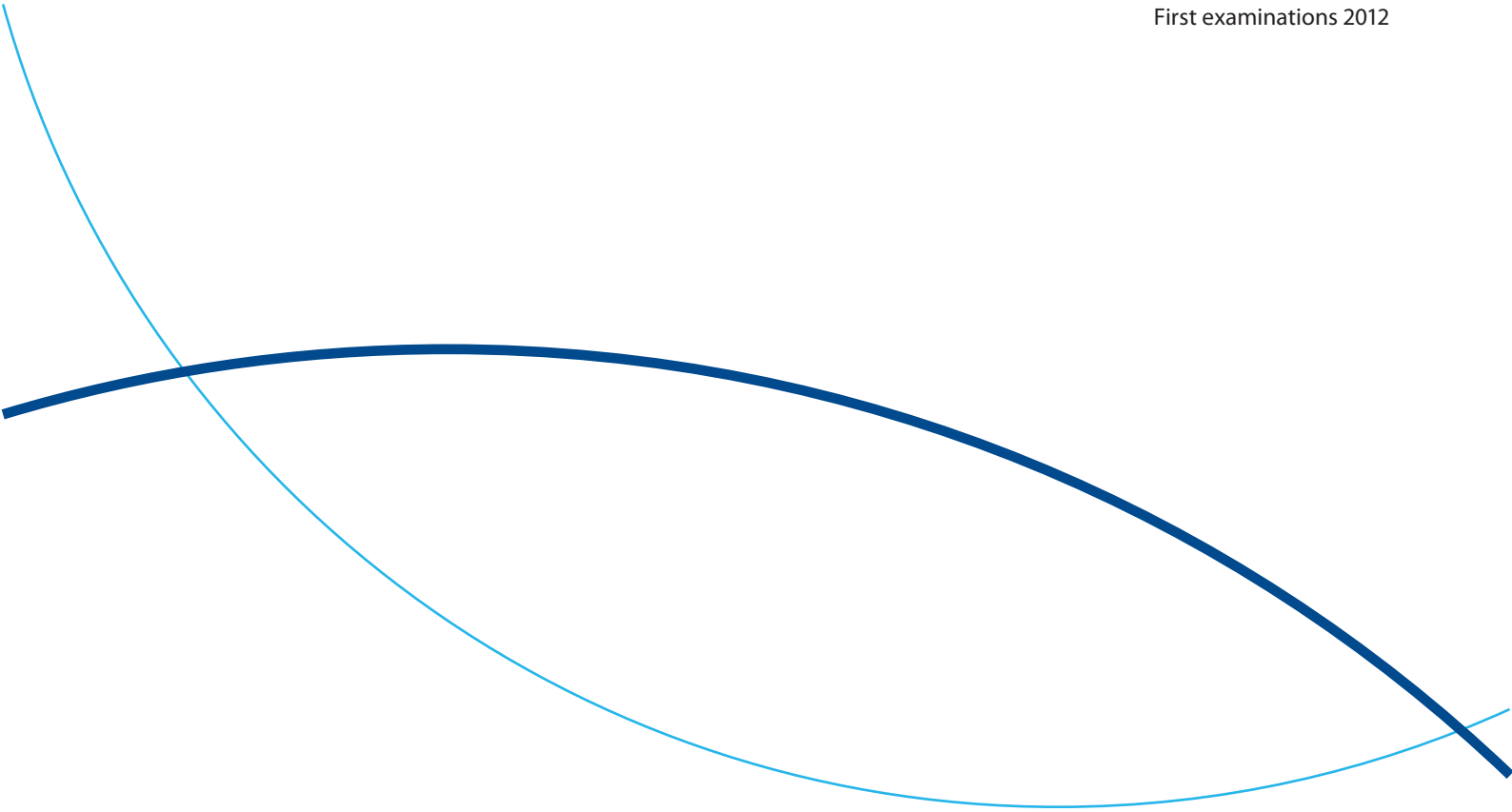

Diploma Programme
Information technology in a global society guide

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IB mission statement

The International Baccalaureate aims to develop inquiring, knowledgeable and caring young people who help to create a better and more peaceful world through intercultural understanding and respect.

To this end the organization works with schools, governments and international organizations to develop challenging programmes of international education and rigorous assessment.

These programmes encourage students across the world to become active, compassionate and lifelong learners who understand that other people, with their differences, can also be right.

IB learner profile

The aim of all IB programmes is to develop internationally minded people who, recognizing their common humanity and shared guardianship of the planet, help to create a better and more peaceful world.

IB learners strive to be:

Inquirers	They develop their natural curiosity. They acquire the skills necessary to conduct inquiry and research and show independence in learning. They actively enjoy learning and this love of learning will be sustained throughout their lives.
Knowledgeable	They explore concepts, ideas and issues that have local and global significance. In so doing, they acquire in-depth knowledge and develop understanding across a broad and balanced range of disciplines.
Thinkers	They exercise initiative in applying thinking skills critically and creatively to recognize and approach complex problems, and make reasoned, ethical decisions.
Communicators	They understand and express ideas and information confidently and creatively in more than one language and in a variety of modes of communication. They work effectively and willingly in collaboration with others.
Principled	They act with integrity and honesty, with a strong sense of fairness, justice and respect for the dignity of the individual, groups and communities. They take responsibility for their own actions and the consequences that accompany them.
Open-minded	They understand and appreciate their own cultures and personal histories, and are open to the perspectives, values and traditions of other individuals and communities. They are accustomed to seeking and evaluating a range of points of view, and are willing to grow from the experience.
Caring	They show empathy, compassion and respect towards the needs and feelings of others. They have a personal commitment to service, and act to make a positive difference to the lives of others and to the environment.
Risk-takers	They approach unfamiliar situations and uncertainty with courage and forethought, and have the independence of spirit to explore new roles, ideas and strategies. They are brave and articulate in defending their beliefs.
Balanced	They understand the importance of intellectual, physical and emotional balance to achieve personal well-being for themselves and others.
Reflective	They give thoughtful consideration to their own learning and experience. They are able to assess and understand their strengths and limitations in order to support their learning and personal development.

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Contents

Purpose of this document

This publication is intended to guide the planning, teaching and assessment of the subject in schools. Subject teachers are the primary audience, although it is expected that teachers will use the guide to inform students and parents about the subject.

This guide can be found on the subject page of the online curriculum centre (OCC) at http://occ.ibo.org, a password-protected IB website designed to support IB teachers. It can also be purchased from the IB store at http://store.ibo.org.

Additional resources

Additional publications such as teacher support materials, subject reports, internal assessment guidance and grade descriptors can also be found on the OCC. Specimen and past examination papers as well as markschemes can be purchased from the IB store.

Teachers are encouraged to check the OCC for additional resources created or used by other teachers. Teachers can provide details of useful resources, for example: websites, books, videos, journals or teaching ideas.

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The Diploma Programme

The Diploma Programme is a rigorous pre-university course of study designed for students in the 16 to 19 age range. It is a broad-based two-year course that aims to encourage students to be knowledgeable and inquiring, but also caring and compassionate. There is a strong emphasis on encouraging students to develop intercultural understanding, open-mindedness, and the attitudes necessary for them to respect and evaluate a range of points of view.

The Diploma Programme hexagon

The course is presented as six academic areas enclosing a central core (see figure 1). It encourages the concurrent study of a broad range of academic areas. Students study: two modern languages (or a modern language and a classical language); a humanities or social science subject; an experimental science; mathematics; one of the creative arts. It is this comprehensive range of subjects that makes the Diploma Programme a demanding course of study designed to prepare students effectively for university entrance. In each of the academic areas students have flexibility in making their choices, which means they can choose subjects that particularly interest them and that they may wish to study further at university.

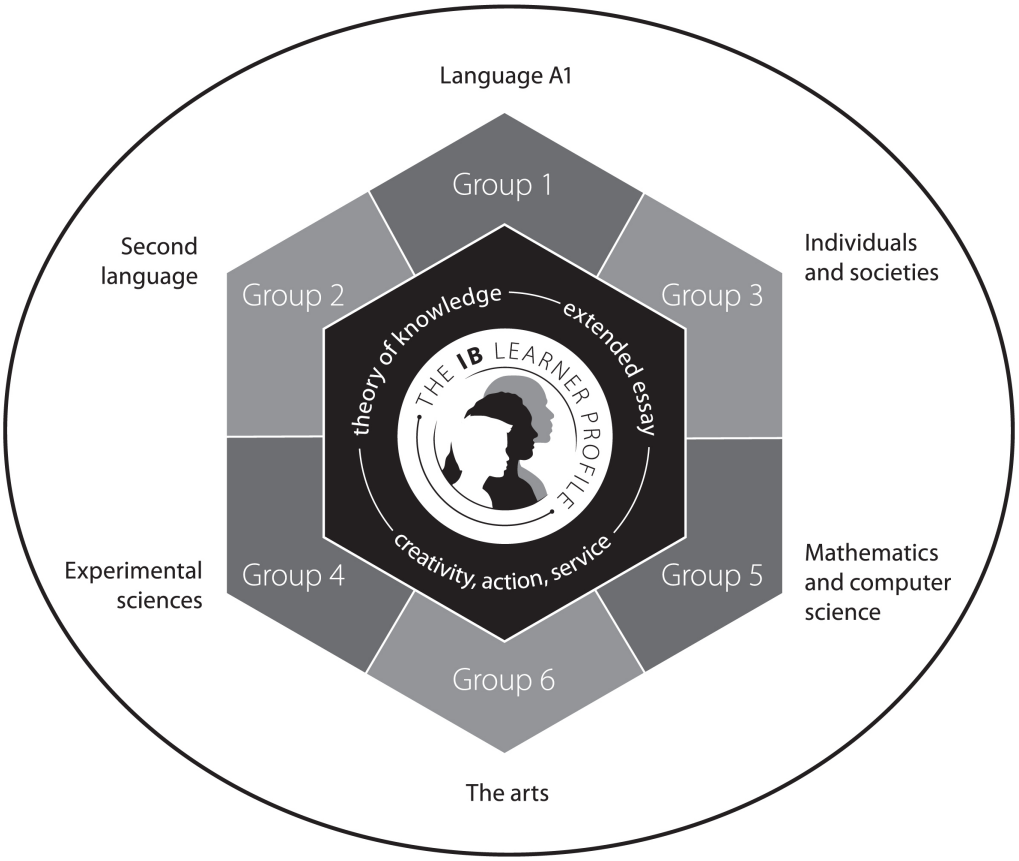

Figure 1
Diploma Programme model

Choosing the right combination

Students are required to choose one subject from each of the six academic areas, although they can choose a second subject from groups 1 to 5 instead of a group 6 subject. Normally, three subjects (and not more than four) are taken at higher level (HL), and the others are taken at standard level (SL). The IB recommends 240 teaching hours for HL subjects and 150 hours for SL. Subjects at HL are studied in greater depth and breadth than at SL.

At both levels, many skills are developed, especially those of critical thinking and analysis. At the end of the course, students' abilities are measured by means of external assessment. Many subjects contain some element of coursework assessed by teachers. The course is available for examinations in English, French and Spanish.

The core of the hexagon

All Diploma Programme students participate in the three course requirements that make up the core of the hexagon. Reflection on all these activities is a principle that lies at the heart of the thinking behind the Diploma Programme.

The theory of knowledge course encourages students to think about the nature of knowledge, to reflect on the process of learning in all the subjects they study as part of their Diploma Programme course, and to make connections across the academic areas. The extended essay, a substantial piece of writing of up to 4,000 words, enables students to investigate a topic of special interest that they have chosen themselves. It also encourages them to develop the skills of independent research that will be expected at university. Creativity, action, service involves students in experiential learning through a range of artistic, sporting, physical and service activities.

The IB mission statement and the IB learner profile

The Diploma Programme aims to develop in students the knowledge, skills and attitudes they will need to fulfill the aims of the IB, as expressed in the organization's mission statement and the learner profile. Teaching and learning in the Diploma Programme represent the reality in daily practice of the organization's educational philosophy.

Nature of the subject

Students of group 3 subjects study individuals and societies. This means that they explore the interactions between humans and their environment in time and place. As a result, these subjects are often known collectively as the human sciences or social sciences.

The IB Diploma Programme information technology in a global society (ITGS) course is the study and evaluation of the impacts of information technology (IT) on individuals and society. It explores the advantages and disadvantages of the access and use of digitized information at the local and global level. ITGS provides a framework for the student to make informed judgments and decisions about the use of IT within social contexts.

Although ITGS shares methods of critical investigation and analysis with other social sciences, it also considers social and ethical considerations that are common to other subjects in group 3. Students come into contact with IT on a daily basis because it is so pervasive in the world in which we live. This increasingly widespread use of IT inevitably raises important questions with regard to the social and ethical considerations that shape our society today. ITGS offers an opportunity for a systematic study of these considerations, whose range is such that they fall outside the scope of any other single discipline.

The nature of the subject is defined by the use of fundamental ITGS terms. For the purpose of the ITGS syllabus the following definitions apply.

- *Information technology* (IT) is the study, design, development, implementation, support or maintenance of computer-based information systems.
- *Social and ethical significance* refers to the effects that the development, implementation and use of information technology has on individuals and societies. Social impacts and ethical considerations are not mutually exclusive and are therefore categorized as a single entity. However, in general:
  - *social impacts* tend to refer to the effects of IT on human life
  - *ethical considerations* tend to refer to the responsibility and accountability involved in the design and implementation of IT.
- An *information system* is a collection of people, information technologies, data, processes and policies organized to accomplish specific functions and solve specific problems.

ITGS has links with subjects not included in group 3, notably computer science, but it should be noted that there are clear differences between the subjects.

ITGS	Computer science
In ITGS, people are central to the study of the subject. This is underpinned by a secure knowledge of the technology within the specified IT system. This technical knowledge ensures that the discussion of the effects of a new IT system on people will not be superficial.	In computer science, the emphasis is on a detailed knowledge of the computer system, followed by an awareness of its effects on people.
ITGS considers the internal workings of an IT system only to the extent of how it contributes to the understanding of a social impact or ethical issue.	Computer science emphasizes a detailed understanding of the logic and internal workings of a system.

ITGS	Computer science
ITGS is concerned with the development of IT systems, with particular emphasis on the effects on clients and end-users.	Computer science is concerned with algorithmic thinking and the ways in which a real-world problem can be decomposed in order to construct a working computable solution.
ITGS looks to implement a new IT system based on the use of currently available software.	Computer science looks to develop a new system using existing building blocks or by creating a totally novel approach as appropriate. This may involve the writing of new code in an appropriate programming environment.
ITGS is concerned with activities such as choosing and using a spreadsheet, finding ways of using it more effectively, and educating other people about its use. It is concerned with the effects of using the software and obtaining reliable results that are beneficial to all who are affected by it.	Computer science examines real-world problems and produces algorithms from which useful software can be derived. The computer scientist creates the initial concepts and designs to produce appropriate and novel solutions to problems or by adapting existing solutions.

The main difference between ITGS and computer science relates to the focus of study. ITGS is about how people are affected by systems already in use and those planned for the future. Computer science looks first at the technology and then later at its interaction with those affected by it.

Some degree of overlap between the two subjects is intentional, inevitable and desirable.

