Enhancing Teaching, Learning and Graduate Employability through University-Enterprise Cooperation

ABAU

Curriculum Development Activities

November 2023

1. Course development

1.1 Introduction

Prince Abdullah Ben Ghazi Faculty of Information & Communication Technology was established in 1997 under the name of the "Applied Science Faculty". It was the first faculty in the Hashemite Kingdom of Jordan, and the second faculty in the Arab world that offer an information technology program for undergraduate students.

The faculty was honored to receive the name of his royal Highness Prince Abdullah Ben Ghazi and was named as Prince Abdullah Ben Ghazi Faculty of Science and Information Technology.

In the early academic year 2011/2012, the faculty was divided into two specialized faculties: Faculty of Science and Prince Abdullah Ben Ghazi Faculty of Information & Communication Technology . The faculty started since its establishment in 1997 offering information technology program. As a result of the rapid advancement in the information technology sciences.

This report delves into two integral facets of the Prince Abdullah Ben Ghazi Faculty of Information & Communication Technology's evolution. The first part provides a comprehensive overview of the changes implemented in the program curriculum, spotlighting the introduction of four new bachelor programs. These changes were spurred by the dynamic nature of information technology sciences, reflecting the faculty's commitment to staying current and relevant in a fast-paced technological landscape.

The second part of this report highlights the notable strides taken through the ELEGANT (Enhancing Teaching, Learning, and Graduate Employability through University-Enterprise Cooperation) project. This initiative focuses on elevating the educational experience by integrating cutting-edge advancements in Artificial Intelligence (AI) and Big Data into the curriculum. The aim is to not only enhance the quality of education but also to prepare students for a future where these technologies play a pivotal role.

As we navigate through the transformative journey of the Prince Abdullah Ben Ghazi Faculty of Information & Communication Technology, this report illuminates the institution's commitment to excellence, adaptability, and staying ahead of the curve in the realm of information and communication technology education based on attended workshops organized by ELEGANT project.

Academic Departments:

The faculty holds three academic programs in information technology, as follows:

1- Department of computer science.

2- Department of software engineering.

3- Department of computer information systems.

Faculty programs:

The faculty offers 4 programs, which are:

1- BSc in computer science.
2- BSc in software Engineering.
3- BSc in computer information systems.

4- BSc in computer graphics & animations.

5- MSc in computer science.

6- MSc in Cyber security.

2. Broad Changes in the Curriculum

2.1.1 Changes in Computer Science (BSc) Program

Computer Science can broadly be defined as the systematic study of computing systems and computation. Increasing use of computers in our daily life has led to a phenomenal increase in the demand for skillful computer science professionals. To help meet this demand, Prince Abdullah Bin Ghazi Faculty of IT established an undergraduate program that relates directly and focuses on theoretical understanding, design, and applications of computer science. The program has both academic and professional orientations which will prepare college graduates to meet complex challenges that may confront them in their professional careers. This program also provides a strong foundation necessary to pursue their advanced studies in the field of computer science.

The BSc program is designed to provide several important features that include a set of core courses to provide breadth in the field, additional specialized courses to provide in-depth knowledge and understanding of multiple major areas of computer science.

As per IEEE/ACM recommendations, as well as the nature of the discipline, the program includes a total of 27 lab contact hours for discipline core courses, 15 contact hours for

Mathematics, and 12 credit hours for electives. Varieties of laboratories are available for the students: general computer labs, high performance computer lab, microcontroller lab and network and security lab.

During ELEGANT workshops we learned how to align our curriculum with best practices in international universities that we have visited, explore the current industry needs and to prepare IT graduates with the appropriate background that will enable a successful career. With the increase in outsource development. Unfortunately, IT graduates lack the interpersonal skills needed to successfully fulfill duties associated with outsourcing. We report findings from qualitative interviews from IT professionals in Fortune 50 businesses, small-to-medium businesses, and non-profit organizations. Our analysis concludes that modifying IT curriculum to provide more emphasis on negotiation skills, time management, cultural differences, outsource management, and information assurance would make the most difference, in addition to a strong technical background. Program Educational Objectives.

Upon completion of the BS in Computer Science Program, graduates through a period of four (4) years, will:

a) Possess necessary analysis, design and implementation skills required to formulate and solve computer science problems.
b) Work productively as socially responsible computer science professionals with effective Communication and collaboration skills.
c) Serve as computer science professionals in national and international level to make significant contributions in the field of Computer Science.
d) Develop technical competencies for professional career growth through adopting emerging computing technologies to promote lifelong learning.

