Republic of the Philippines
OFFICE OF THE PRESIDENT
COMMISSION ON HIGHER EDUCATION

CHED MEMORANDUM ORDER (CMO)
NO. 25 ;
Series of 2015

SUBJECT : REVISED POLICIES, STANDARDS, AND GUIDELINES FOR BACHELOR OF SCIENCE IN COMPUTER SCIENCE (BSCS), BACHELOR OF SCIENCE IN INFORMATION SYSTEMS (BSIS), AND BACHELOR OF SCIENCE IN INFORMATION TECHNOLOGY (BSIT) PROGRAMS

In accordance with the pertinent provisions of Republic Act (RA) No. 7722, otherwise known as the "*Higher Education Act of 1994*," in pursuance of an outcomes-based quality assurance system as advocated under CMO 46 s. 2012, and by virtue of the Commission en banc Resolution No. 268-2015 dated May 25, 2015 the following policies, standards and guidelines (PSGs) are hereby adopted and promulgated by the Commission.

ARTICLE I
INTRODUCTION

Section 1 Rationale

Based on the Guidelines for the Implementation of CMO 46 s 2012, this PSG implements the "shift to learning competency-based standards/outcomes-based education." It specifies the 'core competencies' expected of graduates of *Bachelor of Science in Computer Science (BSCS), Bachelor of Science in Information Systems (BSIS), and Bachelor of Science in Information Technology (BSIT)*, "regardless of the type of HEI they graduate from." However, in "recognition of the spirit of outcomes-based education and ... of the typology of HEIs," this PSG also provides "ample space for HEIs to innovate in the curriculum in line with the assessment of how best to achieve learning outcomes in their particular contexts and their respective missions ..."

The field of computing is ever dynamic; its advancement and development had been rapid and its evolvement is a continuous process (O'Brien, 2008). To face the challenges of advancement, the Commission recognizes the need to be responsive to the current needs of the country. It is essential and important that the country's computing capability be continually developed and strengthened to be at par globally.

It is the objective of the Commission to develop and promote the Policies, Standards and Guidelines (PSG) for BSCS, BSIS and BSIT, to provide a minimum standard for Higher Education Institutions (HEIs) offering or intending to offer these programs. The PSG is developed with consultations from all stakeholders, from the academe to industry (Sarmiento, 2009).

The PSG contains provisions that cultivate the culture of excellence in offering these programs. This is in line with the vision of the Commission to have HEIs produce competent graduates that shall cater to the needs of the industry. The PSG is also designed for all HEIs to exercise their innovativeness and creativity in the development of their curricula in the offering of BSCS, BSIS, and BSIT programs (RA 7722, 1994).

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ARTICLE II
AUTHORITY TO OPERATE

Section 2 Government Recognition

All Higher Education Institutions (HEIs) including private HEIs, State Universities and Colleges (SUCs), and Local Universities and Colleges (LUCs) intending to offer BSCS, BSIS, and BSIT must first secure proper authority from the Commission in accordance with this PSG. All HEIs with existing BSCS, BSIS, and/or BSIT programs are required to shift to outcomes-based approach pursuant to this PSG and must inform the Commission of such shift. SUCs and LUCs should likewise strictly adhere to the provisions in these policies, standards and guidelines.

ARTICLE III
GENERAL PROVISIONS

Section 3 The succeeding articles provide minimum standards and other requirements and prescriptions. The minimum standards for each program are expressed as minimum sets of desired program outcomes which are given in Article IV Section 6. The Commission designed **sample** curricula to attain such outcomes and these are shown in Article V Section 9. The total number of units for each program is here prescribed as the "minimum unit requirement" under Section 13 of RA 7722. In designing the curricula, the Commission employed curriculum maps which are shown in Article V Section 10 as **sample** curriculum map.

Using a learner-centered/outcomes-based approach, the Commission provided sample curricula delivery methods shown in Article V Section 11. The sample course syllabi given in Article V Section 12 show some of these methods.

Based on the curricula and the means of their delivery, the Commission determined the physical resource requirements for the library, laboratories and other facilities and the human resource requirements in terms of administration and faculty, as indicated in Article VI.

Section 4 The HEIs are allowed to design curricula suited to their own contexts and missions provided that they can demonstrate that the same leads to the attainment of the required minimum set of outcomes, albeit by a different route. In the same vein, they have latitude in terms of curriculum delivery and in terms of specification and deployment of human and physical resources as long as they can show that the attainment of the program outcomes and satisfaction of program educational objectives can be assured by the alternative means they propose.

The HEIs can use the **CHED Implementation Handbook for Outcomes-Based Education (OBE) and the Institutional Sustainability Assessment (ISA)** as a guide in complying with Sections 16, 17 and 22 of Article VII, hereof.

This PSG is based on the 10-year basic education system and on the existing General Education (GE) program. It reflects the reform towards outcomes-based education as well as international trends in computer science, information systems and information technology curricula. However, this does not yet include necessary changes as a consequence of the K-12 reform. The latter shall be addressed subsequently.

