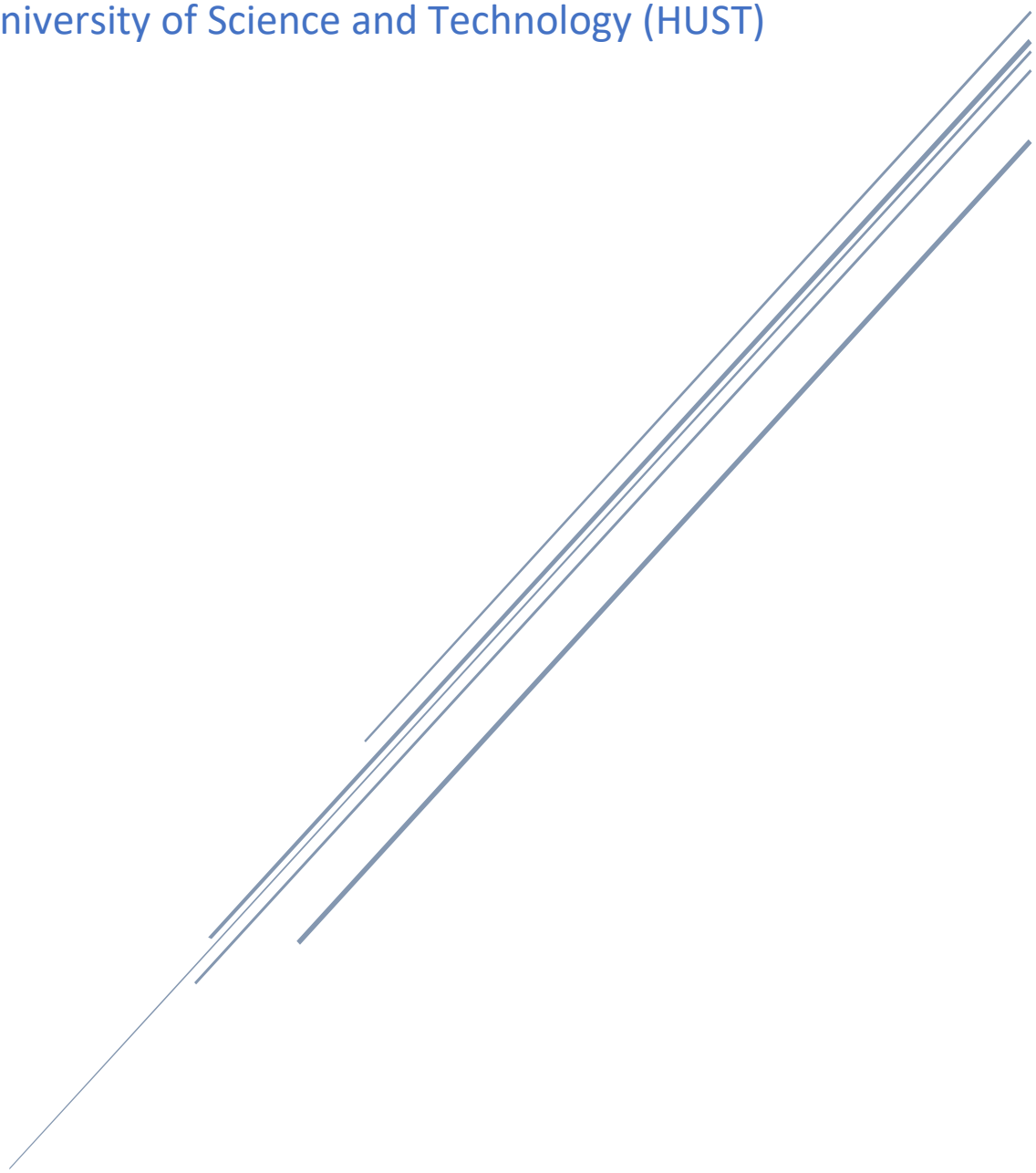
EQUIP UK-VN
Enabling an environment of QUality for International HE Partnerships between the UK and Viet Nam

BRITISH COUNCIL

OBJECTIVE 2 – QUALIFICATION BENCHMARKING

Bachelor in Information Technology
Hanoi University of Science and Technology (HUST)



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Introduction

The Bachelor in Information Technology (ICT) at Hanoi University of Science and Technology provides fundamental concepts and applications of information technology and how they can be applied to business, finance and economics. This is a multidisciplinary programme and for this benchmarking exercise we focus only on modules/courses related to data analytics.