Distinction between SL and HL

Students at standard level (SL) and higher level (HL) in ITGS are presented with a syllabus that has a common core consisting of three strands: social and ethical significance, application to specified scenarios, and IT systems. Higher level students also study the HL extension.

The HL course in ITGS differs from the SL course in ITGS as follows.

- The HL course has 240 hours devoted to teaching, compared with 150 hours for the SL course.
- HL students study the following as part of the HL extension, which consists of two additional topics in the IT systems strand:
  - IT systems in organizations
  - robotics, artificial intelligence and expert systems.
- The HL course has an additional externally assessed component that comprises a pre-seen case study based on a fictitious organization; this allows students to research various aspects of the subject, which may include new technical concepts and additional subject content, in greater depth.
- The HL topic "IT systems in organizations" requires a study of the theoretical frameworks behind the development of IT-based products and the management of IT projects. This builds on the "Introduction to project management" topic in the SL/HL core, which provides students with the skills and knowledge necessary to develop the work for the internal assessment (the project).

Prior learning

No particular background in terms of specific subjects studied for national or international qualifications is expected or required, and no prior knowledge of ITGS is necessary for students to undertake this course. However, a familiarity with IT terminology, concepts and tools would be an advantage, as would be completing the humanities and technology courses in the IB Middle Years Programme (MYP).

Links to the Middle Years Programme

The MYP humanities course develops technical skills, analytical skills, decision-making skills and investigative skills, all of which are required in ITGS. In addition, an understanding of the key concepts of time, place and space, change, systems and global awareness prepares students for the demands of the ITGS course. This learning will help students to develop not only practical skills but also creative and critical-thinking strategies.

The MYP technology course develops skills linked to the design cycle, which provides the model of thinking and the strategy used to help students investigate problems and design, plan, create and evaluate the product. In order to successfully complete the IB Diploma Programme ITGS project, students are expected to create an IT solution to a specific problem using the product development life cycle, which extends the range of skills developed in MYP technology.

Middle Years Programme technology course	Diploma Programme ITGS course
Develop an appreciation of the significance of technology for life, society and the environment.	Develop the ability to evaluate the social, cultural and ethical considerations arising from widespread use of IT for individuals, families, communities and organizations.
Use and apply IT effectively as a means to access, process and communicate information, and to solve problems.	Develop an understanding of IT systems and the skills and knowledge to use them effectively.
Develop respect for others' viewpoints and appreciate alternative solutions to problems.	Compare the effectiveness of a range of possible solutions to a social and/or ethical consideration that has been identified in an IT context. In the case of the project, to justify the choice of the preferred solution used to resolve the inadequacies identified.
Use knowledge, skills and techniques to create products and solutions of the appropriate quality.	Effective use of an appropriate range of basic and complex IT tools during the study of ITGS and for the development of the ITGS project.
Develop problem-solving, critical and creative-thinking skills through the application of the design cycle.	Regularly consult with the client and obtain feedback about the product from the client using an appropriate method that indicates whether the product meets the client's requirements. Recommend proposals for the future improvement of the product.
Design cycle.	Product development life cycle (PDLC) and system development life cycle (SDLC).

As in the MYP technology course, a *product* can be defined as the solution that students have generated independently. This means that the Diploma Programme ITGS course requires students to become actively involved in, and to focus on, the whole design process rather than just on the final product, building on the skills acquired during the MYP technology course.

The IB technology continuum

The MYP technology course builds on experiences of inquiry that students have gained in their time in the IB Primary Years Programme (PYP). PYP teaching and learning experiences challenge students to be curious, ask questions, explore and interact with the environment physically, socially and intellectually to construct meaning and refine their understanding. Even when there is no technology component in the PYP, the use of structured inquiry is a precursor to the problem-solving and inquiry-based approach of MYP technology. Students continuing on to the IB Diploma Programme (DP) will have experienced the use of the design cycle and will have developed critical-thinking and design skills, which they will be able to apply and extend in ITGS.

ITGS and theory of knowledge

As with other subject areas, there is a variety of ways of gaining knowledge in group 3 subjects. For example, archival evidence, data collection, experimentation, observation, inductive and deductive reasoning can all be used to help explain patterns of behaviour and lead to knowledge claims. Students in group 3 subjects are required to evaluate these knowledge claims by exploring knowledge issues such as validity, reliability, credibility, certainty, and individual as well as cultural perspectives.

The relationship between group 3 subjects and theory of knowledge is of crucial importance and fundamental to the Diploma Programme. Having followed a course of study in group 3, students should be able to reflect critically on the various ways of knowing and methods used in human sciences, and in doing so, become "inquiring, knowledgeable and caring young people" (IB mission statement).

During the course in ITGS a number of issues will arise that highlight the relationships between theory of knowledge and ITGS. Some of the questions that could be considered during the course are identified in the following list.

- What is the difference between data, information, knowledge and wisdom? Are there technologies specifically designed to store and impart data, information, knowledge and wisdom?
- What did Sydney Harris mean when he said that "The real danger is not that computers will begin to think like men, but that men will begin to think like computers"? Was he right, or was it based on a misunderstanding of either men or computers?
- What do we mean by "holistic" and "reductionist" approaches to knowledge? What are the strengths and weaknesses of each approach?
- Is it possible to capture the richness of concepts such as "intelligence" or "judgment" via a reductionist approach? How can we know?
- If we attach a camera or microphone to a computer, it can receive data from the world. Does this mean that a computer can "perceive the world"? In what senses might human perception be a similar or different process?
- On what basis can we trust "knowledge" acquired from a range of sources?
- What role does ethics play in ITGS, science, mathematics and other areas of knowledge?
- A chess machine can beat the top human chess players. Does a machine therefore "know" how to play chess?

- In what ways does the concept of "fuzzy logic" challenge the conventional concepts of reasoning?
- How do we know if other humans feel emotions? Can a machine ever feel an emotion? How would we know?
- To what extent does IT influence the way in which we think about the world? To what extent do these technologies determine what we regard as valuable or important? Could it be argued that the increasing global dominance of a particular form of IT gives rise to an increasing uniformity of thinking?
- In what ways has technology expanded knowledge? In what ways has it affected how much we value the different ways of knowing and areas of knowledge? What fields of study have been founded on technological developments?
- Can it be said that every new technology affects the beliefs of individuals and societies in both positive and negative ways? How can the impact of new technologies be predicted? How reliable are these predictions?
- In what ways does IT influence the accessibility of information and the reasons for believing such information to be true? What are the effects of such control?
- Was Akio Morita correct when he claimed that "You can be totally rational with a machine. But if you work with people, sometimes logic has to take a back seat to understanding"?
- Does IT, like deduction, simply allow the knower to arrange existing knowledge in a different way, without adding anything, or does this arrangement itself represent knowledge in some sense?
- "In expanding the field of knowledge we but increase the horizon of ignorance" (Henry Miller). Is this true of the recent developments in IT?

ITGS and the international dimension

The ITGS course embodies global and international awareness in several distinct ways. It explores the advantages and disadvantages of the access to, and use of, digitized information at both the local and global level. ITGS provides a framework for the IB student to make informed judgments and decisions about the use of IT within a social context. Throughout the course, IB teachers have considerable flexibility in their choice of examples and case studies to ensure that Diploma Programme ITGS is a highly appropriate way to meet the needs of all students, regardless of their geographical location. Inherent in the syllabus is a consideration of different perspectives and economic circumstances, in addition to social and cultural diversity.

An ever-increasing number of people worldwide come into contact with IT on a daily basis. This increasingly widespread use of IT and the ease of access to information have led to the development of a "global village". It has also had unforeseen social impacts and raised new ethical issues. ITGS seeks to develop international understanding and cooperation, as well as fostering a concern for global issues pertaining to the use, misuse and disposal of IT hardware and unwanted digital information.

Aims

Group 3 aims

The aims of all subjects in **group 3, individuals and societies** are to:

1. encourage the systematic and critical study of: human experience and behaviour; physical, economic and social environments; and the history and development of social and cultural institutions
2. develop in the student the capacity to identify, to analyse critically and to evaluate theories, concepts and arguments about the nature and activities of the individual and society
3. enable the student to collect, describe and analyse data used in studies of society, to test hypotheses, and to interpret complex data and source material
4. promote the appreciation of the way in which learning is relevant both to the culture in which the student lives, and the culture of other societies
5. develop an awareness in the student that human attitudes and beliefs are widely diverse and that the study of society requires an appreciation of such diversity
6. enable the student to recognize that the content and methodologies of the subjects in group 3 are contestable and that their study requires the toleration of uncertainty.

ITGS aims

In addition, the aims of the **information technology in a global society (ITGS)** course at SL and HL are to:

7. enable the student to evaluate social and ethical considerations arising from the widespread use of IT by individuals, families, communities, organizations and societies at the local and global level
8. develop the student's understanding of the capabilities of current and emerging IT systems and to evaluate their impact on a range of stakeholders
9. enable students to apply their knowledge of existing IT systems to various scenarios and to make informed judgments about the effects of IT developments on them
10. encourage students to use their knowledge of IT systems and practical IT skills to justify IT solutions for a specified client or end-user.

Assessment objectives

There are four assessment objectives for the SL and HL Diploma Programme ITGS course. Having followed the course at SL or HL, students will be expected to demonstrate the following.

Assessment objective 1: Knowledge and understanding of specified content

- Demonstrate an awareness of IT applications and developments in specified scenarios
- Demonstrate an awareness of the social and ethical significance of specified IT applications and developments
- Demonstrate technical knowledge of ITGS terminology, concepts and tools
- Demonstrate technical knowledge of IT systems
- Demonstrate knowledge and understanding of topics related to the annually issued case study (**HL paper 3 only**)

Assessment objective 2: Application and analysis

- Explain the impacts of IT applications and developments in specified scenarios
- Analyse the social and ethical significance of specified IT applications and developments
- Transfer IT knowledge and make connections between specific scenarios
- Apply technical knowledge of IT systems acquired through independent research to provide supporting evidence in possible decisions relating to future courses of action related to the annually issued case study (**HL paper 3 only**)

Assessment objective 3: Synthesis and evaluation

- Evaluate local and global impacts of specified IT developments through individually researched studies
- Evaluate a solution involving IT to a specified problem using knowledge of IT systems
- Discuss the social and ethical implications of specified IT policies and developments
- Evaluate, formulate and justify possible strategic courses of action related to the annually issued case study (**HL paper 3 only**)

Assessment objective 4: Use of ITGS skills

- Demonstrate evidence of project management in the development of a well-organized product to resolve a specific issue
- Use IT tools and the product development life cycle (PDLC) to create an original product in consultation with a client
- Demonstrate evidence of the use of appropriate techniques to develop an original IT product

Assessment objectives in practice

The following tables show the percentage weighting for each of the assessment objectives across each of the components. This may differ from the allocation of time devoted to each of the assessment objectives in class.

Standard level

Assessment objective	Paper 1	Paper 2	Internal assessment	Overall
1. Knowledge and understanding of specified content	20	10	8	38
2. Application and analysis	14	10	5	29
3. Synthesis and evaluation	6	10	4	20
4. Use of ITGS skills	n/a	n/a	13	13
Component weighting	**40%**	**30%**	**30%**	**100%**

Higher level

Assessment objective	Paper 1	Paper 2	Paper 3	Internal assessment	Overall
1. Knowledge and understanding of specified content	18	7	10	5	40
2. Application and analysis	12	7	8	3	30
3. Synthesis and evaluation	5	6	7	3	21
4. Use of ITGS skills	n/a	n/a	n/a	9	9
Component weighting	**35%**	**20%**	**25%**	**20%**	**100%**

Syllabus outline

At either level (SL or HL) the ITGS course consists of three compulsory interconnected strands that reflect the integrated nature of the course.

- **Strand 1:** Social and ethical significance
- **Strand 2:** Application to specified scenarios
- **Strand 3:** IT systems

Syllabus component	Suggested teaching hours	
	SL	HL
Strand 1: Social and ethical significance **SL/HL core** Social and ethical considerations linked to specified IT developments. Students must study the following 12 issues. 1.1 Reliability and integrity 1.2 Security 1.3 Privacy and anonymity 1.4 Intellectual property 1.5 Authenticity 1.6 The digital divide and equality of access 1.7 Surveillance 1.8 Globalization and cultural diversity 1.9 Policies 1.10 Standards and protocols 1.11 People and machines 1.12 Digital citizenship	40	40
HL extension Social and ethical considerations linked to the two HL extension topics and the issues raised by the annually issued case study.	—	20

Syllabus component	Suggested teaching hours	
	SL	HL
Strand 2: Application to specified scenarios **SL/HL core** Scenarios based on real-life situations must be used when addressing specified IT developments. Students must study the following 6 themes. 2.1 Business and employment 2.2 Education and training 2.3 Environment 2.4 Health 2.5 Home and leisure 2.6 Politics and government	40	40
HL extension Scenarios based on real-life situations must be used when addressing specified IT developments in the two HL extension topics and the annually issued case study.	—	35
Strand 3: IT systems **SL/HL core** The terminology, concepts and tools relating to specified IT developments. Students must study the following 9 topics. 3.1 Hardware 3.2 Software 3.3 Networks 3.4 Internet 3.5 Personal and public communications 3.6 Multimedia/digital media 3.7 Databases 3.8 Spreadsheets, modelling and simulations 3.9 Introduction to project management	40	40
HL extension Students must study the following topics. 3.10 IT systems in organizations 3.11 Robotics, artificial intelligence and expert systems 3.12 Information systems specific to the annually issued case study	—	35

Syllabus component	Suggested teaching hours	
	SL	HL
The project (practical application of IT skills) The application of skills and knowledge to develop an original IT product for a specified client.	30	30
Total teaching hours	**150**	**240**

Approaches to the teaching of ITGS

Teaching ITGS: An integrated approach

The notes that follow show how the three different strands of the syllabus are interconnected with the role of the stakeholder(s), which is central to the course. They suggest how teachers can take an integrated approach when they teach the syllabus, using any of the three strands as a starting point. The **ITGS triangle** illustrates this integrated approach.