ARTICLE IV
PROGRAM SPECIFICATIONS

Section 5 Program Description

5.1 Degree Name

A. Bachelor of Science in Computer Science (BSCS)

Graduates of this program shall be conferred the degree of **Bachelor of Science in Computer Science (BSCS).**

B. Bachelor of Science in Information Systems (BSIS)

Graduates of this program shall be conferred the degree of **Bachelor of Science in Information Systems (BSIS).**

C. Bachelor of Science in Information Technology (BSIT)

Graduates of this program shall be conferred the degree of **Bachelor of Science in Information Technology (BSIT).**

5.2 Nature of the Field of Study

5.2.1 Bachelor of Science in Computer Science (BSCS)

The BS Computer Science program includes the study of computing concepts and theories, algorithmic foundations and new developments in computing. The program prepares students to design and create algorithmically complex software and develop new and effective algorithms for solving computing problems.

The program also includes the study of the standards and practices in Software Engineering. It prepares students to acquire skills and disciplines required for designing, writing and modifying software components, modules and applications that comprise software solutions.

5.2.2 Bachelor of Science in Information Systems (BSIS)

The BS Information Systems Program includes the study of application and effect of information technology to organizations. Graduates of the program should be able to implement an information system, which considers complex technological and organizational factors affecting it. These include components, tools, techniques, strategies, methodologies, etc.

Graduates are able to help an organization determine how information and technology-enabled business processes can be used as strategic tool to achieve a competitive advantage. As a result, IS professionals require a sound understanding of organizational principles and practices so that they can serve as an effective bridge between the technical and management/users communities within an organization. This enables them to ensure that the organization has the information and the systems it needs to support its operations.

5.2.3 Bachelor of Science in Information Technology (BSIT)

The BS Information Technology program includes the study of the utilization of both hardware and software technologies involving planning, installing, customizing, operating, managing and administering, and maintaining information technology infrastructure that provides computing solutions to address the needs of an organization.

The program prepares graduates to address various user needs involving the selection, development, application, integration and management of computing technologies within an organization.

5.3 Program Goals

The BSCS, BSIS, and BSIT graduates are expected to become globally competent, innovative, and socially and ethically responsible computing professionals engaged in life-long learning endeavours. They are capable of contributing to the country's national development goals.

5.4 Specific Professions/careers/occupations for Graduates

A. Bachelor of Science in Computer Science (BSCS)

Primary Job Roles

- Software Engineer
- Systems Software Developer
- Research and Development computing professional
- Applications Software Developer
- Computer Programmer

Secondary Job Roles

- Systems Analyst
- Data Analyst
- Quality Assurance Specialist
- Software Support Specialist

B. Bachelor of Science in Information Systems (BSIS)

Primary Job Roles

- Organizational Process Analyst
- Data Analyst

- Solutions Specialist
- Systems Analyst
- IS Project Management Personnel

Secondary Job Roles
- Applications Developer
- End User Trainer
- Documentation Specialist
- Quality Assurance Specialist

C. Bachelor of Science in Information Technology (BSIT)

Primary Job Roles
- Web and Applications Developer
- Junior Database Administrator
- Systems Administrator
- Network Engineer
- Junior Information Security Administrator
- Systems Integration Personnel
- IT Audit Assistant
- Technical Support Specialist

Secondary Job Roles

- QA Specialist
- Systems Analyst
- Computer Programmer

5.5 Allied Fields

In general, subject to the specific provision below, the following may be considered as allied fields:

1. Basic Sciences, Math and Engineering
2. Programs that have at least 50% of core and professional courses of a specific ITE program
3. Any program deemed to be an allied program by the TPITE such as the following:

A. **Bachelor of Science in Computer Science (BSCS)**

- Applied Mathematics
- Computer Engineering
- Electrical Engineering
- Electronics Engineering
- Entertainment and Multimedia Computing
- Mathematics
- Physics
- Statistics

B. **Bachelor of Science in Information Systems (BSIS)**

- Applied Mathematics
- Industrial Engineering
- Information Management
- Library and Information Science
- Statistics
- Informatics

C. **Bachelor of Science in Information Technology (BSIT)**

- Computer Engineering
- Electrical Engineering
- Electronics Engineering
- Informatics
- Information Management

Section 6 Program Outcomes

The minimum standards for the BSCS, BSIS, and BSIT programs are expressed in the following minimum set of graduate outcomes. The graduate outcomes common to all programs, and those common to the discipline are further mapped into the expanded graduate outcomes specific to the sub-disciplines of CS, IS, and IT, as outlined in Section 6.3.