For this benchmarking exercise we have developed a scoring matrix where we identified 5 themes (programming, knowledge management, knowledge abstraction, knowledge representation/communication and research/soft skills). **Programming** theme entails criteria related to the design and development of not only software but also other artefacts like algorithms, network, IoT framework etc. The theme also includes the evaluation process and collaborative management of the artefacts. **Knowledge management** primarily focuses on processes and techniques of warehousing different types of data. The theme also includes security and privacy issues related to data management. **Knowledge abstraction** theme focuses on different data analytics and machine learning techniques applied to different types of data. **Knowledge representation/communication** theme includes different visualisation techniques used to represent the results (from database query through to data analytics to algorithm) to a wide range of stakeholders. **Research/Soft skills** theme focuses on the understanding and practice of research methods along with the ability to undertake teamwork and present results to a wider audience.

Within each theme, we have a set list of criteria against which each course is scored. The score is within the range of 50 – 100. 90 – 100 (fully meets the criteria); 75 – 89 (mostly meets the criteria); 60 – 74 (partially meets the criteria); 50 – 59 (barely meets the criteria). The marks are indeed subjective and therefore debatable. However, the pattern that emerges as a result of the scoring of each module/course provides a holistic view of the programme and clearly identifies the areas of strengths and improvements.

Design of the programme

1. This 130-credit programme equips students with the capability to design technological solutions for diverse areas, and implement those projects. The programme starts with general knowledge/education (50 credits) that provides a strong foundation in mathematics covering calculus, algebra and statistics. General knowledge also includes compulsory modules/courses in Physics that introduce the concept of electromagnetism along with courses in law and politics. Here the students also have the English language course to increase their proficiency in English. The basic and core modules (47 credits) are labelled under Engineering but are mostly IT related course. The programme has four courses (1 compulsory, 3 elective) for soft skill development with emphasis on technical writing and presentation along with technology project design, management etc. The programme also has elective modules (16 credits) for professional orientation and specialisation in network/IoT/software. Finally, students undertake internship and thesis/courses (8 credits) to gain industrial and academic research experience.
2. For this benchmarking exercise only data/computer science related courses were evaluated. Economics, marketing, finance, and management related courses were not included.

Mode of Delivery

3. All courses are delivered in English and have theory, practice and self-study credit hours. From the course structure document, we could not identify any course with allocated self-directed study time.
4. Most of the courses are theory based and as such assessments are exam/class test based.
5. The programme provides a strong emphasis on soft skill development with four courses to choose from.
6. From the documents provided, it is not clear how the theory part of each course is delivered. The mixing of theoretical courses like maths/physics courses along with predominantly technical courses provide diversification of delivery modality and enhance students' thought process and application ability.
7. For practical sessions, information regarding class size and available resources is necessary to evaluate the effectiveness of the practical sessions.

Learning and Teaching

8. The programme offers a wide range of topics with its 65 courses/modules. This is primarily due to the low credit value (2 usually) for the associated modules. However, delivering such a wide range of courses requires resources and may impact module quality. Therefore, combining some modules would benefit the students as well as staff, in terms of resources and quality.
9. The programme provides an excellent foundation for mathematics (algebra etc.) and statistics. This is critical for all computer science related modules. However, the value of adding courses in physics (PH1110) was not clear.
10. For IT related industries, user requirement gathering and analysis is pivotal. Only IT2000 covers this aspect as a subset. The programme would benefit with more emphasis in this regard.
11. With regard to IT, the programme offers a wide range of courses to develop students' IT skills in a holistic manner. Since the course has a huge emphasis on soft skill development, the offering of elective modules to develop specialisation is constrained.
12. The programme doesn't offer a wide range of programming languages to students. Only object oriented language like Java is offered, but for the development of AI/machine learning based artefacts a good understanding of scripting languages like Python is necessary.
13. The programme has only one course related to data management (Databases). The course also lacks cloud-based unstructured/real-time data warehousing systems like AWS/Datalake.
14. The programme provides a strong mathematical and maths/stat basis to facilitate the understanding of different algorithms. However, machine learning algorithms were not covered well in this programme. From an IS perspective this may put students in a disadvantageous position as modern IS systems use some sort of algorithms.
15. Critical understanding about code sharing (github etc.) seems to be missing. For data science programmes it is important that students are aware and have experience of code sharing, documentation and different licenses used for open-source software/algorithm development.