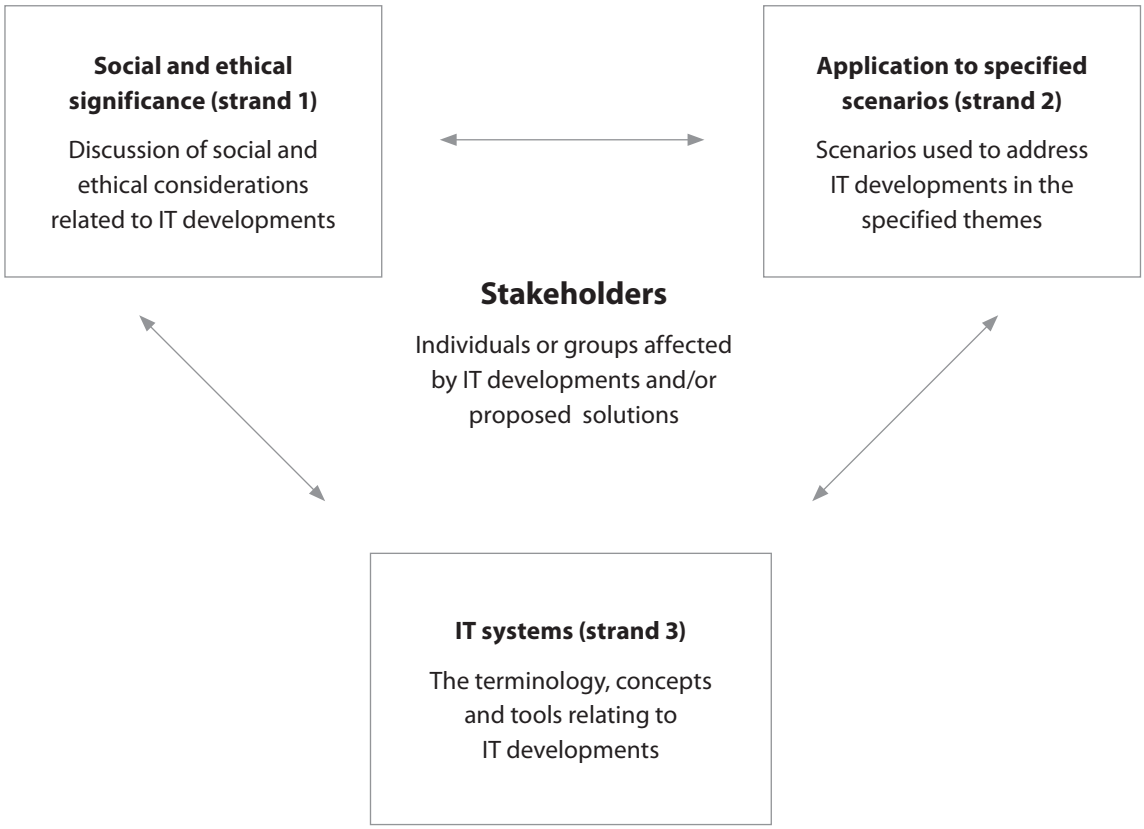

Figure 2
The ITGS triangle, showing how the three strands are interrelated

The teaching of ITGS

Whatever the structure of the course of study devised by the IB teacher, it must take into account the required learning outcomes included in all three strands. The following statements should be considered throughout the teaching of the course.

- The strands are not designed to be presented or studied in isolation. Teachers should adopt an integrated approach to the subject.
- The strands are not designed to be studied in any particular order.
- The constituent parts form a whole.

- The stakeholders remain the central focus of the course.
- A balanced approach to both positive and negative impacts of IT developments must be adopted.

Teaching and learning activities should weave the parts of the syllabus together using the ITGS triangle, and should focus on their interrelationships so that, by the end of the course, students are able to appreciate the connections between all the different strands of the syllabus. The way in which the strands can be approached is flexible and any starting point is acceptable, but the study of real-life scenarios based on current events must be used as a support for teaching.

It is possible to use an iterative process. For example, a strand, or parts of it, may need to be addressed more than once in the delivery of a particular topic.

It is essential that examples are drawn from the local, national and global level.

The following scenario and table illustrate three possible approaches to the integration of the three strands for the same example.

Scenario

A supermarket collects data through various methods (purchases at the check-out counter, applications for loyalty cards, promotions) and stores it in a relational database. Customers are concerned about what information is being collected and stored by the supermarket and how the information will be used.

- **Strand 1:** Social and ethical significance: security, privacy and anonymity of personal data
- **Strand 2:** Application to specified scenarios: business and employment, supermarkets
- **Strand 3:** IT systems: databases, including creating a relational database

Starting from strand 1: Social and ethical significance	Starting from strand 2: Application to specified scenarios	Starting from strand 3: IT systems
A social/ethical issue arises from a news article, involving the security of personal data in a particular scenario and the involvement of different stakeholders (**strands 1 and 2**). To understand how this issue may have occurred, students study a relevant IT system, for example, the security of a database (**strand 3**). As a follow-up, various similar scenarios are considered, to explore the similarities and differences to the original scenario, for example, the security of patients' records in a doctor's surgery (**strand 2**).	The selection of a particular scenario, for example, the use of IT in a supermarket's loyalty scheme (**strand 2**). Development of an understanding of IT systems used within that scenario, for example, the use of a database to store customer details and loyalty points (**strand 3**). Discussion of a range of social and ethical considerations, for example, security and privacy, arising from the storage of information in the loyalty scheme database, including the involvement of different stakeholders (**strand 1**). As a follow-up, various similar scenarios are considered, to explore the similarities and differences to the original scenario (**strand 2**).	Coverage of the skills, concepts and terminology related to an IT system, for example, a relational database in a particular scenario (**strand 3**). As a follow-up, various similar scenarios are considered, to explore the similarities and differences to the original scenario, for example, a customer loyalty database in a supermarket (**strand 2**). Discussion of a range of social and ethical considerations arising from the storage of information in databases, including the involvement of different stakeholders, for example, security and privacy of personal data (**strand 1**).

The practical use of appropriate software in class is essential to the understanding of concepts required in the IT systems strand. For example, the development, creation and use of a database will lead to an understanding of the nature of its functions.

Additionally, class discussions should focus on evaluating possible solutions. This will prepare students for both the internally and externally assessed components.

Whichever approach is used, it must be remembered that the role of stakeholders is critical to the teaching of the subject, and their requirements must be considered at all times.

Further guidance

The IB learner profile

The ITGS syllabus is closely linked to the IB learner profile, which strives to develop internationally minded people who recognize their common humanity and whose aim is to create a better world. By following the ITGS syllabus, students will have fulfilled the attributes of the IB learner profile.

For each attribute of the learner profile, a number of examples selected from the ITGS syllabus are given.

Learner profile attribute	ITGS syllabus
Inquirers	Content: SL/HL core, HL extension, case study. Project: Initial investigation.
Knowledgeable	Content: SL/HL core, HL extension. Project: Research, process, justify appropriate IT techniques. Use software to develop an original product.
Thinkers	Content: The ITGS triangle for analysis, HL extension, formulate strategic plans in case study. Project: Research, process, interpret and evaluate data based on a real-life situation.
Communicators	Content: SL/HL core; make links to theory of knowledge. Project: Produce materials in a range of formats (including extended responses, reports and investigations) based on a series of consultations with a client.
Principled	Content: SL/HL core, HL extension, case study. Project: Research, process and interpret data and information; identify opinions, values and perceptions; make and justify decisions. Test the original product to ensure that it is error-free and secure, protecting any sensitive data.
Open-minded	Content: SL/HL core, HL extension, case study. Respecting differing cultures and the opinions of others. Project: Evaluate sources of information in terms of reliability, bias, relevance and accuracy.

Learner profile attribute	ITGS syllabus
Caring	Content: SL/HL core, HL extension, case study. Project: Liaise with client, reach consensus in the development of an IT solution.
Risk-takers	Content: Case study, formulate strategic plans. Project: Make and justify decisions to use complex techniques to develop best possible product.
Balanced	Content: SL/HL core, HL extension in analysis and judgment type questions. Project: Collection of data and the subsequent analysis and synthesis of the information.
Reflective	Content: Case study, reflecting on possible decisions related to a strategic decision. Project: Evaluate methodology, develop clear and logical arguments and draw conclusions where appropriate.

Topics for extended essays in ITGS

Almost all areas of the syllabus lend themselves to deeper analysis and investigation in an extended essay. Many topics offer a wide range of opportunities for extended essays, although care may be needed to ensure that the research question is not too broad to be satisfactorily answered within the word limit. It is also important to note that there is a requirement to focus in depth on a narrow area of research, and that an extended essay must contain the technical content related to the specific IT system.

Evidence of both primary and secondary research is expected in the ITGS extended essay. Primary sources can include investigations, interviews, surveys or other relevant methods for data collection that are appropriate for an ITGS extended essay. It is advisable to use a range of different types of reliable secondary sources.

Primary information is the information that the student collects in discussion with the client. It can include qualitative and quantitative information. **Secondary information** is information that has already been compiled in a variety of written and electronic forms.

The focus of an ITGS extended essay and of an ITGS project are completely different. The extended essay has as its starting point a research question requiring both secondary and primary research, and addresses all parts of the ITGS triangle to reach a conclusion. The starting point for the ITGS project is a client with a problem that requires an IT product as a solution. The extended essay cannot have the development of an IT product as its main focus.

The online curriculum centre and workshops

All teachers of the ITGS course are strongly encouraged to access the online curriculum centre (OCC) (at http://occ.ibo.org) at regular intervals. The main ITGS subject page contains essential documents including the guide, teacher support materials, specimen papers, subject reports and important subject updates. The OCC is a website on which all teachers can post inquiries, share examples of good practice, ask for advice and access exemplar materials. The content of the ITGS forum on the OCC is provided by ITGS teachers for ITGS teachers.

As ITGS is a dynamic and rapidly evolving subject, the following information will be provided for schools: a list of technical terms that will apply to future examinations and a list of appropriate techniques to be used in the development of the internal assessment. This information will apply for the May session two years after the date of posting. It will be made available in addition to the annually issued case study for HL paper 3.

For example, in May 2012 the following information will be posted on the OCC.

- The annually issued case study for May 2013 and November 2013
- Additional vocabulary linked to IT systems for first examinations May 2014
- A list of appropriate techniques for the development of the project for first submission May 2014

From time to time, special events are held to give teachers an opportunity to participate in activities such as marking work, with the opportunity to gain feedback from senior examiners.

Teachers are also encouraged to participate in face-to-face workshops and online workshops. These special events provide an opportunity to discuss particular aspects of the subject and engage in workshop activities that support the teaching of ITGS.

Syllabus content

Strand 1: Social and ethical significance

The widespread use of information technology (IT) raises questions about the social and ethical considerations that shape the world today. IB students must become familiar with all the social impacts and ethical considerations described in this section. IB teachers should introduce them as appropriate, using the integrated approach illustrated in the **ITGS triangle**. In this way, students can discuss social impacts and ethical considerations that are raised when IT systems are used in a range of scenarios. The use of IT is likely to bring both advantages and disadvantages, and students should be able to discuss the effects of IT in a critical way as well as evaluating possible solutions. It is important that examples are drawn from the local, national and global level from recently published articles. Some examples of scenarios for consideration are listed later in this section.

Analysing social impacts and ethical considerations

Throughout the course, students must analyse and evaluate the social impacts of IT on individuals and society, and consider the ethical issues raised by these impacts.

Social impacts and ethical considerations need to be analysed from both a local and a global perspective, recognizing that attitudes and opinions are diverse within and between different cultures.

Key questions

The discussion of **social impacts and ethical considerations** can be guided by answering the following key questions.

Social impacts	Ethical issues
What are the social impacts associated with a particular IT development? • How did the IT development emerge? • Who are the stakeholders—individuals, institutions and societies who initiate and control the IT developments and are affected by them? • What are the advantages and disadvantages for the stakeholders? • What are the social impacts of the IT development on human life? These may include some or all of the following areas: economic, political, cultural, legal, environmental, ergonomic, health and psychological. • What feasible solutions can be applied to overcome problems?	What are the ethical issues associated with a particular IT development? • Who is responsible? • Who is accountable? • What policies, rules or laws apply to the scenario? • What are the alternative ethical decisions? • What are the consequences of these decisions?

Definitions and examples of social impacts and ethical considerations

The following definitions may be assessed.

It is expected that other appropriate examples would be used to reinforce the understanding of the topic. These would not be assessed.

1.1 Reliability and integrity

Reliability refers to the operation of hardware, the design of software, the accuracy of data or the correspondence of data with the real world. Data may be unreliable if it has been entered incorrectly or if it becomes outdated. The reliability of machines, software and data determines our confidence in their value.

Integrity refers to safeguarding the accuracy and completeness of stored data. Data lacks integrity when it has been changed accidentally or tampered with. Examples of data losing integrity are where information is duplicated in a relational database and only one copy is updated or where data entries have been maliciously altered.

1.2 Security

Security refers to the protection of hardware, software, machines and networks from unauthorized access. Security measures include restricted access to machines and networks for certain employees or to prevent access by hackers. The degree of security of information systems largely determines society's confidence in the information contained in the systems.

1.3 Privacy and anonymity

Privacy is the ability of individuals and groups to determine for themselves when, how and to what extent information about themselves is shared with others. At its extreme, privacy becomes **anonymity** when, for instance, a person uses it to conceal his or her true identity in order to cyber-bully someone else. Conversely, excessive privacy could also conceal the perpetrators of criminal, terrorist or computer hacking acts from law enforcement agencies.

1.4 Intellectual property

Intellectual property includes ideas, discoveries, writings, works of art, software, collections and presentations of data. Copyright, trademarks and patents exist to protect intellectual property. However, the easy and accurate duplication methods made available through IT can undermine such protection.

1.5 Authenticity

Authenticity means establishing a user's identity beyond reasonable doubt. Authenticating the user is crucial in many scenarios, particularly in business and legal matters. A simple example of authentication is a user login to a network. A more advanced example would be the use of encrypted digital signatures in a business transaction or the use of watermarking on digital photographs.

1.6 The digital divide and equality of access

The growth of the use of IT systems has led to disparities in the use of, and access to, information technologies. Disparities exist not only internationally between countries, but also within countries between different socio-economic groups as well as within what may appear to be relatively homogenous groups. This may lead to groups or individuals without access to IT being disadvantaged. For example, while telelearning may bring previously unavailable opportunities to everyone's doorstep, factors such as the cost and availability of hardware, software or access to the internet may create a "digital divide".

1.7 Surveillance

Surveillance is the use of IT to monitor the actions of people. For example, monitoring may be used to track, record and assess employees' performance. It can be used to support claims for promotion or to ensure that employees follow the organization's internet policy appropriately.

1.8 Globalization and cultural diversity

Globalization means the diminishing importance of geographical, political, economic and cultural boundaries. IT has played a major role in reducing these boundaries. For example, any dramatic event anywhere in the world can be broadcast almost instantly by television or on the internet. However, the new "global village" may lead to the extinction of minority languages.

1.9 Policies

Policies are enforceable measures intended to promote appropriate and discourage inappropriate use relating to information technologies. They can be developed by governments, businesses, private groups or individuals. They normally consist of rules governing access to, or use of, information, hardware, software and networks. For example, a school policy on the use of IT would consist of each user signing an acceptable-use policy. It would also address unlawful access to the network through, for example, identity theft or using hacking software, and how these transgressions would be treated. Many websites also require users to agree to specific policies before allowing access to their services.

Policies also affect the exchange of information, for example, by making it subject to copyright laws and raising people's awareness of plagiarism. In general, policies can promote or restrict access, guide behaviour, require the fulfillment of certain conditions prior to or during use, or need to be developed to address unforeseen issues such as cyber-bullying.

1.10 Standards and protocols

Standards and protocols are technical rules and conventions that enable compatibility and therefore facilitate communication or interoperability between different IT systems and their components. They might govern the design and use of hardware, software and information. For example, the communication protocols used on the internet, the ASCII representations for characters, or the design of the printer port on a personal computer are all governed by standards.