6.1 Common to all programs in all types of schools

The graduates have the ability to

a) articulate and discuss the latest developments in the specific field of practice. (Philippine Qualifications Framework (PQF) level 6 descriptor) (Graduate Outcomes: CS10, IS10, IT13)
b) effectively communicate orally and in writing using both English and Filipino (Graduate Outcomes: CS08, IS08, IT10)
c) work effectively and independently in multi-disciplinary and multi-cultural teams. (PQF level 6 descriptor) (Graduate Outcomes: CS07, IS07, IT08)
d) act in recognition of professional, social, and ethical responsibility (Graduate Outcomes:CS09, IS09, IT12)
e) preserve and promote "*Filipino historical and cultural heritage*" (based on RA 7722)

6.2 Common to the discipline

The graduates of BSCS, BSIS, and BSIT must have the ability to

a) analyze complex problems, and identify and define the computing requirements needed to design an appropriate solution (Graduate Outcomes:CS02, IS02-03, IT03)
b) apply computing and other knowledge domains to address real-world problems (Graduate Outcomes: CS01, IS01, IT01)
c) design and develop computing solutions using a system-level perspective (Graduate Outcomes: CS03-05, IS04-05, IT05)
d) utilize modern computing tools (Graduate Outcomes: CS06, IS06, IT07)

6.3 Specific to a sub-discipline and a major

A. Bachelor of Science in Computer Science (BSCS)

Graduate Attribute	Graduate Outcomes Code	Graduate Outcomes
Knowledge for Solving Computing Problems	**CS01**	Apply knowledge of computing fundamentals, knowledge of a computing specialization, and mathematics, science, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements.
Problem Analysis	**CS02**	Identify, analyze, formulate, research literature, and solve complex computing problems and requirements reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines
Design/Development of Solutions	**CS03**	An ability to apply mathematical foundations, algorithmic principles and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices
	CS04	Knowledge and understanding of information security issues in relation to the design, development and use of information systems
	CS05	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
Modern Tool Usage	**CS06**	Create, select, adapt and apply appropriate techniques, resources and modern computing tools to complex computing activities, with an understanding of the limitations to accomplish a common goal
Individual & Team Work	**CS07**	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings
Communication	**CS08**	Communicate effectively with the computing community and with society at large about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions
Computing Professionalism and Ethics	**CS09**	An ability to recognize the legal, social, ethical and professional issues involved in the utilization of computer technology and be guided by the adoption of appropriate professional, ethical and legal practices
Life-Long Learning	**CS10**	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional

B. Bachelor of Science in Information Systems (BSIS)

Graduate Attribute	Graduate Outcomes Code	Graduate Outcomes
Knowledge for Solving Computing Problems	IS01	Apply knowledge of business processes, computing, mathematics and social sciences appropriate to Information Systems

Problem Analysis	IS02	Analyze a problem, identify and define the computing requirements with respect to organizational factors appropriate to its solution and plan strategies for their solution
	IS03	Evaluate information systems in terms of general quality attributes and possible trade-offs presented within the given requirement
Design/Development of Solutions	IS04	Design, implement, and evaluate information systems, processes, components, or programs and to source cost-benefit efficient alternatives to meet desired needs, goals and constraints
	IS05	Use knowledge and understanding of enterprises in modelling and design of information systems
Modern Tool Usage	IS06	Deploy and use effectively skills, tools and techniques necessary for information systems practice
Individual and Team Work	IS07	Function effectively on teams(recognizing the different roles within a team and different ways of organizing teams) to accomplish a common goal
Communication	IS08	Communicate effectively with a range of audiences. Communication skills includes techincal writing, presentation and neogitation, and numeracy.
Computing Professionalism and Ethics in the Society	IS09	Recognize the legal, social, ethical and professional issues involved in the exploitation of computer technology and be guided by the adoption of appropriate professional, ethical and legal practices both in the local and global community
Life-Long Learning	IS10	Recognize the need for and engage in an independent and life-long learning, planning self-learning and improving performance as the foundation for on-going professional development

C. Bachelor of Science in Information Technology (BSIT)

Graduate Attribute	Graduate Outcomes Code	Graduate Outcomes
Knowledge for Solving Computing Problems	IT01	Apply knowledge of computing, science, and mathematics appropriate to the discipline
	IT02	Understand best practices and standards and their applications
Problem Analysis	IT03	Analyze complex problems, and identify and define the computing requirements appropriate to its solution
	IT04	Identify and analyze user needs and take them into account in the selection, creation, evaluation and administration of computer-based systems
Design/Development of Solutions	IT05	Design, implement, and evaluate computer-based systems, processes, components, or programs to meet desired needs and requirements under various constraints
	IT06	Integrate IT-based solutions into the user environment effectively
Modern Tool Usage	IT07	Apply knowledge through the use of current techniques, skills, tools and practices necessary for the IT profession
Individual and Team Work	IT08	Function effectively as a member or leader of a development team recognizing the different roles within a team to accomplish a common goal
	IT09	Assist in the creation of an effective IT project plan
Communication	IT10	Communicate effectively with the computing community and with society at large about complex computing activities through logical writing, presentations, and clear instructions

Computing Professionalism and Social Responsibility	IT11	Analyze the local and global impact of computing information technology on individuals, organizations, and society
	IT12	Understand professional, ethical, legal, security and social issues and responsibilities in the utilization of information technology.
Life-Long Learning	IT13	Recognize the need for and engage in planning self-learning and improving performance as a foundation for continuing professional development

6.4 Common to a horizontal type as defined in CMO 46 s 2012

- Graduates of professional institutions demonstrate a service orientation in one's profession
- Graduates of colleges participate in various types of employment, development activities, and public discourses particularly in response to the needs of the communities one serves
- Graduates of universities participate in the generation of new knowledge or in research and development projects

Graduates of State Universities and Colleges must, in addition, have the competencies to support "national, regional and local development plans." (RA 7722)

A PHEI, at its option, may adopt mission-related program outcomes that are not included in the minimum set.