2.2 Student Outcomes

After completing the BS in Computer Science successfully, student will have the necessary skills to:

(a) **An ability to apply knowledge of computing and mathematics appropriate to the program's student outcomes and to the discipline**

A1.Understanding programming languages, data structures and algorithms.

A2.Demonstrate an understanding of software design and software application.

A3.To apply and demonstrate computational/mathematical/modelling approach for solving computational problems.

(b) **An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution**

B1. Ability to analyse different design/ computing requirements/components and algorithms to solve a problem.

B2. Analyze at least two possible solutions to a given problem and select the best solution for the given problem.

B3. Demonstrate an understanding of software architecture.

(c) **An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs**

C1. Understand the requirement collection and analysis for a computer-based system, process, component, or program.

C2. Capable to design a computer-based system, process, component, or program.

C3. An ability to implement/ evaluate a computer-based system, process, component, or program

(d) **An ability to function effectively on teams to accomplish a common goal**

D1. Ability to work in a team and do the assigned task.

D2. Readiness to share ideas among the team and have good communication among the team members.

D3. Ability to agree on consensus conclusion among the team.

(e) **An understanding of professional, ethical, legal, security and social issues and responsibilities**

E1. Ability to understand professional computing issues.

E2. Awareness on professional responsibilities, ethical theories and legal issues.

E3. Understanding on computer crime and its impact on the society.

(f) **An ability to communicate effectively with a range of audiences**

F1. Ability to use effective written and oral communication skills.

F2. Ability to use modern technologies and techniques to present information to an audience.

F3. To be aware of the intendant audience and approaching them on an appropriate level.

(g) **An ability to analyze the local and global impact of computing on individuals, organizations, and society**

G1. Ability to analyse the computing needs of the individuals, organizations, and society.
G2. Ability to develop/use proper testing measures to find out the impact of computing solution on individuals, organizations, and society.

G3. Understand impact of computing solutions on society and the environment in a global context.

(h) **Recognition of the need for and an ability to engage in continuing professional development**

H1. Identify the professional skills that are required for their professional development.
H2. Ability to read and analyse the technical literature for their continuing professional development and take part in conferences, training program etc.
H3. Identify and discuss emerging technologies related to software engineering and its broad range of applications.

(i) **An ability to use current techniques, skills, and tools necessary for computing practice**.

I1. Ability to select and apply appropriate computational tools or technique/computational skills for a given computing problem.
I2. Ability to make a comparative study of two or more computational tools or techniques or skills.
I3. Ability to learn new computing tools and techniques

2.3 Program Review

During the revision process a variety of Bachelor degree programs in Computer Science from local and international institutions were examined.

The program review process aims to fulfill the following constraints:

- Follow best practices in international universities based on attended workshops attended by ELEGANT project.
- Meet the curricular requirements of ABET.
- Meet the job market needs.

Best practices in international universities based on attended workshops attended by ELEGANT project

The reviewed version of the BSCS program complies with best practices in international universities. Computer Science needs to demonstrate proficiency in the design and the implementation of software systems, in theory as well as in practice.

Specific Core areas must be part of Body of Knowledge for the BSCS program.