1.11 People and machines

The use of IT systems brings significant advantages, for instance in ease of use, being available 24/7, or through its use rather than exposing humans to a potentially hazardous environment. However, this can raise concerns about the rate at which technology is being introduced and issues that may arise from insufficient testing in critical situations such as air traffic control. The ultimate fear of many people is that future systems will be programmed to make decisions that would be better taken by humans, such as the decision to deploy nuclear weapons.

There are also social impacts such as internet addiction, where people feel that they can never get away from IT and are trapped on a "digital treadmill".

1.12 Digital citizenship

Digital citizenship can be defined as appropriate behaviour that represents the responsible, ethical and legal approach that individuals take in any situation with respect to the use of IT. Digital citizenship permeates, in one way or another, all of the preceding social and ethical considerations.

Other specific social and ethical considerations

Other social and ethical considerations may emerge during different scenarios discussed in class. These may be related to changes in attitudes towards the use of IT systems, or new developments in IT such as social networking or e-assessment.

HL extension

In discussing the social and ethical issues linked to the case study, additional considerations may emerge.

Strand 2: Application to specific scenarios

The scenarios listed here are divided into themes as an organizational tool. Examination papers assess scenarios related to these themes. Individual examination questions may address one, some, or all of the themes.

- Every theme must be studied.
- Every topic within each theme must be studied.
- Each topic must be taught using real examples. Some of the examples shown in the tables suggest possible approaches for study.
- Students will be expected to apply their knowledge from the topics taught in class or researched independently to the stimulus material in the externally assessed components. This may include discussing ethical issues and social impacts as well as demonstrating an understanding of the IT systems involved.
- For each of the scenarios addressed, students will be expected to identify relevant stakeholders and to discuss, where relevant, potential stakeholder conflict.

2.1 Business and employment

Topic	Examples
Traditional businesses	Banks, including ATM (automatic teller machines), EFT (electronic funds transfer), hotels, supermarkets, travel agencies.
Online businesses (e-commerce)	Working practices such as teleworking and home working.
Transportation	Airline reservation systems, navigation, package tracking, traffic control systems, IT systems in cars.

The coverage of business and employment should address the IT systems that exist as well as the ethical issues and social impacts that arise from the increased use of information technologies for both employers and employees. Students should be aware of the range of different business environments, ranging from a traditional (offline) business to businesses that are exclusively online.

2.2 Education and training

Topic	Examples
Distance learning over large areas	Hospitals, prisons, retirement homes, schools.
Use of IT in teaching and learning	Educational software, online research and forums, virtual learning environments (VLE), e-books, Web 2.0 educational networks, use of mobile devices, game-based learning, fully immersive environments, filtering and monitoring of students' internet use, 1-to-1, m-learning.
Hardware and network technologies in the classroom	Laptop computers, handheld devices, interactive whiteboards.

Topic	Examples
Provision for special needs	Inclusive software, Braille keyboards, accessibility.
School administration	Record-keeping of staff and finances, libraries, student records, EDI (electronic data interchange).

The development of new IT systems is revolutionizing the delivery of education and training. Technological advances have led to an increase in the dependency of students, staff and administrators on the supporting IT systems.

2.3 Environment

Topic	Examples
Modelling and simulations	Climate change, forecasting natural events or demographic changes.
Data logging	Sensors, probes, real-time data collection.
Satellite communication	Remote sensing devices, satellite imagery, tagging.
Mapping, virtual globes	Geographic information systems (GIS), global positioning systems (GPS), cell/mobile phone tracking, online journey planning, online maps.
E-waste	Development, disposal and recycling of IT equipment, monitoring organizations such as the Basel Action Network.
Resource depletion	Use of non-renewable resources for manufacturing components, electrical consumption of IT systems.

The environmental theme covers a wide range of topics. The increasing processing capability of mobile devices has enabled almost universal access to information, but the increased number of devices has impacted on health and the environment.

2.4 Health

Topic	Examples
Diagnostic and therapeutic tools	Surgery, prosthetic devices, diagnostic technology, rehabilitation, patient monitoring, individualized IT solutions for disabled people, accessibility.
Medical information, administration, marketing and sales	Medical advice, e-prescriptions, telemedicine, electronic health records, international health cards.
Medical research	Global collaboration, database for the Human Genome Project, improving patient rehabilitation.
Psychological and physical considerations	Internet addiction, repetitive strain injury (RSI), ergonomics.

IT has revolutionized medicine. With the increasing size of the world's population, the effective management of health care using IT systems will become even more important.

2.5 Home and leisure

Topic	Examples
Homes and home networks	IT management of home systems: for example, lighting, security, entertainment centres.
Digital entertainment	Films, photographs, music, arts, online and digital games, gambling, virtual worlds.
Social networking	Chat rooms, messaging, blogging, file sharing, wikis.
Published and broadcast information	Books, newspapers, digital radio and TV, e-books, podcasts.
Digital policing	Monitoring organizations such as the Recording Industry Association of America (RIAA) and the Motion Picture Association of America (MPAA).
Hardware, software and networks	Portable digital devices and their ability to remotely control other devices, IT-enabled appliances.

The growth of the internet and the ability to transfer information globally in real time has revolutionized the way in which increasing numbers of people live. The global online society, the development of English as the dominant online language, and the constant availability of information may lead to a homogenization of peoples, with some cultures being subsumed into others or lost.

2.6 Politics and government

Topic	Examples
Political processes	Online campaigning, voting, lobbying, fund-raising and advertising.
Government information sites	For example, travel warnings, tourist information, environmental information and warnings, government policies, city government websites.
Access to, and updating of, personal information held on government databases	Collection, storage and updating of personal data: for example, driving licence, TV licence, tax returns, passport applications and renewals, medical records, military service records, social security information, online police records.
Government control and use of information	Censorship, data matching across agencies, archiving, biometric data, national identity cards.
Law and order	Police surveillance, terrorist monitoring, DNA data.
Military	Cyberwarfare, smart weapons, espionage, battlefield technology.

The importance of IT is becoming increasingly evident in political campaigns. With increased amounts of information available to governments, ethical issues relating to its possible misuse are becoming more and more important.

Strand 3: IT systems

Students are required to demonstrate knowledge and understanding of the technical concepts within the IT systems strand. They are expected to demonstrate this technical knowledge by the use of correct and appropriate technical language and provide, where appropriate, a step-by-step description of how the IT system works.

Teachers must be aware that the technical knowledge should concentrate on breadth of knowledge rather than depth and should bear this in mind during the teaching of the course. In all of the topics, but particularly "Internet", "Personal and public communications", "Multimedia/digital media", "Databases" and "Spreadsheets, modelling and simulations", students are expected to carry out practical activities to reinforce their theoretical knowledge. It should also be noted that programming is not explicitly required as part of the ITGS course, although it may be used in the development of the project.

Due to the rapidly changing nature of IT systems, a list of new (additional) technical terms that will apply to future examinations will be provided for schools on the OCC.

SL/HL core

3.1 Hardware

Introduction

The **hardware** topic deals with a computer system consisting of input devices, output devices, a central processing unit and storage. ITGS students are required to understand the meaning of the terms and concepts listed here and, where appropriate, briefly describe how they work.

The increasing tendency to develop hardware in modular units raises a range of social impacts and ethical issues such as the use of non-renewable natural resources, the global transportation of manufactured components and their eventual disposal by individuals, organizations and governments. Students are expected to discuss possible solutions and evaluate their effectiveness.

Possible scenario

A computer user is planning to upgrade their current computer system to a newer model and must use their knowledge to:

- understand the specifications of the proposed new system
- evaluate other physical considerations that may influence the choice of the physical environment of the proposed new system, such as ergonomics and other health-related issues
- suggest upgrades to the computer system to take advantage of improvements in components, such as processing speed
- describe how the proper disposal of the old computer system can take place and whether the choice of computer may be affected by the manufacturer's policies on disposal.

IT concepts to address in this topic

The computer system

- Types of computers: personal digital assistant (PDA), laptop, desktop computer
- MAC address
- Motherboard
- Central processing unit (CPU), microprocessor, clock speed: for example, megahertz (MHz), gigahertz (GHz), terahertz (THz)
- Primary storage: read-only memory (ROM), random-access memory (RAM)

- Secondary storage: optical, magnetic, flash memory: for example, USB (universal serial bus) flash drive
- Bit, byte, kilobyte (KB), megabyte (MB), gigabyte (GB), terabyte (TB), petabyte (PB), exabyte (EB), zettabyte (ZB), yottabyte (YB)
- Character encoding: ASCII (Unicode and American Standard Code for Information Interchange)
- Ports

Input and output devices

- Keyboards, mice, touch pads
- Optical mark recognition (OMR), optical character recognition (OCR), magnetic ink character recognition (MICR), radio frequency identification (RFID), radio tag, bar code scanners, magnetic stripe readers
- Microphones
- Smart card readers
- Webcams, digital cameras, digital video cameras
- Sensors, probes, real-time data collection
- Composite devices: for example, game controllers
- Touch-sensitive devices: for example, pads
- Printers, monitors, speakers, projectors
- CD-ROM (compact disc read-only memory), DVD (digital versatile/video disk) readers and burners

3.2 Software

Introduction

The **software** topic deals with the software associated with a typical computer system. ITGS students are required to understand the meaning of the terms and concepts listed here and, where appropriate, briefly describe how they work or their relevance to the user.

The development of software can have social impacts such as increased access for disabled people, and ethical issues, for example, only producing packages in a limited number of languages, effectively making English the global language. Students are expected to examine the effects of these developments on stakeholders.

Possible scenario

A computer user is planning to update the software on their current computer system to the most recent versions and must use their knowledge to:

- select a suitable operating system based on information such as price and ease of installation
- select suitable software for the computer and decide which source to obtain the software from
- ensure that the software is installed legally, is registered and that user support is available
- select the appropriate software to prevent viruses or malicious software from damaging the contents of the home computer.

IT concepts to address in this topic

Fundamentals

- Applications: word processing, desktop publishing, presentations, photo and video editing, music and sound development, website development
- System software: operating systems and utilities

- Interfaces: graphical user interface (GUI), command line interface (CLI), menu-driven interface (MDI), voice
- Licensing: shareware, public domain, freeware, proprietary and open source software
- Licensing authorities: Business Software Alliance (BSA)
- Commercial and custom-built (bespoke) software
- Registration, serial number, warranty, copyright agreement
- Web-based software
- User support: manuals, assistants, tutorials, help systems, "Read Me" files
- Macros, templates, wizards
- File formats, for example, RTF (rich text format), TXT (text), PDF (portable document format), XLS (Excel spreadsheet), SWF (small web format), ZIP (zipped file), JPG/JPEG (Joint Photographic Experts Group bitmap), PNG (portable network graphics bitmap), CSV (comma-separated values), HTM/HTML (hypertext markup language)
- Data transfer: ASCII (American Standard Code for Information Interchange), tab-delimited text file, zipped file

System utilities

- Defragmentation/optimization and disk utility software
- Backup, file management, account and accessibility management
- Monitor and keyboard settings, for example, international settings, disability settings
- Virus scan, malware detectors and removers
- Compression/decompression (lossless, lossy)
- Colour synchronization

3.3 Networks

Introduction

This topic addresses the role of **networks** in a range of different scenarios. Almost all businesses, institutions and organizations, and an increasing number of households, are linked by networks.

The increasing use of networks raises a range of social impacts and ethical issues such as unauthorized access, intrusive software (viruses, worms and Trojan horses), spam, phishing, pharming, spoofing and identity theft. Students are expected to discuss possible solutions and evaluate their effectiveness.

Possible scenario

An organization is considering developing a network to facilitate the sharing and transfer of information. The student must use their knowledge to demonstrate an understanding of:

- the types of networks that exist and the specific scenarios where they are used
- the development of an acceptable-use policy for a network
- the protocols that exist to ensure compatibility within and between networks
- the ways in which the effectiveness of a network may be measured
- the impacts that the ineffective management and network failure can have for many organizations.

IT concepts to address in this topic

Network technologies

- Client, host, server
- Mainframe, supercomputers
- Grid computing, distributed processing
- Ethernet, peer-to-peer (P2P)
- Local area network (LAN), wide area network (WAN), virtual LAN (VLAN), wireless LAN (WLAN), home network
- Internet, intranet, extranet, virtual private network (VPN)
- Routers, switches, hubs
- Connection types: optical fibre, cable, wireless technologies such as wireless fidelity (WiFi), worldwide interoperability for microwave access (WiMax), Bluetooth, microwave
- Network operating systems and utility software
- Cloud computing
- Storage technologies: for example, SAN (storage area network), RAID (redundant array of inexpensive disks)

Network functionality

- Protocols
- Synchronous, asynchronous
- Remote access
- Bandwidth, broadband
- Bit rates

Network administration

- Electronic security: for example, authorized access, levels of access, biometrics, login, password, firewalls, proxy server, encryption, secure socket layer (SSL), audit trails
- Licences: single-user, multi-user, concurrent, network, site
- Physical security: for example, locks
- Monitoring: for example, keystroke monitoring, system performance, surveillance
- Network policies: for example, backup, archiving, disaster recovery, usage, redundancy, failover
- Codes of ethics and professional conduct: for example, ACM (Association for Computing Machinery)
- Data centres
- Energy usage, uninterruptable power supply (UPS)

3.4 Internet

Introduction

The **internet** and World Wide Web are omnipresent in contemporary society. This topic introduces ITGS students to the technology that enables access to the internet. The tools and applications that contribute to the creation of web-based resources and websites are addressed under topic 3.6, "Multimedia/digital media".

The use of the internet for activities such as e-commerce, academic research and social networking can raise ethical issues and have positive or negative social impacts. These may include exposure to undesirable materials, cyber-bullying, e-fraud, improved communication between individuals and groups, intellectual property theft, plagiarism, spamming and the global dissemination of ideas. Students are expected to discuss, where appropriate, possible solutions to a specified problem and evaluate their effectiveness.

Possible scenario

A school is considering using the internet to enhance the learning opportunities of its students. Before making a final decision it intends to obtain an outline of the different facilities available. It must also consider the potential problems of opening this "window on the world". Where appropriate, the ITGS student should investigate different environments to experience the range of available learning opportunities. This may include research using different collaborative websites, educational websites or online sources of information.