Section 7 Minimum Performance Indicators

Graduate attributes can be assessed through set of performance indicators provided in the following table.

Graduate Attribute	Performance Indicators
Knowledge for Solving Computing Problems	Completed and successfully defended Capstone Project /Thesis in line with the discipline.
Problem Analysis	Documented software/hardware requirements specifications following computing industry standards.
Design/Development of Solutions	Designed and developed a computing solution using object-oriented approach.
Modern Tool Usage	Used an integrated development environment.
Individual & Team Work	Worked in a group to develop a machine project.
Communication	Presented a proposed solution in class or in a public forum.
Computing Professionalism and Ethics	Immersed/exposed in an actual working environment in industry.
Life-Long Learning	Created a report on a conducted independent learning activity.

An institution may enhance the minimum performance indicators using an industry or globally accepted reference competency inventory.

ARTICLE V
CURRICULUM

Section 8 Curriculum Description

Section 8.1 General Description

The curricula for BSCS, BSIS, and BSIT shall include the required GE courses, six (6) core courses common to all programs, professional courses required for each program, and electives as well as domain specific courses when needed. The students are also required to undertake practicum work and complete a thesis or capstone project.

	BSCS	BSIS	BSIT
General Education	54.0	54.0	54.0
Common Courses	18.0	18.0	18.0
Professional Courses	48.0	48.0	48.0
Professional Electives	9.0	12.0	12.0
Additional Math Requirement	3.0	0.0	0.0
PE	8.0	8.0	8.0
NSTP	6.0	6.0	6.0
Minimum Total Units	**146.0**	**146.0**	**146.0**

The minimum total number of units is 146. For the Centers of Excellence (COEs), the Professional Courses and Electives, and Additional Math Requirement may have a minimum of 48 units (instead of 60) as long as the learning outcomes of the knowledge areas are met, resulting to a minimum total number of 134 units.

The General Education courses for the BSCS, BSIS, and BSIT programs shall be as follows:

GENERAL EDUCATION	Units	Total Units
Language and Humanities		**24**
English	9	
Filipino	6	
Humanities (Literature, Arts, Philosophy, etc.)	9	
Mathematics, Natural Sciences and Technology		**15**
Mathematics (Algebra, Statistics)	6	
Natural Sciences	6	
Electives (Trigonometry, Physics, Science and Society, etc.)	3	
Social Sciences & Communications		**15**
Life & Works of Rizal	3	
Philippine History & Culture	3	
Psychology, Sociology, Anthropology, Economics (w/ Taxation & Agrarian Reform Integrated), Asian/Western Civilization, Mass Comm., Society and Culture (w/ Family Planning), Politics & Governance (w/ Philippine Constitution)	9	

The common courses for the BSCS, BSIS, and BSIT programs shall be as follows:

- Introduction to Computing
- Computer Programming 1 (Fundamentals of Programming)
- Computer Programming 2 (Intermediate Programming)
- Data Structures and Algorithms
- Information Management
- Applications Development and Emerging Technologies

HEIs shall comply with the minimum requirements prescribed in this PSG. In addition, they may enrich the prescribed curricula with additional courses based on their institutional and program goals and objectives.

COURSE SPECIFICATIONS: CORE COMPUTING COURSES

CC100 -- INTRODUCTION TO COMPUTING

This course provides an overview of the Computing Industry and Computing profession, including Research and Applications in different fields; an Appreciation of Computing in different fields such as Biology, Sociology, Environment and Gaming; an Understanding of ACM Requirements; an Appreciation of the history of computing; and Knowledge of the Key Components of Computer Systems (Organization and Architecture), Malware, Computer Security, Internet and Internet protocols, HTML4/5 and CSS.

Course Credits : 3 units
Course Pre-Requisite : None

CC101 -- PROGRAMMING 1

The course covers the use of general purpose programming language to solve problems. The emphasis is to train students to design, implement, test, and debug programs intended to solve computing problems using fundamental programming constructs.

Course Credits : 3 units
Pre-Requisite : None

CC102 -- PROGRAMMING 2

This course is a continuation of CC101 – Programming 1. The emphasis is to train students to design, implement, test, and debug programs intended to solve computing problems using basic data structures and standard libraries.

Course Credits : 3 units
Pre-Requisite : CC101 -- Programming 1

CC103 -- DATA STRUCTURES AND ALGORITHMS

The course covers the standard data representation and algorithms to solve computing problems efficiently (with respect to space requirements and time complexity of algorithm). This covers the following: Stacks, Queues, Trees,

Graphs, Maps, and Sets. Thorough discussion of sorting and searching algorithms and hashing is covered.

Course Credits : 3 units
Pre-Requisite : CC102 – Programming 2

CC104 – INFORMATION MANAGEMENT

This course covers information management, database design, data modeling, SQL, and implementation using relational database system.

