IB DIPLOMA COURSE OUTLINE 2021 – 22

Subject group and course title: **Group 4 – Computer Science**

Course purpose:

Aims and objectives:

- The course aims:
  - Incorporate a diverse curriculum that is engaging, accessible, inspiring and rigorous.
  - Is underpinned by computational thinking:
    - think procedurally, logically, concurrently, abstractly, recursively and think ahead
    - utilize an experimental and inquiry-based approach to problem-solving
    - develop algorithms and express them clearly
    - appreciate how theoretical and practical limitations affect the extent to which problems can be solved computationally
- Course Objectives:
  - Demonstrate knowledge and understanding of specified content, methods, terminology.
  - Apply and use relevant facts and concepts, relevant design methods and techniques, appropriate communication
  - methods to present information.
  - Construct, analyse, evaluate and formulate success criteria, solution specifications including task outlines, designs
  - and test plans, appropriate techniques with a specified solution
  - Demonstrate the personal skills of cooperation and perseverance as well as appropriate technical skills for effective problem solving in developing a specified product.

Curriculum outline:

The topics that must be studied in SL/HL, including some practical work, are:

- Topic 1: System fundamentals
- Topic 2: Computer organization
- Topic 3: Networks
- Topic 4: Computational thinking, problem-solving and programming

The **HL** students will **additionally** cover the following the following topics:

- Topic 5: Abstract data structures
- Topic 6: Resource management
- Topic 7: Control

Additional subject content will be introduced at HL by the annually issued case study.

Finally, students' study one of the following options:
Option A: Databases
Option B: Modeling and simulation
Option C: Web science
Option D: Object-oriented programming (OOP)

Topics covered (in order taught during the two years)

First Year SL and HL:

- Topic 1. System Fundamentals
  - Systems in Organizations
    - Planning and system installation
    - User focus
    - System Backup
    - Software Deployment
  - System Design basics
    - Components of a computer system
    - System design and analysis
    - Human interaction with the system
- Topic 2. Computer organization
  - Computer Architecture
  - Secondary memory
  - Operating systems and application systems
  - Binary representation
  - Simple logic gates
- Topic 3. Networks
  - Network Architecture
  - Data Transmission
  - Wireless Networking
- Topic 4. Computational thinking, problem-solving and programming
  - General Principals
    - Thinking procedurally
    - Thinking logically
    - Thinking ahead
    - Thinking concurrently
    - Thinking abstractly
  - Connecting computational thinking and program design (Part I)
    - Introduction to Pseudocode
    - Pseudocode: Variables
    - Pseudocode: Conditionals & Iterations

First Year HL (in addition to the above):

- Topic 6. Resource Management
  - System resources
  - Role of the operating system
- Topic 7. Control
  - Centralized control systems
  - Distributed systems

First Year Option SL and HL (Option C-Web Sciences)

- C.1 Creating the web
- Web Design Tools
  - HTML
  - CSS

Second Year SL and HL:

- Topic 4. Computational thinking, problem-solving and programming
  - Connecting computational thinking and program design (Part II)
    - Arrays
    - Search/Sorting
    - Collections
  - Introduction to programming
    - Nature of programming languages
    - Use of programming languages (C++)

Second Year HL (in addition to the above):

- Topic 5. Resource Management
  - System resources
  - Role of the operating system

Second Year Option SL and HL (Option C-Web Sciences)

- C.2 Searching the web
- C.3 Distributed approaches to the web
- C.4 The evolving web
- Web Design Tools
  - Javascript

Second Year Option HL (in addition to the above):

- C.5 Analysing the web
- C.6 The intelligent web

Assessment model

All students (SL/HL) will need to demonstrate:

1) Understand and know:
   a) relevant facts and concepts
   b) appropriate methods and techniques
   c) computer science terminology
   d) information presentation methods.
2) Apply and use:
   a) relevant facts and concepts
   b) relevant design methods and techniques
   c) terminology to effectively communicate
   d) appropriate communication methods to present information
3) Development, analysis, evaluation and formulation:
   a) Success criteria, solution specification, including work outline, design and test plan
   b) Techniques suitable for a particular solution.
4) Demonstrate individual cooperation and perseverance as well as appropriate technical skills to effectively solve problems during the development of a particular product.

Throughout the course, the teaching will aim to:

- encourage the sense of inquiry
- focus on the understanding of clear concepts
- develop your understanding of the subject in both local and global contexts
- focus on effective teamwork and collaboration

- differentiate the level of difficulty to meet your needs as a learner
- assess your progress with regular feedback as well as with a final exam.

Assessment tools

During class it is used PowerPoint presentations, examples, discussions, group or individual projects, personal assignments and homework. After the coverage of each topic constitute a type of formative assessment (quizzes). A semester exam contributes mostly to summative type of assessment.