Assessment and feedback

16. No information was available with regard to assessment or exam samples.
17. No information was provided as to how student feedback is captured, evaluated and utilised for the improvement of the courses.

Conclusion and Recommendations

18. Teaching modality
    a. More discussion-based teaching approach including flip classroom type teaching model can be introduced to increase student engagement and self-directed study.
    b. Project-based learning approaches can be implemented to get more knowledge about different real-life projects, their shortcomings etc.
19. Teaching content
    c. Low code/No code-based programming are becoming popular (10.3390/electronics10101192) in universities with the rise of online education and as a result of COVID-19. Adaptation with new trends will help students to develop new applications/algorithms more easily. This impacts not only skill development but confidence also.
    d. More emphasis can be given to scripting languages like Python as well as users' requirement analysis.
    e. Less emphasis can be given to remotely related subjects like psychology, physics.
    f. Analysis of real-life data from different domains (finance, healthcare, social media etc.) is essential to get an understanding about different design, development and deployment of IT in these domains.
    g. Engagement with stakeholders and requirement capture is pivotal. Therefore, with different types of programming/machine learning courses these aspects need to be included.
    h. Use of online content/courses can introduce students to new topics and choice of learning sources (in contrast to recommended books). This diversity of content and modality of delivery not only helps students to be in line with current trends but also initiates peer learning.
    i. Skill development in code sharing (through github etc.) and open licence needs to added to the course curriculum along with collaborative code development (e.g. Google Colab, AWS).
    j. Basic understanding of how to protect intellectual property rights related to algorithms and the process of protecting these rights through third party.
    k. Critical understanding of research methods in higher education and steps involved from idea generation through to publication and/or application can be incorporated.
    l. Basic knowledge of social media-based profile creation e.g. LinkedIn profile that will facilitate future job prospects can be incorporated to develop profile.
20. Assessment
    m. More emphasis on project based assessments (instead of exams) would help students to get experience of team work and other aspects of project management.