Course Credits : 3 units
Course Pre-Requisite : CC103 – Data Structures and Algorithms

CC105 – APPLICATIONS DEVELOPMENT AND EMERGING TECHNOLOGIES

Development of applications using web, mobile, and emerging technologies with emphasis on requirements management, interface design, usability, testing, deployment, including ethical and legal considerations.

Course Credits : 3 units
Pre-Requisite : CC102 – Programming 2

Section 8.2 Specific Description of Program Curricula

A. Bachelor of Science in Computer Science (BSCS)

The Computer Science curriculum includes foundation and professional courses that cover theory, algorithms, software design and development, and new developments in computing.

The curriculum should include courses in the following Knowledge Areas as recommended in ACM Computer Science Curricula 2013[1]:

1. Algorithms and Complexities
    a. Design and Analysis of Algorithms
    b. Automata Theory and Formal Languages
    c. Computational Science
2. Architecture and Organization
3. Discrete Structures
    a. Logic, Sets, Relations, Functions, and Proof Techniques
    b. Graphs, Trees, Matrices, Combinatorics and Recurrences
4. Human Computer Interaction
    a. Fundamentals of HCI
    b. Graphics and Visual Computing
5. Information Assurance and Security
6. Networks and Communications
7. Operating Systems

[1] acm.org

a. Fundamentals of Operating Systems
b. Parallel and Distributing Computing

8. Programming Languages (Design and Implementation)
9. Software Development Fundamentals
    a. Fundamentals of Programming
    b. Intermediate Programming
    c. Data Structures and Algorithms
    d. Object Oriented Programming
10. Software Engineering
    a. Analysis and Design
    b. Implementation and Management
    c. Intelligent Systems
11. Social Issues and Professional Practice

B. Bachelor of Science in Information Systems (BSIS)

The Information Systems curriculum encompasses introductory and professional courses to cover the various information systems functional areas as follows:

1. Fundamentals of IS
2. Professional Issues in Information Systems
3. IT Infrastructure and Network Technologies
4. Systems Analysis, Design and Development
5. Enterprise Architectures
6. IS Project Management
7. IS Strategy, Management and Acquisition

In addition, the curriculum shall include business enterprise domain courses such as the following:

1. Organization and Management Concepts
2. Financial Management
3. Business Process Design and Management
4. Evaluation of Business Performance
5. Quantitative Methods

C. Bachelor of Science in Information Technology (BSIT)

The Information Technology curriculum includes basic and advanced courses on planning, development, integration, and management of information technology infrastructure that provide computing solutions to address the needs of organizations.

The curriculum should include courses in the following Knowledge Areas as recommended in ACM Information Technology Curricula 2008[2]:

1. Information Technology Fundamentals
2. Human Computer Interaction
3. Information Assurance and Security

[2] acm.org

- Fundamentals of IAS
- Advanced Topics of IAS

4. Information Management
    - Fundamentals of IM
    - Fundamentals of Database Systems
    - Advanced Database Systems
5. Integrative Programming and Technologies
    - Fundamentals of Programming
    - Intermediate Programming
    - Data Structures and Algorithms
    - Object Oriented Programming
    - Event Driven Programming
6. Networking
    - Fundamentals of Networking
    - Advanced Networking
7. Platform Technologies
    - Intangible Technologies
    - Tangible Technologies
8. Systems Administration and Maintenance
9. Systems Integration and Architecture
    - Fundamentals of SIA
    - Advanced SIA
10. Social and Professional Issues
11. Web Systems and Technologies

Section 8.3 Internship/On-the-job-training/Practicum.

Internship/OJT/Practicum is an immersion program wherein the students will have the chance and opportunity to be with the IT industry. This program is important because the students will have the chance to apply the skills, knowledge and attitude learned in the school and at the same time the opportunity to experience the corporate environment. Learning expectations in the IT related field should be established between the HEI and the industry in the form of a Memorandum of Agreement (MOA) or Memorandum of Understanding (MOU).

Internship is a requirement for the BSCS, BSIS and BSIT programs. Students are eligible to enroll the internship program after completing 70% of the total number of units in the curriculum. The minimum number of internship hours (preferably in a full time capacity) for the BSIS and BSIT programs is 486 hours and 162 hours for the BSCS program.

Section 8.4 Thesis/Capstone Project

Thesis is required for BSCS while Capstone Project is required for BSIS and BSIT. Both function as terminal project requirements that would not only demonstrate a student's comprehensive knowledge of the area of study and research

methods used but also allow them to apply the concepts and methods to a specific problem in their area of specialization.

BS Computer Science students are required to complete a thesis that is focused on the theories and concepts of computing in the form of a scientific work.

BS Information Systems students must complete a project such as business application development, or an Information Systems plan.

BS Information Technology students must complete a capstone project such as a software/system development with emphasis on the IT infrastructure, or an IT Management project.