How are key concepts served (methodology)?

Change, computational thinking as well as knowledge of how computers and other digital devices work are the main concepts for computer science. It is about interaction and influence in cultures, societies, and the behavior of individuals and societies, as well as the ethical issues involved.

How does the course foster international mindedness?

Computer science uses different methods to produce explanations, but all methods are based on observational data and are based on the common rigor of using inductive or deductive reasoning. Explanation can be in the form of a theory, and sometimes requires a model that contains elements that cannot be directly observed. Generating these theories usually requires creativity and imagination. When this predictive theoretical model is not possible, the explanation may be the determination of correlations between factors and outcomes. This correlation can lead to causal mechanisms that can be experimentally tested, thus improving the interpretation.

How are IB Learner Profile attributes promoted?

Students will:

- Inquirers: They develop curiosity as they acquire the skills needed to conduct research and demonstrate independence in learning. They decompose systems in order to find the appropriate algorithms
- Knowledgeable: They explore concepts, ideas and topics of local and global importance. In doing so, they acquired in-depth knowledge and developed an understanding of a broad and balanced subject area. Students use appropriate techniques in order to develop a product or to modify an existing product
- Thinkers: They demonstrate initiative in applying their thinking skills critically and creatively to view and approach complex issues and make ethically decisions. In Case Study, students formulate a strategic plan and they develop a product that can be used and maintained by others.
- Communicators: Understand and express ideas and information confidently and creatively in more than one language and in a variety of forms of communication. Work effectively. For their solution, appropriately contact customers and/or advisors to develop a product that meets their requirements
- Principled: Act with integrity and honesty, with a deep sense of fairness, justice, and respect for the dignity of individuals, groups, and communities. They take responsibility for their own actions and the associated consequences. On solution product, students, test the product to make sure it is error-free and safe, protecting all sensitive data
- Open-minded: They understand and value their culture and personal history and are open to the

views, values and traditions of other people and communities. They are used to looking for and assessing different points of view and want to develop based on their experience.

- Caring: They show empathy, compassion, and respect for the needs and feelings of others. They commit to service and act to make positive changes in the lives of others and the environment. For solution, they contact with real life clients in order to reach consensus on product development
- Risk-takers: By identifying and use techniques to develop the appropriate solution/product, they tackle unfamiliar situations and uncertainties with courage and foresight and has the independence to explore new roles, ideas, and strategies.
- Balanced: Through collecting data, then analyze and synthesize the information to determine the most suitable product, they Understand the importance of intellectual, physical and emotional balance to achieve personal well-being for yourself and others.
- Reflective: Evaluate the methods used to develop the product in order to recommend future improvements, they are thinking of their own learning and experiences. They can assess and understand their strengths and limitations to support their learning and personal growth.

How does the course meet student needs via ATL?

Thinking skills: An example is on topic 4 where students are able to identify six thinking skills that are considered essential for programming. They think procedurally, logically, abstractly, concurrently, ahead, and recursively. This approach is necessary for programming and forms a great foundation for general problem solving.

Communications skills: Includes listening to end-user needs, clearly communicating algorithms and documentation, and providing meaningful training

Social skills: Includes collaboration and awareness on accessibility, digital divide, privacy and intellectual property

Self-management skills: Involves effective and balanced organisation to optimize student overall well-being

Research skills: This involves, effective and targeted questions, academic integrity and referencing

Describe connections with CAS

Students can understand the importance of discipline and how it affects the lives of real people. The experience gained will include reflection to reveal personal growth and mastery of learning outcomes, such as: Identifying one's own strengths and developing areas of development, Demonstrating that challenges have been overcome, Develop new skills in the process, Show how to start and plan CAS experiences, Demonstrate commitment and persistence in CAS experiences, Demonstrate skills and recognize the benefits of working collaboratively, Demonstrate engagement with issues of global importance, Recognize and consider the ethics of choices and actions

Describe connections with TOK

- What is the difference between data, information, knowledge and wisdom? To what extent can computers store and impart data, information, knowledge and wisdom?
- Computational thinking includes: procedure, logic, pre-planning (thinking ahead), concurrency, abstraction and recursion. To what extent are these ways of thinking distinct? To what extent can knowledge in different areas (mathematics, ethics, and so on) be analysed in these ways?

- It has been said that human memory is more like an improvised performance than a movie on a DVD. What does this mean? How does human memory differ from computer memory?
- How does a computer language differ from a natural language?

Recommended resources

https://www.ibo.org; http://www.flowgorithm.org; https://graded-cs-resources.github.io/CodingBatPseudo/

http://ibcomp.fis.edu/pseudocode/pcode.html

Instructor's name

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