CRITERIA	Calculus I	Calculus II	Calculus III	Algebra	Basic physics	Introduction to Programming	Probability and Statistics I	Discrete Mathematics	Fundamentals of optimization	Applied Statistics and Experimental Design	Introduction to Information Technology and Communication	Data Structures and Algorithms	Computer Architecture	Database	Mobile Programming	Introduction to Information Security	Operating Systems	Object-oriented Programming	Introduction to Software Engineering	Introduction to Deep Learning	Systems Analysis and Design	Network Programming	Technology Project Management4	Introductory Information Security	Applied Algorithms	Team work and Communication skill	Programming techniques	Technical Writing and Presentation	Introduction to Management	Business Culture and Entrepreneurship	Applied Psychology	Technology and Technical Design Thinking	Industrial Design	Software Design and Construction	Mobile Programming	Architecture of Information Systems	IP Network Design and Implementation	Network Security	IoT and Applic	Software Quality Assurance	Web technologies and e-Services
	MATH & BASIC SCIENCE (32)										BASIC ENGINEERING (47)																	SOFT SKILLS (9)						ELECTIVE MODULES (16)							
PROGRAMMING																																								
General knowledge on different software/algorithm, their application, strenghts and limitations.																		73	93		98					92							89					81	89		
Knowledge and skill to undertake requirement analysis. Ability to collect and summarise the requirements. Also understand the market demand/trend in context of software/algorithm development.																	78		91		84												83					72	73	91
Ability to work in a team environment and understanding of the importance of communication in a multi disciplinary/institutional team environment.															65				94						81	62								65						
Demonstrate the knowledge and skill of project management. Particularly the differentiation and applicability of different types of project management approaches and the relevance to the project in hand.															87			84																87						
Demonstrate critical understanding of the software/algorithm design approaches and availability of design tools														92	93		87			92						85							92	93						
Demonstrate critical understanding of the software/algorithm development approaches and availability of development tools/languages.														84			76	93																				64		
Critical knowledge about the importance of software/algorithm evaluation/testing and the steps of releasing.														74				84	81																			91		
Critical knowledge about the importance of software/algorithm security related issues.																																								
Demonstrate critical knowledge on both object oriented and scripting languages.																																								
Ability to code in distributed cloud as well as stand-alone environement using wide range of programming languages.																																							72	
Good knowledge on privacy, security issues related to software/hardware/algorithm.																					84																	82		
Critical understanding of code sharing, archiving and protection through cloud-based repository platforms.																																								
Good knowledge about different cloud based computing platforms, e.g. AWS																																						95		
Understanding about opensource/stand-alone/cloud-based software/hardware/algorithm.																																								
Critical knowledge on computing performance and how to address performance related challenges.																																								
KNOWLEDGE MANAGEMENT																																								
Good understanding about big data and their impact on business and society.															93																										
Critical knowledge about different steps of data management pipeline – from collection to data analytics															85																										
Critical understanding about different data types, sources of data types and their strengths and limitations.															78																										
Critical understanding about different data collection processes and resources along with regulations associated to the processes including ethics and permission requirements.																																								
Demonstrate the knowledge on data privacy and it differs in different domains – manufacturing, medical etc.																																								
Critical understanding about data quality, particularly standard process of measuring data quality.																																								
Demonstrate the appreciation towards the importance of data cleaning and knowledge on different steps, tools used for data cleaning.																																								
Understanding about the data validation process and its importance towards data management.																					86																				
Good knowledge about different data warehousing techniques and technical details for implementing different types of databases.															75																										
Updated knowledge about data warehousing for both structured and unstructured data.																																								
Critical knowledge about the approach to query the data as per the requirements of the users.															72																										
Good understanding about the process of data transformation in relation to the users requirements.																																								
Provide detailed knowledge and skill on different data security related issues and how to identify different types of threats.																											92								93					92	
Explain different types of data protection measures that can be taken to safeguard data breach.																											95								82						
Understand institutional policies related to data security and privacy and tools required to implement these policies.																											63								73						
Good understanding about intellectual property rights and governance laws.																											68														
KNOWLEDGE ABSTRACTION																																								
Demonstrate good knowledge of algebra and calculus that enables students to refresh their high school math knowledge.	97	94	96	91																																				
Provide detailed understanding of distribution and probability statistics.																	89		94	91		95																		
Critical understanding on intelligent agent and different types of logic representations.																65	76																								
Different algorithms (un/supervised, adaptive) – their applications and refinement of algorithm parameters.																		93		74		72																			
Critical knowledge on algorithm testing, evaluation and optimisation.																		64		97		67																			
Good understanding of ethics and policy related to algorithm development and deployment.																																								
Up to date knowledge on state of the art algorithms implemented by different stakeholders.																						67																			
Basic understanding on how to protect intellectual property rights related to algorithms and the process of protecting these rights through third party.																																								
Provide detailed understanding of algorithms used for image analysis and object detection from including timelapse and multimodal images.																																								
KNOWLEDGE REPRESENTATION/COMMUNICATION																																								
Evaluate and apply data visualisation grammar and principle to the whole of the visualisation process and the resulting presentations.																																							67	
Evaluate the capabilities of different visualisation tools and programming languages, both proprietary and open-source, to support the discovery and display of critical and valuable answers hidden in small, medium and large data.																																								
Implement analysis and visualisation techniques using realistic data sources from disparate disciplines and using the most appropriate visualisation tools in order to identify the valuable questions and to develop well justified, actionable answers.																																								
Good understanding of processes to know the audience in terms of their requirements, domain knowledge etc.																																								
Differentiate between exploratory and explanatory data visualisation and or knowledge representation.																																								
RESEARCH/SOFT SKILLS																																								
Understanding of core aspects of philosophy and its sub discipline.																									93			87	85	75		93	89								
Explore and express different ideas of philosophy and their relevance to research in higher education.																												82													
Introduction to the main ideas of logic and methods of recognising relevant information to construct persuasive arguments.																														89										
Develop analytical, argumentative problem-solving skills.																									86			91				86								
Develop critical thinking and problem-solving skill in a collaborative manner.																										84		78					75							
Critical understanding of research methods in higher education and steps involved from idea generation through to publication and or application.																													89											
Critical understanding of project management and role of different team members at different levels along with the interplay.																									74		95			91		74							
Knowledge about different administrative and operational tasks required for successful project management.																													96	94			72							
Basic understanding of activities related to dissemination of research outcome to wider audience.																												84												
Basic knowledge of social media-based profile creation e.g. LinkedIn profile that will facilitate future job prospects.																																								