It is expressly understood that Computing Thesis and Capstone Projects need not require surveys, statistics, and descriptive methods, unless appropriate.

a. A **Thesis** is a technical report on a systematic investigation of a problem that can be solved using Computing. It may include a solution, an approximate or partial solution, a scientific investigation, or the development of results leading to the solution of the problem.

   A Computer Science thesis must be anchored on Computer Science principles.

b. A **Capstone Project** is an undertaking appropriate to a professional field. It should significantly address an existing problem or need.

   An Information Systems Capstone Project focuses on business processes and the implications of introducing a Computing solution to a problem.

   An Information Technology Capstone Project focuses on the infrastructure, application, or processes involved in implementing a Computing solution to a problem.

Scope of the Theses / Capstone Projects

The Thesis or Capstone Project should integrate the different courses, knowledge, and competencies learned in the curriculum. Students are encouraged to produce innovative results, generate new knowledge or theories, or explore new frontiers of knowledge or application areas.

The HEI should have specific guidelines on Thesis and Capstone Projects. Attached as Annex A is a sample guideline.

Section 9 Sample Curriculum

9.1. Components
General Education. Core Courses, Electives, etc.

A. Bachelor of Science in Computer Science (BSCS)

The following is a list of professional and elective courses in the sample curriculum for BSCS:

Course Code	Knowledge Area Code	Course Title	Units
Required Courses			
CC101	CC	Introduction to Computing	3.0
CC102	SDF	Fundamentals of Programming	3.0
CC103	SDF	Intermediate Programming	3.0
CC104	SDF	Data Structures and Algorithms	3.0
CC105	IM	Information Management	3.0
CC106	IM	Applications Development and Emerging Technologies	3.0
DS101	DS	Discrete Structures 1	3.0
DS102	DS	Discrete Structures 2	3.0
SDF 104	SDF	Object-oriented Programming	3.0
AL101	AL	Algorithms and Complexity	3.0
AL102	AL	Automata Theory and Formal Languages	3.0
AR101	AR	Architecture and Organization	3.0
IAS101	IAS	Information Assurance and Security	2.0
HCI101	HCI	Human Computer Interaction	1.0
NC101	NC	Networks and Communications	3.0
OS101	OS	Operating Systems	3.0
PL101	PL	Programming Languages	3.0
PRC101	PRC	Practicum	3.0
SE101	SE	Software Engineering 1	3.0
SE102	SE	Software Engineering 2	3.0
SP101	SP	Social Issues and Professional Practice	3.0
THS102	THS	CS Thesis Writing 1	3.0
THS103	THS	CS Thesis Writing 2	3.0
Recommended Electives			
CN101	CN	Computational Science	3.0
GV101	GV	Graphics and Visual Computing	3.0
PD101	PD	Parallel and Distributed Computing	3.0
IS101	IS	Intelligent Systems	3.0
SF101	SF	System Fundamentals	3.0

Bachelor of Science in Information Systems (BSIS)

The following is a list of professional and elective courses in the sample curriculum for BSIS:

Course Code	Knowledge Area Code	Course Title	Units
CC101	ITF	Introduction to Computing	3
CC102	PF	Computer Programming 1	3
CC103	PF	Computer Programming 2	3
CC104	PIF	Data Structures and Algorithms	3
CC105	DIM	Information Management	3
CC106	UE	Application Development and Emerging Technologies	3
IS101	FIS	Fundamentals of Information Systems	3
IS102	PIS	Professional Issues in Information Systems	3
IS103	NIT	IT Infrastructure and Network Technologies	3
IS104	SAD	Systems Analysis and Design	3
IS105	EA	Enterprise Architecture	3
IS106	IPM	IS Project Management 1	3
IS107	ISMA	IS Strategy, Management and Acquisition	3
DM101	DBC	Organization and Management Concepts	3
DM102	DBC	Financial Management	3
DM103	DBC	Business Process Management	3
DM104	DBC	Evaluation of Business Performance	3
QUAMET	MATH	Quantitative Methods	3
CAP101	CAP	Capstone Project 1	3
CAP102	CAP	Capstone Project 2	3
PRAC101	PRC	Practicum for Information Systems	6
		Recommended Electives	
ADV01	ITD	Enterprise Systems	3
ADV02	ITD	Human Computer Interaction	3
ADV03	BD	IT Audit and Controls	3
ADV04	BD	IS Innovations and New Technologies	3
ADV05	ITD	IT Security and Management	3
ADV06	ITD	IT Service Management	3
ADV07	ITD	IS Project Management 2	3
ADV08	ITD	Data Mining	3
ADV09	BD	Business Intelligence	3
ADV10	BD	Enterprise Resource Planning	3
ADV11	BD	Supply Chain Management	3
ADV12	BD	Customer Relationship Management	3

Bachelor of Science in Information Technology (BSIT)

The following is a list of professional and elective courses in the sample curriculum for BSIT:

Course Code	Knowledge Area Code	Course Title	Units
CC101	CP	Introduction to Computing	3
CC102	PF	Computer Programming 1	3
CC103	PF	Computer Programming 2	3
CC104	PF	Data Structures and Algorithms	3
CC105	IM	Information Management	3
CC106	WS	Application Development and Emerging Technologies	3