IT concepts to address in this topic

Fundamentals

- WWW (World Wide Web), URL (uniform resource locator), internet, intranet, extranet
- Internet protocols: for example, HTTP (hypertext transfer protocol), HTTPS (hypertext transfer protocol secure), FTP (file transfer protocol), TCP/IP (transmission control protocol/internet protocol)
- IP address
- Modem, browser, internet service provider (ISP), bandwidth, download, upload, streaming audio/video, compression, decompression, cache
- Domain names, domain name system (DNS)
- Features of a website: for example, hyperlinks, navigation, metatags, tags, forms
- Features of a browser: for example, bookmarks, visited links, tabs
- Web-based languages: for example, hypertext markup language (HTML), JavaScript
- Adding functionality to a browser (for example, plug-ins)
- Data-driven websites: for example, active server page extended (ASPX), personal home page (PHP)
- Site management: for example, web hosting, uploading
- Other site use: for example, bounce rate, click-through rate (CTR), avatar, profile

Tools

- Search engines, web crawler/spider, search directories, search techniques, filtering, keyword density, keyword prominence, ranking of sites
- Social networking: for example, newsgroups, message boards, chat rooms, forums, instant messaging
- Email, email server, list server
- Web 2.0, Web 3.0 and beyond, collaborative online tools: for example, wikis, blogs, micro-blogs, RDF (resource description framework) site summary feeds, RSS (really simple syndication) feeds, mashups, forums, social bookmarking, online collaborative applications, podcasts, photocasts, vidcasts, social networking sites, templates, tagging, viral marketing, webcasts, widgets, virtual worlds and learning environments
- Web databases, encyclopedias

Services

- Online advertising and marketing technologies: for example, banners, pop-ups, cookies
- Push–pull technologies: for example, email newsletters
- Content management systems: for example, Moodle, Blackboard
- E-commerce technology: for example, business-to-business (B2B), business-to-consumer (B2C), consumer-to-consumer (C2C), payment services, secure transactions
- The World Wide Web Consortium (W3C)

Internet threats and security

- Internet security: for example, firewall, proxy server, SSL (secure sockets layer), encryption, public and private keys, digital signatures
- Internet threats: for example, global viruses, hackers, spam, phishing, pharming, spyware, adware

Practical techniques

- Collaborative online tools: for example, wikis, blogs, RSS feeds, mashups, forums, social bookmarking, online collaborative applications, podcasts, photocasts, vidcasts, social networking sites, templates, virtual worlds and virtual learning environments

3.5 Personal and public communications

Introduction

Developments in technology have allowed an increasing number of mobile devices to be developed that enable people to communicate anytime, anyplace, anywhere. There is a wealth of information available to society that can be accessed on demand and has changed the way in which people behave.

It is important that the ITGS student is able to discuss the social impacts and ethical issues related to these technologies. These may include the health implications of mobile devices, unauthorized access to wireless networks, interception of communications, storage of personal communications for security purposes, and tracking of people.

Possible scenarios

Students may investigate, both theoretically and practically, the plethora of devices and means of communication that exist in contemporary society, and leading on from this research discuss how they work independently and as part of a network. Further research may lead students to weigh up the benefits and drawbacks of the increasing use of these devices. The ITGS student should also evaluate the potential of existing converging technologies and their compatibility and make predictions about future developments.

IT concepts to address in this topic

Technologies

- Personal digital assistants (PDAs) and handheld digital devices
- Global positioning systems (GPS), navigation systems and geotagging
- Cell/mobile phones
- Digital radio and TV
- Embedded systems

Services

- Accessing, distributing and sharing text, photos, video, audio, television via portable and non-portable digital devices
- Synchronization of information between portable systems, desktop systems, servers and web-based services

- Videoconferencing
- Remote access: for example, teleworking, distance learning
- Telephony: voice over internet protocol (VOIP)

3.6 Multimedia/digital media

Introduction

Multimedia/digital media involves the use and integration of media (for example, text, images and graphic elements, animation, sound and music, and video) to create digital products that are available online or offline.

This topic introduces ITGS students to the technologies that make information accessible through different media and online services. It is important that the ITGS student is aware of the actual uses of multimedia/digital media and, bearing in mind **the emphasis on practical work in this topic**, has practised using the tools in order to be able to evaluate their effectiveness in various scenarios.

Multimedia/digital media raises questions about a range of impacts, issues and solutions that the ITGS student must investigate, including copyright, intellectual property, and current practices and policies used to grant permission for use.

Possible scenario

A school would like to create a print yearbook with an online version. The print version would contain only text and photos. The online version would also include audio, video and multimedia files. The yearbook team is also considering burning the website version on to a DVD and including it in the back of the printed version of the yearbook. A number of factors need to be considered in producing the print yearbook, the website and the DVD. These are:

- whether to develop the IT products in school or to use a commercial provider
- whether the necessary IT systems are available to produce a high-quality print yearbook and to create an online yearbook and DVD with audio and video files
- whether the content to be included in all three versions of the yearbook is accessible
- what professional guidelines must be followed in the design of the three products
- what copyright, intellectual property and licensing are required for three versions of the yearbook
- what can be learned from yearbooks produced by other schools in these three formats.

IT concepts to address in this topic

Theoretical concepts

- Design guidelines for creating multimedia/digital media
- Design methods: for example, site map, storyboard

Data collection

- Primary and secondary data
- Multimedia file formats: for example, text formats, audio formats, video formats, presentation formats, image/graphics formats
- Policies, copyright, citing sources, Creative Commons, licensing and watermarking
- Digital rights management (DRM)

Product development

- Folder and file management: importance of file and folder naming, appropriate folder structures
- Tutorials: for example, help pages, online manuals

- Templates and wizards, online and provided with software
- Importing and exporting data
- Integrating software applications and online tools: for example, embedded videos, web-based database

Components

Text

- Text-processing software
- Formatting: for example, page layout, fonts, headers and footers
- File formats: for example, PDF, RTF, TXT
- Typography

Graphics, images and animations

- Software types: for example, albums, animated, 3D, bitmapped, vector, photo editing, photo casting, simulation
- Bit depth, colour depth (grayscale, shades of gray, millions of colours)
- Layers, grouping, divisions, alignment
- Resolution, pixels, dots per inch (dpi)
- File formats: for example, JPG, GIF, TIF
- Computer-generated imagery (CGI)

Audio

- Audio-editing software, podcasts
- Digital audio: for example, MIDI (musical instrument digital interface), MP3 (MPEG-1 audio layer 3), MP4 (MPEG-4 part 14), WAV (waveform audio format)
- File formats: for example, MP3, MP4, WAV

Video

- Video-editing software, vidcasts and special effects (for example, morphing, transitions)
- Digital video: for example, AVI (audio video interleave), MPEG (Moving Picture Experts Group), video CODECs (coder-decoders)
- File formats: for example, AVI, MOV

Integrating the components

- Software types to house and display the multimedia components: for example, word processing, desktop publishing, presentations, web pages

Generic techniques

- Differences in files (for example, graphics, images, audio, video) for print and online versions
- Inserting and manipulating objects (graphics, sound or video files)
- Tables: cell merge, borders, cell padding, cell spacing, nested tables
- Layers
- Links: relative and absolute, internal and external, for example, anchors, pop-ups

Word processing and desktop publishing (DTP)

- Referencing and reviewing: for example, spellchecker, thesaurus, outliners, word count
- Inline and floating graphics

Interactive multimedia, slideshows and websites

- Applications and online tools used for creating and making available interactive multimedia, games, presentations, slideshows and websites
- Use of scripting in creating web pages (for example, HTML, JavaScript, URL links to online media)
- Integration of online tools

3.7 Databases

Introduction

Databases lie at the heart of most IT systems whether in businesses, organizations or other institutions. Databases enable organizations to maintain accurate and comprehensive records. In order to appreciate the role that databases play, the ITGS student must have an understanding of how they work, which can only be gained from the design and creation of basic relational databases as well as by examining how databases are used in specified scenarios (for instance, schools, retail stores, online shopping, online reservations).

The increasing use of databases raises a range of social impacts and ethical issues such as the rights of individuals with respect to the storage and potential sale of their personal data or the ease of data mining and data matching. Students are expected to discuss these issues and, where appropriate, evaluate possible solutions.

Possible scenario

A vet requires information about pet owners and their pets. The ITGS student must be able to develop an original IT solution to meet the vet's needs. This knowledge should be acquired through a practical activity where the student creates a (minimum) three-table relational database (first normal form only) that uses queries to interrogate the data, forms to enable the easy input and viewing of data, and reports to provide printed information as required.

IT concepts to address in this topic

Database organization

- Table
- Field, data types, key field/primary key, secondary key
- Record
- Flat-file database, relational database, normalization
- Database management system
- Specialized databases: for example, web databases, online encyclopedias

Functions

- Data validation: data types, range check, check digit, field size, input mask, drop-down list
- Queries: for example, searching, sorting, filtering, use of Boolean operators (AND, NOT, OR)
- Data entry form
- Report generation
- Macros
- Transfer of data between databases and other applications

Data storage and access

- Data integrity, reliability, redundancy
- Data matching, data mining
- Database security

Practical database techniques

- Table
- Field, data types, key field/primary key, secondary key
- Record
- Linking tables to create a relational database
- Data maintenance: changing, editing, deleting records
- Queries: for example, searching, sorting, filtering, use of Boolean operators (AND, NOT, OR)
- Data entry form
- Report generation
- Creating and editing simple macros
- Mail merge

3.8 Spreadsheets, modelling and simulations

Introduction

The increasing capabilities of computers have allowed individuals and organizations to develop software that can be used to test "what-if" scenarios and create simulations and models of real-world events.

Spreadsheets, through the use of worksheets and graphs, can be used to manage, predict using a series of "what-if" scenarios, and display financial details of businesses.

Modelling and simulations can be used to recreate or predict the conditions that may result from an event, for example, the areas that will be affected by coastal flooding as a result of different levels of global warming.

It is important that the ITGS student is aware of the benefits of creating accurate spreadsheets, models and simulations as well as the social impacts that could result from simulations being unable to replicate the real world, and the ethical issues that may arise during the development of the model.

Possible scenarios

Students are expected to carry out practical activities using spreadsheets, for example, the development of a spreadsheet that allows a teacher to add marks from a class test so as to generate information such as the grade for the test.

Students are expected to use modelling and simulations to reinforce their theoretical knowledge, and to apply the ITGS triangle to a range of real-life scenarios.

IT concepts to address in this topic

Theoretical and practical concepts for spreadsheets

- Cell types: for example, text, number, date, currency, hyperlinks
- Formulas: relative and absolute cell references
- Sorting, filtering and replicating data
- Types of charts
- Formatting and presentation: for example, text (fonts), background, paragraphs, pages

- Data validation, verification and testing
- Functions: maths, text, logic, date
- Protection for sheets and workbooks, cell locking
- Advanced functions: for example, lookup, pivot tables, macros
- Worksheet modelling: "what-if" analysis (scenarios, goal seek tool)

Modelling and simulation technologies and considerations

- Model
- Simulation
- Types of simulations and models
- Virtual reality, augmented reality, gaming: for example, MMORPG (massively multiplayer online role-playing game)
- Graphics and animations (2D, 3D)
- Visualization of data
- Feedback loop

Developing and using models and simulations

- The validity of the model and verification of the results of a simulation, reproducibility of results
- Relationship of model to reality
- Relationship between a model and a simulation

3.9 Introduction to project management

Introduction

All IT development requires a management method. Knowledge and understanding of the **product development life cycle (PDLC)** should be used as a framework to develop an IT solution for the internal assessment. It is recommended that this topic is covered before students start work on the project.

IT concepts to address in this topic

Theoretical fundamentals

- Client, end-user, developer
- Data collection techniques for content and product design, citing of sources
- Role of testing and processes used
- Technical and end-user documentation (manuals)
- End-user training

The product development life cycle (PDLC)

- Investigation of existing system(s)
- Feasibility study
- Requirements specification
- Project schedule
- Product design
- Product development and technical documentation
- Client and end-user evaluation

Practical techniques

- Appropriate design techniques
- Data capture
- Product testing and debugging

HL extension

3.10 IT systems in organizations

Introduction

This topic builds on the concepts introduced in "Introduction to project management" and provides students with a more in-depth understanding of the development of IT systems.

Most organizations, at some stage in their development, require the introduction of a new IT system as well as the maintenance and eventual retirement of their current systems. The ability of the organization to manage this change can determine the future viability of the organization.

Students should consider the interrelationship between stakeholders, IT systems, data, processes and policies, which provides the framework for the different project management approaches needed in order to accomplish the specified task. For example, students should research real examples of the role of IT professionals who maintain legacy or develop new IT systems, to reinforce the theoretical concepts addressed in this topic.

Possible scenarios

Students may take the development of their internal assessment as a starting point for the application of the theoretical and practical aspects of this topic. This may take the form of producing a Gantt chart to indicate the stages in the development of the solution, on the agreed date, or how differing methodologies may lead to variations in the completion of tasks.

Other scenarios may include a city government that wishes to introduce an improved IT system to provide a more secure and effective method of record keeping in its public libraries. This would include the replacement of the storage area network (SAN) to accommodate the increased amount of data requiring archiving, along with the need to provide a disaster recovery system.

IT concepts to address in this topic

Information systems, people and teams

- The role and need for IT in organizations
- Organizational IT policies
- IT personnel and organizational structure: for example, information system (IS) managers, support staff, network manager, database administrator
- Development personnel: for example, manager, programmer, analyst, project manager

The system development life cycle (SDLC)

- Analysis of current situation
- Organizational requirements
- Methods of data collection: questionnaires, interviews, observation, literature searches
- Feasibility study
- Identification of possible IT solutions
- Requirements specification
- Justification of preferred IT solution

- Project plan (who, why, what, when and how part of the project)
- Project goals, scope and constraints, such as financial, time, technical, human-resource-related, risks, communication, procurement, quality
- Project initiation document
- Design considerations
- Inputs, data structure, processes, outputs, user interface
- Prototyping
- Development of the IT solution
- Initial testing, alpha testing
- Quality assurance and quality control
- Implementation
- Training and support of staff, documentation to support the new IT system
- Changeover methods: direct, phased and parallel running
- Beta testing
- Maintenance
- Phase out

Project management issues

- Need for project management
- Development methodologies: agile development and waterfall development
- Project management methodologies: for example, PRINCE2 (projects in controlled environments 2), SSADM (structured systems analysis and design method), PMBoK (project management body of knowledge), CMMI (capability maturity model integration)
- Iteration
- Time constraints, tasks, resources and milestones; Gantt and Pert charts
- Modelling systems: for example, entities, entity relationship diagrams (ERD), data flow diagrams
- Maintenance of legacy systems
- System support: for example, internal support, maintenance contract
- Incident management and escalation

3.11 Robotics, artificial intelligence and expert systems

Introduction

The increasing capability of IT systems has allowed developers to implement systems that attempt to understand and imitate human behaviour. These systems have already had profound effects on society, although their effectiveness is largely determined by the accuracy of the algorithms that underpin them.

The increasing use of robotics, artificial intelligence (AI) and expert systems raises a range of ethical issues. For example, at which point should humans hand over key decision-making to a computer? Should robots have the same rights as humans? What social impacts might arise with the replacement of human workers or the creation of smart weapons?

Possible scenario

A hospital administrator is considering using a computer-controlled robotic device to assist with knee surgery. The robotic system models the patient's knee area prior to surgery. During the procedure the robot is controlled by the surgeon using a joystick. The system eliminates the effects of tremors in the surgeon's hands and limits the range of movement of the cutter to areas of the knee that have been predetermined by the model. Although there are claims that the surgery is less invasive and patients have a shorter recovery time, questions may be raised about the reliability and the cost of the system.