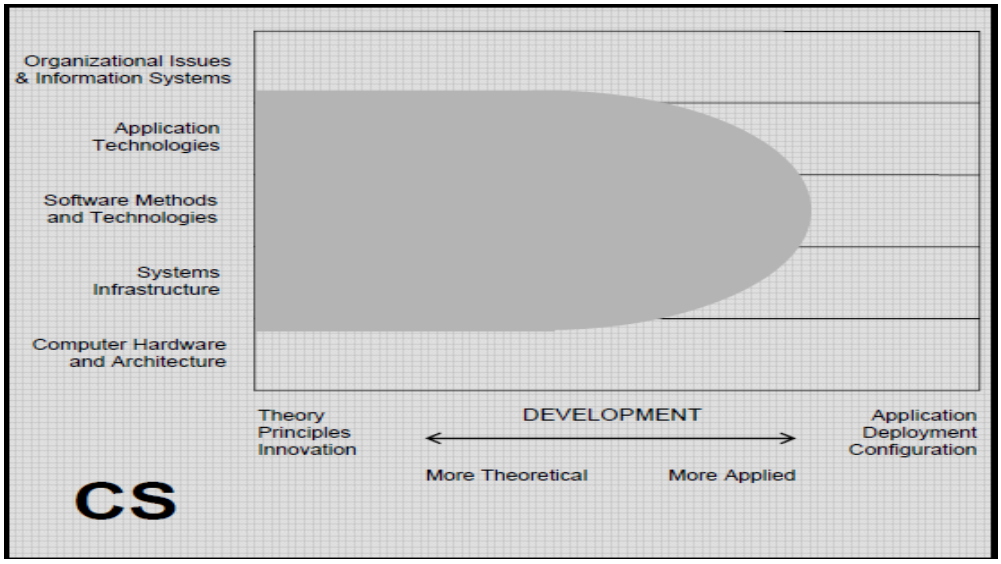

Figure 1: Problem space for Computing: Computer Science Discipline

ABET Requirements

While reviewing the program structure, course descriptions, and course syllabi for Computer Science program, special attention is being given to incorporate factors relating to formal accreditation criteria and the requirements set out by the internationally known accrediting agency ABET.

The review process of the BSCS program showed that the current program is not fully compliant with ABET Requirements. ABET requires the computer science program to cover a minimum 6 credit hours of basic sciences which is not covered in our syllabus, as well as one missing course on parallel and distributed computing.

Table 1 summarizes the gap analysis between the reviewed BSC program and the accreditation bodies' requirements.

Subject Area	Current Program	ABET
Maths& Stats	15	Min 15
Natural Science	0	6

Computer Sciences	56 (**Specialization**) +11(College)	40
Computer Science Electives	12	
Humanities& General Electives	18	Any
Senior Design Project	3	3
Total Credits	133	-
Max no. cr.hrs per semester	18	18
Min no. cr.hrs per semester	15	15

Table 1: Summary of accreditation bodies requirements

Local, regional and international computing field challenges

As per College mission and objectives, academic programs must be developed under universally recognized standards as well as offering flexible structures to be responsive to the needs of marketplace. Also programs should proactively engage

2.4 Career Opportunities

These are list of jobs market available for graduates of BS in Computer Science:

- Software developers
- System programmers
- Data manager
- Software Project manager
- Database designer
- IT consultants
- Web Developer
- Web engineer
- Mobile application developer

- Technical support representatives
- Network and security operators
- Computer Science/IT Lecturers/ Researcher.

3. Changes to the Computer Science (BSc) Programme

In order to meet the ABET criteria of the program, the following modifications are summarized below:

- Change the university requirement courses to cope with the university's new plan requirements and the IT new era: introduce new courses such as the technical/applied English course (6 credit hours), introduce innovation, entrepreneurship, and creativity course (2 Credit hours) and introduce a computer skills and e-learning course (1 Credit hour) instead of (3 Credit hours) in previous plans.
- Change the college requirement courses to cope with the international and national IT markets by adding new programming languages – python programming (3 Credit hours).
- Introduce the basic science courses (9 Credit hours) to cope with the ABET requirements: Physics with a laboratory work session, probability & statistics, linear algebra as supportive courses.
- Add new courses: parallel and distributed computing, embedded systems, modeling & simulation, web application security, operation research, IoT, Human computer interaction (suggested by IEEE/ACM curricula 2013).
- Revise the majority of the course outlines in the new proposed plan to include professional, ethical, legal, security and social issues and responsibilities topics.

- Procedures for assessment shall demonstrate to the best practices in international universities such as CMU, professional bodies, and future employers.
- Consider Senior project. Design component is important and graduating student should show the ability to integrate subjects from different areas. The senior project is recommended to be divided into two parts CS451 (1-cirdet), CS452 (2-credits), and must be available only after the completion of a minimum of 90 credit hours.
- A continuous period of 16 weeks (6 Credit hours) (280 real training hours) spent in industry with the purpose of acquiring practical experience in different areas of Information Technology. The period starts with an orientation course in one semester and then follows with the COOP course in the second semester. During this period, a student is exposed to the profession of IT by working in the field. Students are required carry a major design project and to submit a final report and give a presentation about the experience and the knowledge they gained during their cooperative work.

4. Changes to the Software Engineering (BSc) Program

To meet the ABET criteria of the software engineering program, the following modifications are summarized below:

- Change the university's compulsory courses to cope with the university's new plan requirements and the IT new era: introduce new courses such as the technical/applied English course (6 credit hours), the innovation, entrepreneurship, and creativity course (2 credit hours), and the computer skills and e-learning course (1 credit hour) instead of (3 credit hours) in previous plans.