HCI101	HCI	Introduction to Human Computer Interaction	3
IAS101	IAS	Information Assurance and Security 1	3
IAS102	IAS	Information Assurance and Security 2	3
IM101	IM	Fundamentals of Database Systems	3
IPT101	IPT	Integrative Programming and Technologies 1	3
MS101	MS	Discrete Mathematics	3
MS102	MS	Quantitative Methods (incl. Modeling & Simulation)	3
NET101	NET	Networking 1	3
NET102	NET	Networking 2	3
PRAC101	PRC	Practicum	6
SA101	SA	Systems Administration and Maintenance	3
SIA101	SIA	Systems Integration and Architecture 1	3
SP101	SP	Social and Professional Issues	3
CAP101	THS	Capstone Project and Research 1	3
CAP102	THS	Capstone Project and Research 2	3
Recommended Electives			
IPT102	IPT	Integrative Programming Technologies 2	3
PT101	PT	Platform Technologies	3
WS101	WS	Web Systems and Technologies	3
PF101	PF	Object-Oriented Programming	3
SIA102	SIA	Systems Integration and Architecture 2	3
HCI102	HCI	Human Computer Interaction 2	

9.2. Sample Program of Study

A. Bachelor of Science in Computer Science (BSCS)

Year	Freshmen Year		Sophomore Year		Junior Year			Fourth Year		TOTAL
Sem	1st	2nd	1st	2nd	1st	2nd	Summer	1st	2nd	
TOTAL	**18.5**	**18.5**	**18.5**	**18.5**	**20.0**	**18.0**	**3.0**	**19.0**	**12.0**	**146.0**
GE	**9.0**	**9.0**	**6.0**	**6.0**	**6.0**	**6.0**		**6.0**	**6.0**	**54.0**
Common	**6.0**	**3.0**	**3.0**	**3.0**	**3.0**					**18.0**
Prof		**3.0**	**6.0**	**3.0**	**8.0**	**9.0**	**3.0**	**10.0**	**6.0**	**48.0**
Electives				**3.0**	**3.0**	**3.0**		**3.0**		**12.0**
PE	**2.0**	**2.0**	**2.0**	**2.0**						**8.0**
NSTP	**1.5**	**1.5**	**1.5**	**1.5**						**6.0**
CS Units	6	6	9	9	14	12	3	13	6	78
	CC101* Introduction to Computing									
AL				AL101* Algorithms and Complexity	AL102* Automata Theory and Formal Languages					
AR					AR101* Architecture and Organization					
DS		DS101* Discrete Structures 1	DS102* Discrete Structures 2							
HCI								HCI101* Human Computer Interaction		
IAS					IAS101* Information					

					Assurance and Security					
IM				CC105 (IM101)** Information Management						
NC									NC101** Networks and Communications	
OS								OS101** Operating Systems		
PL						PL101** Programming Languages				
SDF	CC102 (SDF101)** Fundamentals of programming	CC(103) SDF102** Intermediate Programming	SDF104** Object-oriented Programming CC104 (SDF103)** Data structures and algorithms							
SE						SE101** Software Engineering 1		SE102** Software Engineering 2		
SF										
SP						SP101* Social Issues and Professional Practice 1				
THS								THS101** CS Thesis 1	THS102*** CS Thesis 2	
PRC							PRAC101** Practicum			
Elective				Math Elective*	CS Elec1**	CS Elec 2**		CS Elec 3**		
CC					CC 106** Application Development and Emerging Technologies					

* Pure Lecture

** 2 hours lecture, 3 hours lab per week

*** Supervised Independent Study

B. Bachelor of Science in Information Systems (BSIS)

Year	Freshmen Year		Sophomore Year		Junior Year		Fourth Year		Total
Sem	1st	2nd	1st	2nd	1st	2nd	1st	2nd	
TOTAL	**21.5**	**21.5**	**21.5**	**21.5**	**21**	**21**	**12**	**6**	**146**
GE	**12**	**12**	**6**	**9**	**6**	**9**			**54**
Electives				**3**	**3**	**3**	**3**		**12**
PE	**2**	**2**	**2**	**2**					**8**
NSTP	**1.5**	**1.5**	**1.5**	**1.5**					**6**
IS Units	6	6	12	9	15	12	12	6	78
ITF	CC101** Introduction to Computing								
PIF			CC104** Data Structures						

			and Algorithms						
DIM					CC105** Information Management				
PIS		IS101* Fundamentals of Information Systems	IS102* Professional Issues in Information Systems						
NIT			IS103** IT Infrastructure and Network Technologies						
SAD				IS104** Systems Analysis and Design					
EA					IS105** Enterprise Architecture				
PF	CC102** Computer Programming 1	CC103** Computer Programming 2							
IPM						IS106* IS Project Management 1			
ISMA							IS107* IS Strategy Management and Acquisition		
UE							CC106** Application Development and Emerging Technologies		
DBC			DM101* Organization and Management Concepts	DM102* Financial Management	DM103* Business Process Management	DM104* Evaluation of Business Performance			
MATH					QUAMET* Quantitative Methods				
CAP						CAP101*** Capstone Project 1	CAP102*** Capstone Project 2		
PRC								PRAC101*** Practicum for Information Systems	
ADV (Elective)				PROFEL 1	PROFEL 2	PROFEL 3	PROFEL 4		