IT concepts to address in this topic

Robotics

- Input devices: for example, camera, sensors, microphones
- Output devices: for example, claws, wheels, motors, relays, speakers
- Robot, android, cyborg
- Sensors: for example, heat, proximity, magnetism, light, humidity, pH

Artificial intelligence

- Artificial intelligence versus computational intelligence
- Man or machine: Turing test, CAPTCHA (completely automated public Turing test to tell computers and humans apart)
- Capabilities and limitations: for example, learning to identify human emotions, evaluation of living things and machines (intuition, prior knowledge, judgment)
- AI techniques: searching, pattern recognition, heuristics, machine learning
- Fuzzy logic, set theory
- Machine learning: can machines become independent?
- Natural language communication and translators
- Neural networks: similarity to biological systems
- Pattern recognition: OCR (optical character recognition), image analysis, speech recognition, speech synthesizers
- Processing and storage requirements

Expert systems

- Collection, creation and maintenance of knowledge base
- Creation of inference engine, inference rule ("if–then" rules), chaining, suitable domains for expert systems
- Expert systems, knowledge base, knowledge engineer, expert system shells, inference engine, domain, common-sense knowledge
- Purpose of an algorithm within expert systems: for example, fault finding, product development

Applications of robotics, artificial intelligence and expert systems

- Embedded systems: for example, cell/mobile phones, GPS, washing machines
- Internet search engines
- Smart systems: for example, used at home or in warfare, medicine, cars
- Use of artificial intelligence (AI): for example, language translation, chess, voice recognition, modelling, games, predictive text, business intelligence systems

- Use of expert systems: for example, medical diagnosis, fault diagnosis, flight simulators, fraud detection
- Use of robots: for example, in industry, health, warfare, airlines, space, underwater exploration

3.12 Information systems specific to the annually issued case study

Additional subject content may be introduced as part of the annually issued case study. The additional terms will be listed as an appendix in the case study.

Assessment in the Diploma Programme

General

Assessment is an integral part of teaching and learning. The most important aims of assessment in the Diploma Programme are that it should support curricular goals and encourage appropriate student learning. Both external and internal assessments are used in the Diploma Programme. IB examiners mark work produced for external assessment, while work produced for internal assessment is marked by teachers and externally moderated by the IB.

There are two types of assessment identified by the IB.

- Formative assessment informs both teaching and learning. It is concerned with providing accurate and helpful feedback to students and teachers on the kind of learning taking place and the nature of students' strengths and weaknesses in order to help develop students' understanding and capabilities. Formative assessment can also help to improve teaching quality, as it can provide information to monitor progress towards meeting the course aims and objectives.
- Summative assessment gives an overview of previous learning and is concerned with measuring student achievement.

The Diploma Programme primarily focuses on summative assessment designed to record student achievement at, or towards, the end of the course of study. However, many of the assessment instruments can also be used formatively during the course of teaching and learning, and teachers are encouraged to do this. A comprehensive assessment plan is viewed as being integral with teaching, learning and course organization. For further information, see the IB *Programme standards and practices* document.

The approach to assessment used by the IB is criterion-related, not norm-referenced. This approach to assessment judges students' work by their performance in relation to identified levels of attainment, and not in relation to the work of other students. For further information on assessment within the Diploma Programme please refer to the publication *Diploma Programme assessment: Principles and practice*.

To support teachers in the planning, delivery and assessment of the Diploma Programme courses, a variety of resources can be found on the OCC or purchased from the IB store (http://store.ibo.org). Teacher support materials, subject reports, internal assessment guidance, grade descriptors, as well as resources from other teachers, can be found on the OCC. Specimen and past examination papers, as well as markschemes, can be purchased from the IB store.

Methods of assessment

The IB uses several methods to assess work produced by students.

Assessment criteria

Assessment criteria are used when the assessment task is open-ended. Each criterion concentrates on a particular skill that students are expected to demonstrate. An assessment objective describes what students should be able to do, and assessment criteria describe how well they should be able to do it. Using assessment criteria allows discrimination between different answers and encourages a variety of responses.

Each criterion comprises a set of hierarchically ordered level descriptors. Each level descriptor is worth one or more marks. Each criterion is applied independently using a best-fit model. The maximum marks for each criterion may differ according to the criterion's importance. The marks awarded for each criterion are added together to give the total mark for the piece of work.

Markbands

Markbands are a comprehensive statement of expected performance against which responses are judged. They represent a single holistic criterion divided into level descriptors. Each level descriptor corresponds to a range of marks to differentiate student performance. A best-fit approach is used to ascertain which particular mark to use from the possible range for each level descriptor.

Markschemes

This generic term is used to describe analytic markschemes that are prepared for specific examination papers. Analytic markschemes are prepared for those examination questions that expect a particular kind of response and/or a given final answer from the students. They give detailed instructions to examiners on how to break down the total mark for each question for different parts of the response. A markscheme may include the content expected in the responses to questions or may be a series of marking notes giving guidance on how to apply criteria.

Assessment outline—SL

First examinations 2012

Assessment component	Weighting
External assessment (3 hours)	**70%**
Paper 1 (1 hour 45 minutes) **Five** structured questions that assess in an integrated way the three strands of the syllabus. • Social and ethical significance • Application to specific scenarios • IT systems Students answer **three** of five structured questions on any of the SL/HL core topics. (60 marks)	**40%**
Paper 2 (1 hour 15 minutes) This paper consists of **one** unseen article. Students are required to write a response to this article. (26 marks)	**30%**
Internal assessment This component is internally assessed by the teacher and externally moderated by the IB at the end of the course. **Project (30 hours)** The development of an original IT product for a specified client. Students must produce: • a cover page using prescribed format • an original IT product • documentation supporting the product (word limit 2,000 words). (30 marks)	**30%**

Assessment outline—HL

First examinations 2012

Assessment component	Weighting
External assessment (4 hours 45 minutes)	**80%**
Paper 1 (2 hours 15 minutes) **Seven** structured questions in **three** sections that assess in an integrated way the three strands of the syllabus. • Social and ethical significance • Application to specific scenarios • IT systems **Section A** Students answer **two** of three structured questions on any of the SL/HL core topics. **Section B** Students answer **one** of two structured questions based on topic 3.10, "IT systems in organizations". **Section C** Students answer **one** of two structured questions based on topic 3.11, "Robotics, artificial intelligence and expert systems". (80 marks)	**35%**
Paper 2 (1 hour 15 minutes) This paper consists of **one** unseen article. Students are required to write a response to this article. (26 marks)	**20%**
Paper 3 (1 hour 15 minutes) **Four** questions based on a pre-seen case study. (30 marks)	**25%**

Assessment component	Weighting
Internal assessment This component is internally assessed by the teacher and externally moderated by the IB at the end of the course. **Project (30 hours)** The development of an original IT product for a specified client. Students must produce: • a cover page using prescribed format • an original IT product • documentation supporting the product (word limit 2,000 words). (30 marks)	**20%**

External assessment

Three different methods are used to assess students.

- Detailed markschemes specific to each examination paper that are not published in this guide
- Assessment criteria for SL/HL paper 2 and the internal assessment that are published in this guide
- Markbands for SL paper 1, HL paper 1 and HL paper 3 that are published in this guide

The assessment criteria used in SL/HL paper 2 are related to the command terms and associated assessment objectives established for the ITGS course, which are linked to the group 3 grade descriptors.

The markbands used in SL paper 1, HL paper 1 and HL paper 3 are related to the command terms and associated assessment objectives established for the ITGS course, which are linked to the group 3 grade descriptors.

The markbands are:

- SL and HL paper 1 part (c) and HL paper 3 question 3
- HL paper 3 question 4.

The command terms used in external assessment indicate the depth of response that is required of students. These are classified according to the following assessment objectives.

- Assessment objective 1: Knowledge and understanding of specified content
- Assessment objective 2: Application and analysis
- Assessment objective 3: Synthesis and evaluation

There is a progression in demand from assessment objective 1 to 3.

A list of the different command terms used in the external assessment of the subject is provided here. Definitions of the command terms can be found in the "Glossary of command terms" in the appendix.

Assessment objective 1: Knowledge and understanding

- Calculate
- Define
- Describe
- Identify
- Outline
- State

Assessment objective 2: Application and analysis

- Analyse
- Compare
- Construct
- Contrast

- Distinguish
- Explain

Assessment objective 3: Synthesis and evaluation

- Discuss
- Evaluate
- Justify
- To what extent
- Formulate (HL paper 3 only)

External assessment details—SL

Paper 1

Duration: 1 hour 45 minutes
Maximum mark: 60
Weighting: 40%

The purpose of the paper is to assess the student's ability to demonstrate the following objectives in relation to the three strands of the syllabus: social and ethical significance, application to specified scenarios and IT systems.

- Assessment objective 1: Knowledge and understanding
- Assessment objective 2: Application and analysis
- Assessment objective 3: Synthesis and evaluation

This paper consists of five structured questions based on stimulus material, drawn from across a range of specified scenarios, which assess in an integrated way the three strands of the syllabus.

Students are required to answer three questions from five.

There may be up to three questions common to this paper and HL paper 1, section A.

Each question will be structured with three parts; the first two parts may be subdivided.

The number of marks for each part will be given on the paper, and is linked to the command term used. This will indicate to students the depth of the response required.

All command terms can be used in this paper with the exception of formulate.

The maximum mark for each question is 20.

Paper 2

Duration: 1 hour 15 minutes
Maximum mark: 26
Weighting: 30%

The paper

The purpose of the paper is to assess the student's ability to demonstrate the following objectives in relation to the three strands of the syllabus: social and ethical significance, application to specified scenarios and IT systems.

- Assessment objective 1: Knowledge and understanding
- Assessment objective 2: Application and analysis
- Assessment objective 3: Synthesis and evaluation

The paper is based on an unseen article.

The IT-related article is chosen to provide suitable stimulus material, being contemporary in nature and related to at least one social/ethical consideration.

In addition to the 5 minutes' reading time allowed in the examination, students are advised to take approximately 15 minutes to read and reflect upon the text carefully before formulating their response.

The response should be approximately 750 words.

The format of the examination paper requires students to:

- describe **one** social/ethical concern related to the IT system in the article and the relationship of a primary stakeholder to it
- describe how the IT system works and explain how it relates to the social/ethical concern previously described
- evaluate the impact of the social/ethical issues on relevant stakeholders
- evaluate **one** possible solution related to the impact previously identified.

The number of marks for each part will be given on the paper, and is linked to the command term used. This will indicate to students the depth of the response required.

Preparation for the examination

Throughout the course, students will be expected to study a range of articles similar in nature to the example in the teacher support material or from previous examinations, both as a learning tool and as preparation for the examination. Examples of ways in which this can be carried out during the course include the following.

- A student studying personal and public communications may be provided with a current news article and be required to complete a report for a technically non-literate audience.
- A student may use the article as part of a revision exercise on a topic such as software fundamentals.
- A student studying a prescribed social/ethical issue may use a news article to help develop ideas further.
- A class may take the roles of the various stakeholders in the scenario and prepare for a class debate to evaluate the social impacts and ethical issues raised.
- A class will take the article as a starting point and take discussions relating each of the assessment criteria beyond what has been explicitly stated in the article.

External markbands and assessment criteria—SL

SL and HL paper 1 part (c) and HL paper 3 question 3 markband

Marks	Level descriptor
No marks	• A response with no knowledge or understanding of the relevant ITGS issues and concepts. • A response that includes no appropriate ITGS terminology.
Basic 1–2 marks	• A response with minimal knowledge and understanding of the relevant ITGS issues and concepts. • A response that includes minimal use of appropriate ITGS terminology. • A response that has no evidence of judgments and/or conclusions. • No reference is made to the scenario in the stimulus material in the response. • The response may be no more than a list.
Adequate 3–4 marks	• A descriptive response with limited knowledge and/or understanding of the relevant ITGS issues and/or concepts. • A response that includes limited use of appropriate ITGS terminology. • A response that has evidence of conclusions and/or judgments that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced. • Implicit references are made to the scenario in the stimulus material in the response.
Competent 5–6 marks	• A response with knowledge and understanding of the relevant ITGS issues and/or concepts. • A response that uses ITGS terminology appropriately in places. • A response that includes conclusions and/or judgments that have limited support and are underpinned by a balanced analysis. • Explicit references to the scenario in the stimulus material are made at places in the response.
Proficient 7–8 marks	• A response with a detailed knowledge and understanding of the relevant ITGS issues and/or concepts. • A response that uses ITGS terminology appropriately throughout. • A response that includes conclusions and/or judgments that are well supported and underpinned by a balanced analysis. • Explicit references are made appropriately to the scenario in the stimulus material throughout the response.

Paper 2: Assessment criteria

Criterion A: The issue and stakeholder(s)

This criterion requires the student to make reference to relevant social/ethical concerns and stakeholders.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1	Either an appropriate social/ethical concern **or** the relationship of one primary stakeholder to the IT system in the article is identified.
2	Either an appropriate social/ethical concern **or** the relationship of one primary stakeholder to the IT system in the article is described **or** both are identified.
3	Either an appropriate social/ethical concern **or** the relationship of one primary stakeholder to the IT system in the article is described; the other is identified.
4	Both an appropriate social/ethical concern **and** the relationship of one primary stakeholder to the IT system in the article are described.

Criterion B: The IT concepts and processes

This criterion requires the student to make reference to relevant stakeholders, information technologies, data and processes.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	There is little or no understanding of the step-by-step process of how the IT system works and it does not go beyond the information in the article. The major components of the IT system are identified using minimal technical IT terminology.
3–4	There is a description of the step-by-step process of how the IT system works that goes beyond the information in the article. Most of the major components of the IT system are identified using some technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is identified, with some use of ITGS terminology.
5–6	There is a detailed description of the step-by-step process that shows a clear understanding of how the IT system works and that goes beyond the information in the article. The major components of the IT system are identified using appropriate technical IT terminology. The relationship between the IT system referred to in the article and the concern presented in criterion A is explained using appropriate ITGS terminology.

Criterion C: The impact of the social/ethical issue(s) on stakeholders

This criterion requires the student to evaluate the impact of the social/ethical issues on relevant stakeholders.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	The impact of the social/ethical issues on stakeholders is described but not evaluated. Material is either copied directly from the article or implicit references are made to it.
3–5	The impact of the social/ethical issues on stakeholders is partially analysed, with some evaluative comment. Explicit references to the information in the article are partially developed in the response. There is some use of appropriate ITGS terminology.
6–8	The impact of the social/ethical issues on stakeholders is fully analysed and evaluated. Explicit, well-developed references to information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.

Criterion D: A solution to a problem arising from the article

The **single** proposed solution must address at least one problem related to the impact identified in criterion C.

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below.
1–2	One feasible solution to at least one problem is proposed and described. No evaluative comment is offered. Material is either copied directly from the article or implicit references are made to it.
3–5	One appropriate solution to at least one problem is proposed and partially evaluated. The response contains explicit references to information in the article that are partially developed. There is some use of appropriate ITGS terminology.
6–8	One appropriate solution to at least one problem is proposed and fully evaluated, addressing both its strengths and potential weaknesses. Areas for future development may also be identified. Explicit, fully developed references to the information in the article are made appropriately throughout the response. There is use of appropriate ITGS terminology.

External assessment details—HL

Paper 1

Duration: 2 hours 15 minutes
Maximum mark: 80
Weighting: 35%

The purpose of the paper is to assess the student's ability to demonstrate the following objectives in relation to the three strands of the syllabus: social and ethical significance, application to specified scenarios and IT systems.

- Assessment objective 1: Knowledge and understanding
- Assessment objective 2: Application and analysis
- Assessment objective 3: Synthesis and evaluation

This paper consists of seven structured questions based on stimulus material, drawn from across a range of specified scenarios, which assess in an integrated way the three strands of the syllabus.