- Change the college-required courses to cope with the international and national IT markets by adding new programming languages: Python Programming (3 credit hours).
- Add new courses: software architecture, system analysis, and design, database management systems, visual programming for mobile applications, software documentation, software quality assurance and management, selected modern programming language, software foundations of security and privacy, artificial intelligence software engineering applications, industrial big data in software engineering, web design, and programming lab.
- Merge some of the courses in the new proposed plan, such as program, file, and data structures and analysis of algorithms, into one course named Data Structures and Algorithms to include professional, ethical, legal, security, and social issues and responsibilities topics.
- Eliminate some of the courses in the new proposed plan, such as program, file, and data structures lab and digital logic lab.
- Revise most of the course outlines in the new proposed plan to include professional, ethical, legal, security, and social issues and responsibilities topics.
- Procedures for assessment shall demonstrate the best practices in international universities such as CMU, professional bodies, and future employers.
- Consider a senior project. Design components are important, and graduating students should show the ability to integrate subjects from different areas. The senior project is recommended to be divided into two parts, SE451 (1-credit), and SE452 (2-credit), and must be available only after the completion of a minimum of 90 credit hours.

- A continuous period of 16 weeks (6 credit hours) (280 real training hours) spent in industry to acquire practical experience in different areas of information technology, with more concentration on software engineering fields. The period of training must be available only after the completion of a minimum of 90 credit hours. During this period, a student is exposed to the profession of IT by working in the field. Students must carry out a major design project, submit a final report, and give a presentation about the experience and knowledge they gained during their cooperative work.

5. Changes to the Computer Graphics & Animations (BSc) Program

To meet and serve the labor market needs and related the national and international requirements of the program, the following modifications are summarized below:

- Change the university-required courses to cope with the university's new plan requirements and the IT new era: introduce new courses such as the technical/applied English course (6 credit hours), introduce innovation, entrepreneurship, and creativity course (2 Credit hours) and introduce a computer skills and e-learning course (1 Credit hour) instead of (3 Credit hours) in previous plans.
- Change the college-required courses to cope with the international and national IT markets by adding new programming languages – python programming (3 Credit hours).
- Add new courses aimed at enhancing students' knowledge and skills, ensuring their readiness for successful entry into the job market: Interactive 2D Animation Techniques, Motion Graphics, Texturing, Lighting, and Rendering Techniques, 3D Production Techniques for Animation, three courses with three levels of gaming design and development.

- Introduce new laboratories for various courses to provide students with increased opportunities for practical exercises and hands-on experience: Introduction to Computer Graphics Lab, Interactive 2D Animation Techniques Lab., 3D Character Design and Rigging Lab. Some other labs are embedded with courses (2 hours theory and 3 hours practical): Digital Image Editing, Storyboarding Fundamentals, 3D Modeling and Design, Texturing, Lighting, and Rendering Techniques, and 3D Production Techniques for Animation.
- Revise most of the course outlines and pre-requisites in the new proposed plan to include professional, ethical, legal, security, and social issues and responsibilities topics.
- Procedures for assessment shall demonstrate the best practices in international universities such as CMU, professional bodies, and future employers.
- A continuous period of 16 weeks (6 Credit hours) (280 real training hours) spent in industry to acquire practical experience in different areas of Information Technology. The period starts with an orientation course in one semester and then follows with the COOP course in the second semester. During this period, a student is exposed to IT by working in the field. Students must carry out a major design project to submit a final report and give a presentation about the experience and the knowledge they gained during their cooperative work.

6. Changes to the Information Systems (BSc) Program

- The reasons for changing a curriculum for an Information Systems specialization:
- Industry Relevance: Updating the curriculum ensures alignment with the current trends and technological advancements in the industry, keeping students well-prepared for the job market's evolving needs.
- Technological Advancements: Given the rapid pace of technological advancements, revising the curriculum allows for the inclusion of

new tools, software, and methodologies, ensuring students are acquainted with the latest technologies.