Students are required to answer two questions in section A, one question in section B and one question in section C.

There may be up to three questions common to section A of this paper and SL paper 1.

Each question will be structured with three parts; the first two parts may be subdivided.

The number of marks for each part will be given on the paper, and is linked to the command term used. This will indicate to students the depth of the response required.

- All command terms can be used in this paper with the exception of formulate.

The maximum mark for each question is 20.

Paper 2

Duration: 1 hour 15 minutes
Maximum mark: 26
Weighting: 20%

The assessment for HL paper 2 is the same as the assessment for SL paper 2.

Paper 3

Duration: 1 hour 15 minutes
Maximum mark: 30
Weighting: 25%

The paper

This paper is based on a case study produced annually by the IB and published on the OCC.

A clean copy of the case study must be downloaded by the IB coordinator and be taken into the HL paper 3 examination.

The purpose of the paper is to assess the student's ability to demonstrate the following objectives in relation to the three strands of the syllabus: social and ethical significance, application to specified scenarios and IT systems.

- Assessment objective 1: Knowledge and understanding
- Assessment objective 2: Application and analysis
- Assessment objective 3: Synthesis and evaluation

This paper consists of four structured questions, which assess in an integrated way the three strands of the syllabus.

Students are required to answer all of the questions.

The questions are related to the scenario in the case study.

In addition to the case study further stimulus material may be provided in the examination paper.

Questions 1 and 2 may be subdivided.

Question 4 will require the synthesis of information from a range of sources, including the citing of independent research and investigations, to develop an extended response to a specified issue.

The number of marks for each part will be given on the paper, and is linked to the command term used. This will indicate to students the depth of the response required.

All command terms can be used in this paper.

The case study

The case study is a valuable teaching tool that can be used to integrate all three strands of the syllabus.

This case study will be provided 12 months before the May examination session (18 months before the November session) so that students can carry out detailed research prior to the HL paper 3 examination, which consists of 25% of the final mark.

The ITGS case study provides the stimulus material for the investigation of a scenario involving the use of IT in a global context. The information obtained will prepare students and form the basis of the requirements for answering the questions in HL paper 3.

The case study is an opportunity to keep abreast of current technology by introducing new technical concepts or issues requiring a more in-depth investigation than that required for IT systems in the rest of the course.

It is expected that some of the hours allocated to the HL extension should be used for research into the case study and related scenarios.

Through their investigation of the case study, students should be able to:

- demonstrate an understanding of the IT concepts fundamental to the IT system(s) in the case study (assessment objective 1)
- demonstrate an understanding of how the IT system(s) in the case study work (assessment objective 1)
- analyse the social impacts and ethical issues relevant to the case study (assessment objective 2)
- explain how scenarios specified in the case study may be related to other similar local and global scenarios (assessment objective 2)

- explain technical issues relating to the case study (assessment objective 2)
- use and quote, where appropriate, information that may be gathered from local and global sources including field trips, interviews, primary and secondary research, invited guest speakers and online interviews, as a basis for the strategic developments linked to the case study (assessment objective 3)
- evaluate, formulate or justify strategic solutions based on the synthesis of information from the case study itself, additional research and new stimulus material provided in the examination paper (assessment objective 3).

External markbands and assessment criteria—HL

Paper 1

Part (c) is assessed using the SL and HL paper 1 part (c) and HL paper 3 question 3 markband, as detailed in "External markbands and assessment criteria—SL".

Paper 2

HL paper 2 is assessed using the same assessment criteria as detailed in "External markbands and assessment criteria—SL".

Paper 3

Question 3 is assessed using the SL and HL paper 1 part (c) and HL paper 3 question 3 markband, as detailed in "External markbands and assessment criteria—SL".

Question 4 is assessed using the HL paper 3 question 4 markband detailed below.

HL paper 3 question 4 markband

There must be evidence of independent research and investigation for students to reach the top level.

Marks	Level descriptor
No marks	• A response with no knowledge or understanding of the relevant ITGS issues and concepts. • A response that includes no appropriate ITGS terminology.
Basic 1–3 marks	• A response with minimal knowledge and understanding of the relevant ITGS issues and concepts. • A response that includes minimal use of appropriate ITGS terminology. • A response that has no evidence of judgments, conclusions or future strategies. • No reference is made to the information in the case study or independent research in the response. • The response may be no more than a list.

Adequate 4–6 marks	• A descriptive response with limited knowledge and/or understanding of the relevant ITGS issues and/or concepts. • A response that includes limited use of appropriate ITGS terminology. • A response that has evidence of conclusions, judgments or future strategies that are no more than unsubstantiated statements. The analysis underpinning them may also be partial or unbalanced. • Implicit references are made to the information in the case study or independent research in the response.
Competent 7–9 marks	• A response with knowledge and understanding of the relevant ITGS issues and/or concepts. • A response that uses ITGS terminology appropriately in places. • A response that includes conclusions and/or judgments that have limited support and are underpinned by a balanced analysis. • Explicit references to the information in the case study or independent research are made at places in the response.
Proficient 10–12 marks	• A response with a detailed knowledge and understanding of the relevant ITGS issues and/or concepts. • A response that uses ITGS terminology appropriately throughout. • A response that includes conclusions, judgments or future strategies that are well supported and underpinned by a balanced analysis. • Explicit references are made appropriately to the information in the case study and independent research throughout the response.

Internal assessment

Purpose of internal assessment

Internal assessment is an integral part of the course and is compulsory for both SL and HL students. It enables students to demonstrate the application of their skills and knowledge, and to pursue their personal interests, without the time limitations and other constraints that are associated with written examinations. The internal assessment should, as far as possible, be woven into normal classroom teaching over a period of time and not be a short intensive activity in the course or after the course has been taught.

The internal assessment requirements at SL and at HL are the same. However, it contributes to a different percentage of the overall mark. Students are required to produce a project that consists of a cover page, the product (IT solution) and documentation. The focus of the ITGS project is on providing an original IT solution for a client.

The internal assessment component, as well as being interesting, practical and productive, forms an important part of the assessment of the ITGS course. It is imperative, therefore, that the teacher provides appropriate guidance to students.

Guidance and authenticity

The SL and HL project submitted for internal assessment must be the student's own work. However, it is not the intention that students should decide upon a title or topic and be left to work on the internal assessment component without any further support from the ITGS teacher. Both the teacher and the client for the product should play an important role during both the planning stage and the period when the student is working on the internally assessed work. It is the responsibility of the ITGS teacher to ensure that students are familiar with:

- the requirements of the type of work to be internally assessed
- the ITGS course ethical guidelines
- the assessment criteria; students must understand that the work submitted for assessment must address these criteria effectively.

Teachers and students must discuss the internally assessed work. Students should be encouraged to initiate discussions with the teacher to obtain advice and information, and students must not be penalized for seeking guidance. However, if a student could not have completed the work without substantial support from the teacher, this should be recorded on the appropriate form from the *Handbook of procedures for the Diploma Programme*.

It is the responsibility of teachers to ensure that all students understand the basic meaning and significance of concepts that relate to academic honesty, especially authenticity and intellectual property. Teachers must ensure that all student work for assessment is prepared according to the requirements and must explain clearly to students that the internally assessed work must be entirely their own.

As part of the learning process, teachers can give advice to students on a first draft of the internally assessed work. This advice should be in terms of the way the work could be improved, but this first draft must not be heavily annotated or edited by the teacher. The next version handed to the teacher after the first draft must be the final one.

All work submitted to the IB for moderation or assessment must be authenticated by a teacher, and must not include any known instances of suspected or confirmed malpractice. Each student must sign the coversheet for internal assessment to confirm that the work is his or her authentic work and constitutes the final version of that work. Once a student has officially submitted the final version of the work to a teacher (or the coordinator) for internal assessment, together with the signed coversheet, it cannot be retracted.

Authenticity may be checked by discussion with the student on the content of the work, and scrutiny of one or more of the following:

- the student's initial proposal
- the first draft of the written work
- the references cited
- the style of writing compared with work known to be that of the student.

The requirement for teachers and students to sign the coversheet for internal assessment applies to the work of all students, not just the sample work that will be submitted to an examiner for the purpose of moderation. If the teacher and student sign a coversheet, but there is a comment to the effect that the work may not be authentic, the student will not be eligible for a mark in that component and no grade will be awarded. For further details refer to the IB publication *Academic honesty* and the relevant articles in the *General regulations: Diploma Programme*.

The same piece of work cannot be submitted to meet the requirements of both the internal assessment and the extended essay.

Group work

The development of the project must be undertaken by the student on an individual basis. Collaborative or group work may not be undertaken by students.

Time allocation

It is recommended that a total of approximately 30 teaching hours for both SL and HL should be allocated to the work. This should include:

- time for the teacher to explain to students the requirements of the internal assessment, including 10 hours to introduce the systems development life cycle
- time for the teacher to explain to students the requirements of the project, including codes of ethical behaviour and confidentiality
- class time for students to work on the project
- time spent by the student making arrangements with the selected client and visiting to collect data
- time for consultation between the teacher and each student
- time to review and monitor progress, and to check authenticity.

Additional time may be needed outside normal class time for students to acquire any additional IT skills required for the project, to consult with their client and to work on their own.

Requirements and recommendations

Teachers and students will need to discuss issues relating to the design of the product, the collection of data and subsequent consultation with the client. Students should be encouraged to initiate discussions with the teacher to obtain advice and information, and will not be penalized for seeking advice.

Ethical guidelines for internal assessment

Given the nature of the project, students must take into account ethical problems and implications for undertaking research and developing the product, for example, ensuring the confidentiality and security of data. Wherever possible, original data from the client should be used or be collected by the student.

The following guidelines must be applied.

- Obtain consent from the client for whom the product is being developed before the initial investigation is begun.
- Store all data collected securely in order to maintain confidentiality.
- Give the actual data provided by the client. Do not alter or create data in their name without their express permission.
- Use the data collected for the project only; do not use it for any other purpose without the express permission of the client.
- Develop and maintain a close working relationship with the client.

Health and safety guidelines

Schools are advised to follow best practice in health and safety for ITGS research. Each school is ultimately responsible for the health and safety of students.

Using assessment criteria for internal assessment

For internal assessment, a number of assessment criteria have been identified. Each assessment criterion has level descriptors describing specific levels of achievement, together with an appropriate range of marks. The level descriptors concentrate on positive achievement, although for the lower levels failure to achieve may be included in the description.

Teachers must judge the internally assessed work at SL and at HL against the seven criteria (A–G) using the level descriptors.

- The same assessment criteria are provided for SL and HL.
- The aim is to find, for each criterion, the descriptor that conveys most accurately the level attained by the student, using the best-fit model. A best-fit approach means that compensation should be made when a piece of work matches different aspects of a criterion at different levels. The mark awarded should be one that most fairly reflects the balance of achievement against the criterion. It is not necessary for every single aspect of a level descriptor to be met for that mark to be awarded.
- When assessing a student's work, teachers should read the level descriptors for each criterion until they reach a descriptor that most appropriately describes the level of the work being assessed. If a piece of work seems to fall between two descriptors, both descriptors should be read again and the one that more appropriately describes the student's work should be chosen.
- Where there are two or more marks available within a level, teachers should award the upper marks if the student's work demonstrates the qualities described to a great extent. Teachers should award the lower mark if the student's work demonstrates the qualities described to a lesser extent.

- Only whole numbers should be recorded; partial marks, that is fractions and decimals, are not acceptable.
- Teachers should not think in terms of a pass or fail boundary, but should concentrate on identifying the appropriate descriptor for each assessment criterion.
- The highest level descriptors do not imply faultless performance but should be achievable by a student. Teachers should not hesitate to use the extremes if they are appropriate descriptions of the work being assessed.
- A student who attains a high level of achievement in relation to one criterion will not necessarily attain high levels of achievement in relation to the other criteria. Similarly, a student who attains a low level of achievement for one criterion will not necessarily attain low achievement levels for the other criteria. Teachers should not assume that the overall assessment of the students will produce any particular distribution of marks.
- The assessment criteria must be made available to students.

Internal assessment details—SL and HL

Project

Duration: 30 hours
Maximum mark: 30
Weighting: SL 30%; HL 20%

Introduction

The requirement of the project is to develop an original IT solution to a real problem for a specified client. Students should undertake a challenging task using advanced techniques published annually on the OCC to demonstrate their practical IT and project management skills.

Key terms

The terms *developer* and *student* are synonymous. In this scenario the developer is the student.

The terms *product* and *IT solution* are interchangeable. In general, the IT solution refers to the product before it has been completed.

Choice of topic

In identifying a problem, students can select any topic that interests them. It does not have to be directly related to the specified themes in the syllabus.

There are several possibilities in choosing the client: the client chosen may be from inside the school environment, but must not be the ITGS teacher, or from outside the school, such as family or friends.

Examples of clients from within the school could include the following.

- The IB Diploma Programme theatre teacher (**client**) requires a method of managing the finance and seat booking for a school theatre production (**problem**). A possible solution is to develop a multiple-page spreadsheet that links a diagrammatic representation of the seating plan with the financial information.
- The IB Primary Years Programme or kindergarten teacher (**client**) requires a method to introduce the basic greetings in another language to 4-year-olds (**problem**). A possible solution is to develop a multimedia presentation that includes a series of sound and video clips.

- The IB Diploma Programme history teacher (**client**) requires an effective way for students to record and analyse information obtained from a scheduled field trip (**problem**). A possible solution is to develop a comprehensive desktop-published workbook including the development of a reusable template and the significant manipulation of images.

Examples of clients from outside the school could include the following.

- A photographer (**client**) requires a method of increasing his visibility and consequently his income from the sale of images (**problem**). A possible solution is to develop a website.
- A manager of a local sports team (**client**) requires a method of keeping accurate records of players' details, attendance at training sessions and performance throughout the season (**problem**). A possible solution is to develop a relational database.

Students will need to work closely with the client throughout the lifetime of the project. Therefore, it is recommended that, wherever possible, students select a client who is known to them or their family. This could also include members of the school community, local clubs and/or businesses. It is strongly advised that a contributor's agreement is signed.

Requirements

The project consists of three parts.

- A cover page
- The product (IT solution)
- The documentation

All must be submitted for moderation in digital rather than hard copy format. Instructions for the submission of student work can be found in the *Handbook of procedures for the Diploma Programme*.

Project components

Cover page

The cover page form is included within a ZIP file in either HTML or TXT format, available on the OCC. The cover page form must be used.

The cover page must be submitted in HTML format and provide access to the product and the documentation via **relative** hyperlinks.

The cover page is not included in the overall word count for the project.

If additional information to access or locate the product is required—for example, a username and password—this must be provided in the cell provided on the cover page.

The cover page must be called [cand_no]_[cand_name]_CoverPage.htm and be located in the top-level folder.

Product

The product is the IT solution.

Students should aim to develop a product that uses advanced techniques (see the list of appropriate techniques for the development of the project on the OCC), is fully functional, and the complete internal structure of the product must be available for moderation.

It should be noted that products created using templates that show no evidence of modification in their structure, design or functionality are not permitted. Examples of **inappropriate** products include:

- the development of a website (product) using a web-based template that completely determines its structure and layout
- a product consisting of a data mashup consisting only of secondary data
- the use of unmodified exemplar products or templates provided with software such as the Northwind database in Microsoft Access®.
- Any text within the product is not included in the overall word count for the project.

Documentation

To assist students in the development and submission of the project, the ZIP file contains the cover page, analysis form, project schedule form and product design form.

The documentation must consist of eight files.

The final documentation consists of the following.

- **Information added to forms** to provide evidence of the analysis, a project schedule and the design of the product.

  The information added to the forms must be in the following style(s):

  – bullet points or tables to list information

  – scanned diagrams or other appropriate images as part of the design process

  – other styles of non-extended writing or diagrammatic representation such as flow charts, Gantt charts or spider diagrams where appropriate.

  This information is not included in the word count unless the student includes extended writing. In this case, the words will be included in the word count.

  The templates in the ZIP file must be used.

- **A series of documents** that use text (continuous writing) that:

  – identifies the client's problem and explains how the present scenario is inadequate

  – justifies the rationale behind the choice and development of the IT solution

  – evaluates the success of the product in resolving the existing inadequacies.

  This is the **only** information included in the word count and **must not exceed 2,000 words**.

  It is recommended that the templates in the ZIP file are used.

- **Evidence of consultation with the client**, such as a written record of the interview (either a summary or transcript), a sound file, a video, or an exchange of emails that may be supported by a questionnaire, providing evidence of the initial consultation and the gathering of feedback from the client after the product is completed. This information must be referenced under the appropriate criterion heading, and is not included in the word count.

  It is recommended that the name of the client and their occupation and the date of the consultation are clearly stated.

  Because of the different media that can be used, there are no templates in the ZIP file for evidence of consultation between the student and the client.

Organization of documentation

The documentation must be located in the **documentation folder** and consist of eight files. It is associated with criteria A–F.

The following table indicates the content and nature of each of the files and the criterion that it relates to.

File	Nature of submission	Criterion
Initial investigation [of problem]	Text	A
Initial consultation [with client]	Methods such as a written record of the interview (either a summary or transcript), a sound file, a video, or an exchange of emails that may be supported by a questionnaire	A
Analysis	Analysis form including additional text	B
Project schedule	Project schedule form	C
Product design	Product design form	D
Product development	Text with screenshot evidence	E
Feedback from client	Methods such as a written record of the interview (either a summary or transcript), a sound file, a video, or an exchange of emails that may be supported by a questionnaire	F
Product evaluation and future product development	Text	F

It is strongly recommended that the documentation is submitted in a commonly used format such as PDF, RTF or TXT.

Appendices are not required.

Development of the project

Students are advised to use the following guidelines to produce their project. This will ensure it fulfills the requirements of the criteria.

When developing the ITGS project, the student must follow the processes as set out in each of the criteria. Criteria A–D inclusive must be reviewed by the teacher before allowing the student to proceed to making the product in criterion E.

Criterion A: Initial investigation and initial consultation with client

The client and the information problem

The student must identify a specific client who has a problem with the present situation that can be best addressed by an IT solution. The client is the person(s) who needs the IT solution (product). After consulting with the client, the student must explain the inadequacies of the present situation, which may or may not involve the use of an IT system.

The following key questions should be considered.

- Who is the client?
- What is the present situation?
- What are the inadequacies of the present situation?

This information must be obtained from the client and can be presented in a variety of ways, such as a written record of the interview (either a summary or transcript), a sound file, a video, or an exchange of emails that may be supported by a questionnaire.

Criterion B: Analysis

The student must ensure that the proposed IT solution addresses the inadequacies identified in criterion A.

The **analysis form** must be used.

The analysis must consist of the following two parts, which must be submitted as a single document.

- A completed requirements specification using the first section of the form
- Justification for the proposed solution, as extended writing using the second section of the form

Requirements specification

The following information must be included.

- System interaction
- Input and output requirements
- Processing
- Security
- Specific performance criteria that are evaluated in criterion F to determine the effectiveness of the solution

Justification of proposed solution

The rationale behind the choice of the proposed solution must be in **extended writing** justifying how the choice of this particular product is the most effective IT solution to the problem identified in criterion A. It is expected that this is based largely on the information within the requirements specification.

Other information that can be included in the justification for the proposed IT solution may refer to:

- whether the student has the IT skills and access to the software required to develop the IT solution
- whether the client's hardware and software is compatible with the IT solution
- the level of training necessary for the client to use and maintain the proposed IT solution
- to what extent the input and output requirements of the client are met by the IT solution
- whether the data required for the IT solution can be obtained by either the client or the student
- how any security implications for the development and operation of the IT solution can be resolved.

Criterion C: Project schedule

The **project schedule form** must be used.

The project schedule must be implemented for the proposed IT solution in criterion B.

A plan based on the research into the proposed IT solution and the factors involved (stakeholders, software, hardware, network requirements, data, input and output, processes and policies) is developed that addresses:

- the key events in planning, designing, developing, testing and implementing the product in the form of a timeline
- any other issues that may arise which may affect the development of the product.

Criterion D: Product design

The **product design form** must be used. It should include:

- design methodologies appropriate to the type of IT product being designed
- different levels of draft design, such as the overall structure as well as the internal layout of the product itself. This can also include investigation into specific elements used within the product (such as fonts, graphic elements, effects)
- identification of a range of appropriate resources and techniques required for the development of the product
- evidence of a test plan that addresses the main areas of functionality of the product
- evidence of the agreement of the client to develop the product.

The product design should be in sufficient detail so the product could be independently created by an IT-literate third party.

Criterion E: Product development

The product is created using the information submitted in the requirements specification (criterion B), project schedule (criterion C) and the product design (criterion D).

The student must present a list of the techniques used in the product at the start of this criterion.

A complex product is defined as one that includes at least three appropriate advanced techniques. The list of techniques will be posted on the OCC annually.

A simple product cannot be awarded more than 4 marks for criterion E.

The information in the documentation linked to the development of the product must provide a detailed account, using extended writing, to justify the following.

- The structure of the product and why it is appropriate
- The techniques used (see the list on the OCC), including screenshots, in the development of the product, and reasons why they are appropriate to it
- Additional technical information, if appropriate, that will support the functionality of the product, such as web hosting or security information

Any reference material such as templates, program code, applets or other materials that have been used or modified must be acknowledged. Failure to do so will be considered a significant omission.

Criterion F: Product evaluation and future product development

This criterion should be completed as two parts. The first part deals with the evaluation of the product by the client, including any feedback given and including any problems identified. The second part makes recommendations for the future development of the product.

Feedback from client

This information must be obtained from the client and can be presented in a variety of ways, such as a written record of the interview (either a summary or transcript), a sound file, a video, or an exchange of emails that may be supported by a questionnaire.

The evaluation of the completed product should refer directly to the specific performance criteria that form part of the requirements specifications in criterion B, as well as any other appropriate feedback obtained from the client at handover.

Recommendations for the future development of the product

The student will use the client feedback and the evaluation of the specific performance criteria to recommend possible future developments to the product. These recommendations should succinctly explain how possible future developments of the product will be of benefit to the client and/or other stakeholders.

Criterion G: Required elements

The three required elements are marked independently.

1. The content and functionality of the product are sufficient to reliably evaluate its effectiveness.

   If the product contains insufficient content to reliably evaluate its effectiveness, such as a database with insufficient records to test the output of queries or a single-page website, this required element has not been fulfilled and no marks will be awarded.

   If the product does not function as intended, this required element has not been fulfilled and no marks will be awarded.

2. The prescribed cover page is used and functions as required.

   The prescribed cover page has been used and the moderator can successfully use this to navigate to both the product and the documentation.

   – If the links do not function, this required element has not been fulfilled and no marks will be awarded.

   – If the nature of the product means it cannot be directly accessed by the link, there must be clear and concise instructions on the cover page. If they are not sufficiently clear for the moderator to easily locate the product, this required element has not been fulfilled and no marks will be awarded.

3. Folder structure and file naming.

   Folder structure

   The project should be organized in such a way that there is evidence of the use of appropriate folder names and structures that enable individual files to be located if links fail.

   File naming

   The project should be organized in such a way that there is evidence of:

   – the use of appropriate file names to enable the client or an IT-literate third party to be able to locate and modify files if necessary

   – the use of an appropriate file-naming convention that would allow either the client or an IT-literate third party to make future modifications to the product.

   If the product does not demonstrate appropriate file names and folder structures, this required element has not been fulfilled and no marks will be awarded.

Assessing the project

There are seven criteria for the project.

The criteria should be applied systematically against the relevant parts of the project.

- The documentation supporting the product is assessed in criteria A–F inclusive.
- The functionality and organization of the product and cover page are assessed in criterion G.

Criterion	Marks
Criterion A: Initial investigation	3
Criterion B: Analysis	5
Criterion C: Project schedule	3
Criterion D: Product design	4
Criterion E: Product development	8
Criterion F: Product evaluation and future product development	4
Criterion G: Required elements	3
Total	30

Internal assessment criteria—SL and HL

Criterion A: Initial investigation

Marks	Level descriptor
0	The work does not reach the standard described by the descriptors below.
1	A client **and** a problem with the present situation are identified.
2–3	A client is identified. The inadequacies of the present situation are explained with cited reference to the consultation with the client.

Criterion B: Analysis

Requirements specification

The specific performance criteria within the requirements specification will be used in criterion F to evaluate the effectiveness of the product.

Justification of proposed solution

This is completed in extended writing.

Marks	Level descriptor
0	The work does not reach the standard described by the descriptors below.
1	The analysis form is used, refers to the scenario described in criterion A **and** includes either a requirements specification that can be used to partially evaluate the effectiveness of the IT solution **or** a limited explanation of why the IT solution was chosen.
2–3	The analysis form is used, refers to the scenario described in criterion A **and** includes a requirements specification that can be used to partially evaluate the effectiveness of the IT solution **and** an adequate explanation of why the IT solution was chosen.
4–5	The analysis form is used, refers to the scenario described in criterion A **and** includes a requirements specification that can be used to effectively evaluate the success of the IT solution **and** a detailed justification of why the IT solution was chosen.

Criterion C: Project schedule

The project schedule must include the following.

- Dates
- Actions
- Details

Marks	Level descriptor
0	The work does not reach the standard described by the descriptors below.
1	The project schedule uses the project schedule form **and** refers to the proposed IT solution identified in criterion B, providing an outline schedule of the tasks involved in planning, designing, developing, testing and implementing the IT solution.
2–3	The project schedule uses the project schedule form **and** refers to the proposed IT solution identified in criterion B, providing a detailed schedule of the tasks involved in planning, designing, developing, testing and implementing the IT solution. The project schedule can be used as a basis for the development of the IT solution.

Criterion D: Product design

There are four significant components to the product design.

- Overall structure
- Internal structure
- List of resources
- List of techniques

The following information should also be included as part of the product design.

- Test plan
- Agreement of client

Marks	Level descriptor
0	The work does not reach the standard described by the descriptors below.
1–2	The product designs for the IT solution identified in criterion B use the product design form but have significant omissions. It is possible for the student to create the product from them, but they lack sufficient detail for an IT-literate third party to see how the product was created.
3–4	The product designs for the IT solution identified in criterion B use the product design form and include sufficient detail for an IT-literate third party to see how the product was created.

Criterion E: Product development

The student must demonstrate the techniques, with screenshots, that were used to develop the IT solution identified in criterion B for the client identified in criterion A and justify why they have been used.

A complex product is defined as one that includes at least three appropriate advanced techniques. The list of techniques will be posted on the OCC annually.

Marks	Level descriptor
0	The work does not reach the standard described by the descriptors below.
1–2	The IT solution identified in criterion B is created. The techniques used to develop the complex product are identified **or** the techniques used to develop the simple product are described.
3–4	The IT solution identified in criterion B is created. The structure of the complex product **and** the techniques used to develop it are described (with screenshots) **or** the structure of the simple product and the choice of techniques used to create it are justified (with screenshots).
5–6	The IT solution identified in criterion B is created. The structure of the complex product **and** the choice of techniques used to develop it have been explained (with screenshots), with minor omissions. Sources have been acknowledged.
7–8	The IT solution identified in criterion B is created. The structure of the complex product **and** the choice of techniques used to develop it have been fully justified (with screenshots). Sources are cited appropriately.

Criterion F: Product evaluation and future product development

The student must evaluate the effectiveness of the finished product, based on feedback from the client. This must include direct references to the specific performance criteria identified in the requirements specification as part of criterion B.

The student must recommend proposals for future improvements of the product.

Marks	Level descriptor
0	The work does not reach the standard described by the descriptors below.
1–2	A limited evaluation of the product, based on feedback from the client is completed, and superficial and impractical recommendations are made for its further development. There is limited reference to the specific performance criteria identified in the requirements specification.
3–4	The product is evaluated, based on feedback from the client and the specific performance criteria identified in the requirements specification, **and** appropriate recommendation(s) are made for future development of the product.

Criterion G: Required elements

This criterion assesses the extent to which the three formal requirements are met.

- The content within the product is sufficient for an IT-literate third party to reliably evaluate its effectiveness **and** the product functions as required.
- The prescribed cover page is used and functions as required.
- Appropriate file names and folder structures are used throughout the project.

Marks	Level descriptor
0	None of the formal requirements are met.
1	Any **one** of the formal requirements is met.
2	Any **two** of the formal requirements are met.
3	All **three** of the formal requirements are met.

Appendix

Glossary of command terms

Command terms with definitions

Students should be familiar with the following key terms and phrases used in examination questions, which are to be understood as described below. Although these terms will be used frequently in examination questions, other terms may be used to direct students to present an argument in a specific way.

Command term	Assessment objective (AO)	Definition
Analyse	AO2	Break down in order to bring out the essential elements or structure.
Calculate	AO1	Obtain a numerical answer showing the relevant stages in the working.
Compare	AO2	Give an account of the similarities between two (or more) items or scenarios, referring to both (all) of them throughout.
Construct	AO2	Display information in a diagrammatic or logical form.
Contrast	AO2	Give an account of the differences between two (or more) items or situations, referring to both (all) of them throughout.
Define	AO1	Give the precise meaning of a word, phrase, concept or physical quantity.
Describe	AO1	Give a detailed account.
Discuss	AO3	Offer a considered and balanced review that includes a range of arguments, factors or hypotheses. Opinions or conclusions should be presented clearly and supported by appropriate evidence.
Distinguish	AO2	Make clear the differences between two or more concepts or items.
Evaluate	AO3	Make an appraisal by weighing up the strengths and limitations.
Explain	AO2	Give a detailed account including reasons or causes.
Formulate	AO3	Express precisely and systematically the relevant concept(s) or argument(s)
Identify	AO1	Provide an answer from a number of possibilities.
Justify	AO3	Give valid reasons or evidence to support an answer or conclusion.

Command term	Assessment objective (AO)	Definition
Outline	AO1	Give a brief account or summary.
State	AO1	Give a specific name, value or other brief answer without explanation or calculation.
To what extent	AO3	Consider the merits or otherwise of an argument or concept. Opinions and conclusions should be presented clearly and supported with appropriate evidence and sound argument.