- Feedback Integration: Incorporating feedback from stakeholders, including students, faculty, industry experts, and employers, helps in refining the curriculum to better meet the needs and expectations of all involved parties.
- Emphasis on Specializations: Adjusting the curriculum can allow for a more focused approach to specific specializations within Information Systems, such as cybersecurity, data analytics, cloud computing, etc., catering to the growing demand in these areas.
- Global Perspectives: Introducing global perspectives, possibly through partnerships, international case studies, or collaborations with institutions abroad, can enrich the curriculum, offering a more comprehensive view of Information Systems in a global context.
- Interdisciplinary Learning: Incorporating interdisciplinary elements from related fields like business management, psychology, or engineering can provide a holistic education, preparing students to tackle complex real-world problems.
- Adherence to Accreditation Standards: Curriculum updates may be necessary to ensure adherence to the latest accreditation standards set by educational governing bodies, ensuring program quality and recognition.
- Adaptation to Learning Styles: Tailoring the curriculum to accommodate various learning styles, including hands-on experiences, practical projects, and interactive learning methods, enhances student engagement and knowledge retention.
- Ethical and Legal Considerations: Reflecting changes in ethical and legal considerations within the field of Information Systems,

ensuring students are aware of and adhere to the latest regulations and ethical practices.

- Continuous Improvement: A dynamic curriculum that undergoes periodic review and updates reflects a commitment to continuous improvement, ensuring that educational offerings remain robust, relevant, and valuable.

These reasons collectively support the necessity and benefits of updating an Information Systems curriculum to ensure students receive the most comprehensive and relevant education in the field. Accordingly, we made the following changes:

- Change the university-required courses to cope with the university's new plan requirements and the IT new era: introduce new courses such as the technical/applied English course (6 credit hours), introduce innovation, entrepreneurship, and creativity course (2 Credit hours) and introduce a computer skills and e-learning course (1 Credit hour) instead of (3 Credit hours) in previous plans.
- Change the college-required courses to cope with the international and national IT markets by adding new programming languages – python programming (3 Credit hours).Add new courses and laboratories: Computer Networks Lab, Web server's Applications Development, Visual Programming for Mobile Applications, Visual Programming for Mobile Applications Lab, Networks security and Management. In addition, various tracks have been emphasized through elective specialization courses, such as machine learning, computer graphics and animation, Internet of Things (IoT), and a focus on advanced topics in the field of big data.
- Revise most of the course outlines in the new proposed plan to include professional, ethical, legal, security, and social issues and responsibilities topics.
- Procedures for assessment shall demonstrate the best practices in international universities such as CMU and Stanford, professional bodies, and future employers.
- Consider Senior project. The design component is important and graduating students should show the ability to integrate subjects from different areas. The senior project is

recommended to be divided into two parts CIS471 (1-cirdet), and CIS472 (2-credits), and must be available only after the completion of a minimum of 90 credit hours.

- A continuous period of 16 weeks (6 Credit hours) (280 real training hours) spent in industry to acquire practical experience in different areas of Information Technology. Through this course, students are to apply, in the real world, what they have learned during their study journey in the University. During this period, a student is exposed to the profession of IT by working in the field. Students must carry out a major design project to submit a final report and give a presentation about the experience and the knowledge they gained during their cooperative work.

7. Changes to the currently offered courses

This section outlines the significant improvements made to various programs at ABAU through the ELEGANT (Enhancing Teaching, Learning, and Graduate Employability through University-Enterprise Cooperation) project. The focus has been on incorporating advancements in Artificial Intelligence (AI) and Big Data into the curriculum.

7.1 Program: Computer Science Program:

1. CS300: Visual Programming for Smart Devices" Course, course code (30801300): Enhanced with additional practical exercises and a comprehensive course project. The inclusion of project milestones and assessment criteria based on work conducted during June 2022.Submission of the course project is mandatory by the course's conclusion. See the attached appendix for the evaluation form.
2. CS361 Cloud Computing" Course, course code (30801361): Aligned course material with Huawei professional certification content. All students are prepared for Huawei certificate exams, resulting in an impressive 85% success rate upon completion.

7.2 Program: Software Engineering:

1. SE311: Artificial Intelligence and its Applications" Course, course code(30803311): Revamped with integration of Huawei AI professional certificate material to meet market demands. All students are scheduled to take the Huawei certificate exam at the course's conclusion, with an expected success rate of 60%.
2. SE467: Software Development Tools" Course, course code(30803467): Conclude the course with a capstone project that requires students to apply a diverse set of software development tools to solve a complex problem. This project should encompass various stages of the development lifecycle, providing a comprehensive learning experience.

7.3 Program: Information Systems:

1. CIS428: Data Mining" Course, course code(30802428): Improved by evaluating and implementing a variety of emerging methodologies and technologies. Emphasis on processing raw input data for various data mining algorithms. Focus on discovering and measuring patterns from diverse databases. Selection and application of suitable data-mining algorithms with appropriate interpretation and reporting.
2. CIS444: Pattern Classification & Clustering" Course, course code(30802444): Enhancements include demonstrating practical experience through the implementation and experimentation of learned algorithms for the Introduction to computational methods for classification and clustering of high-dimensional data, classification and clustering fundamental concepts, decision tree learning, parzen windows, principal components, Fisher's discriminates, feature selection, Bayesian classifiers, statistical clustering, competitive learning, non-linear regression, and model selection, Hidden Markov models, support vector machines.

7.4 Program: Computer Graphics & Animation

1. CGA351: Game Programming" Course, course code (30807351): Improved by

expand the course content to include modules on VR and AR game development, reflecting the growing trends in the gaming industry. Incorporate hands-on exercises and projects that involve creating immersive experiences using VR and AR technologies..

2. CGA445: Digital Films Design" Course, course code (30807445): incorporating the latest industry trends and technologies in digital filmmaking. Integration of modules focusing on emerging digital filmmaking tools and software. Introduction of practical sessions that involve hands-on experience with industry-standard digital film design software. Collaboration with professionals from the digital filmmaking industry to provide insights into current practices and real-world challenges.

7.5 Cross-Cutting Initiatives

1. Interdisciplinary Workshops and Seminars: Beyond individual program enhancements, ABAU has initiated interdisciplinary workshops and seminars, fostering collaboration among students from different programs. Topics include the intersection of AI, CS, and Big Data in real-world applications, encouraging students to explore interdisciplinary approaches to problem-solving. Guest lectures from industry experts to provide insights into the practical integration of these technologies across diverse fields.
2. Entrepreneurship and Innovation Modules: ABAU recognizes the importance of nurturing an entrepreneurial mindset. As a part of the curriculum improvements, entrepreneurship and innovation modules are introduced across various programs.

Students gain exposure to startup methodologies, design thinking, and project management skills to foster a culture of innovation. Incorporation of case studies highlighting successful ventures that have leveraged AI, CS, and Big Data.

7.6 Assessment and Feedback Mechanisms:

1. Continuous Feedback Loops: A robust feedback system has been established to ensure continuous improvement in the curriculum. Regular surveys and feedback sessions with students and faculty to gather insights on the effectiveness of the enhanced courses. Flexible mechanisms for incorporating timely feedback into ongoing course structures.
2. Monitoring Graduate Employability: A monitoring system is in place to track the employability of graduates who have undergone the enhanced curriculum. Collaboration with industry partners to assess the alignment of graduate skills with industry needs. Regular updates to the curriculum based on the evolving demands of the job market.

7.7 Technology Infrastructure Upgrades:

1. Laboratory and Infrastructure Enhancements: Upgrades to computer laboratories to ensure they are equipped with the latest hardware and software relevant to AI, CS, and Big Data. Integration of cloud-based computing resources to facilitate hands- on experience in cloud computing courses. Collaboration with industry sponsors to provide students with access to cutting-edge technologies.
2. Virtual Learning Platforms: Expansion of virtual learning platforms to facilitate remote access to course materials and resources. Integration of online collaboration tools to enhance virtual teamwork, particularly relevant for courses that involve practical projects.

8. Conclusion:

The curriculum improvements made under the ELEGANT project at ABAU represent a proactive response to industry advancements in AI, CS, and Big Data. The integration of practical experiences, alignment with professional certifications, and collaboration with industry experts ensure that ABAU's programs remain at the forefront of preparing students for the dynamic demands of the workforce. The commitment to continuous improvement positions ABAU as a leader in fostering not only academic excellence but also graduate employability in cutting-edge fields.

Websites of Different Programmes

links to the University website where the new and revised curricula can be found
1- Information security and cyberspace

https://www.bau.edu.jo/Plans2.aspx?colno=1&specno=257&degno=3&planno=

Study plan file pdf
https://www.bau.edu.jo/PlansPdf/staticPlans/2.pdf

2- Computer drawing and animation
https://www.bau.edu.jo/Plans2.aspx?colno=1&specno=256&degno=3&planno=6

Study plan file pdf
https://www.bau.edu.jo/PlansPdf/staticPlans/6.pdf

3- Computer Science
https://www.bau.edu.jo/Plans2.aspx?colno=1&specno=1&degno=3&planno=3