* - Pure Lecture

** - 2 hours lecture, 3 hours lab per week

*** - Supervised Independent Study

A. Bachelor of Science in Information Technology (BSIT)

Year	Freshmen Year		Sophomore Year		Junior Year			Fourth Year		Total
Sem	1st	2nd	1st	2nd	1st	2nd	Summer	1st	2nd	
TOTAL	21.5	21.5	21.5	21.5	21	18	6	6	9	146
GE	12	9	9	6	9	9				54
Electives			3	3	3				3	12
PE	2	2	2	2						8
NSTP	1.5	1.5	1.5	1.5						6
IT Units	6	9	9	7	12	[illegible]				[illegible]
ITF	CC101** - Introduction to Computing									
HCI		HCI 101** Introduction to Human Computer Interaction								

IAS						IAS 101** Information Assurance and Security 1	IAS 102** Information Assurance and Security 2			
IM				CC105** Information Management 1	IM 101** Advanced Database Systems					
MS		MS 101* Discrete Mathematics		MS102* Quantitative Methods						
NET				NET 101** Networking 1	NET102** Networking 2					
PF	CC102** Computer Programming 1		CC104** Data Structures and Algorithms							
		CC 103** Computer Programming 2	PF 101** Object Oriented Programming							
SA								SA 101** Systems Administration and Maintenance		
SIA					SIA 101** Systems Integration and Architecture 1					
SP						SP 101* Social and Professional Issues				
WS						CC106** Application Development and Emerging Technologies				
THS							CAP 101*** Capstone Project 1	CAP 102*** Capstone Project 2		
PR									PRAC 101*** Practicum	
ADV (Elective)			PT 101** Platform Technologies	IPT 101** Integrative Programming and Technologies	PF 101** Event Driven Programming				SIA 102** Systems Integration and Architecture 2	

* - Pure Lecture

** - 2 hours lecture, 3 hours lab per week

*** - Supervised Independent Study

Section 10 Sample Curriculum Map

Curriculum Map for the Bachelor of Science in Computer Science

Course Code	Knowledge Area	Course Title	Pre-Requisite	Units	Sample Learning Outcomes		CS01	CS02	CS03	CS04	CS05	CS06	CS07	CS08	CS09	CS10
CC101	CC	Introduction to Computing	None	3	LO1	Explain fundamental principles, concepts and evolution of computing systems as they relate to different fields								I	I	I
					LO2	Expound on the recent developments in the different computing knowledge areas										
					LO3	Analyze solutions employed by organizations to address different computing issues										

CC102	SDF	Fundamentals of Programming	None	3	LO1	Design, implement, test, and debug a program, based on a given specification, that uses each of the following fundamental programming components: (1) primitive data types, (2) basic computation, (3) simple I/O, (4) conditional and iterative structures, (5) definition of functions and parameter passing, and(6) recursion	I	I	I			I				
					LO2	Assess and recommend revisions to another programmer's code (1) regarding documentation and program style standards that contribute to readablity and maintainability of software, (2) regarding appropriateness of chosen conditional and iterative constructs given a programming task, and (3)regarding thoroughness in applying procedural abstraction										
CC103	SDF	Intermediate Programming	SDF101	3	LO1	Design, implement, test, and debug a program, based on a given specification, that uses (1) data structures arrays, strings, structures, linked list,and files, (2) conditional, iterative and recursive constructs, and (3) standard libraries in the assigned programming language	I	I	I			I				
					LO2	Assess and recommend revisions to another programmer's code (1) regarding appropriateness of chosen data structure, (2) regarding appropriateness of chosen conditional and iterative constructs given a programming task, and (3)regarding thoroughness in applying procedural abstraction										
					LO3	Argue the costs and benefits of dynamic and static data structure implementations										
CC104	SDF	Data Structures and Algorithms	SDF102	3	LO1	Design, implement, test, and debug a program, based on a given specification, that uses and implements abstract data types (stacks queues, priority queues, sets, maps)	E	E	E		I					
					LO2	Argue strengths and weaknesses among multiple implementations for a problem (i.e., on the aspects of iterative vs. recursive solutions and on the aspects of abstraction,encapsulation, and information hiding)										
CC105	IM	Information Management	SDF102	3	LO1	Analyze an existing database system with respect to quality issues: Reliability, scalability, efficiency, effectiveness and security	E	E	E	E	E	E	E	E		I
					LO2	Design a database based on user requirements using a widely used modeling notation, and be able to use declarative query language to elicit information										
CC106	IM/ CC	Applications Development and Emerging Technologies	IM101/ CC105	3	LO1	Develop specifications for a software development effort that precisely articulates the functional requirements expected execution paths, and the explicit use of cutting edge or emerging technologies, which includes hardware devices and software library APIs	E	E	E		E					
					LO2	Select and use a defined coding, documentation writing, and licensing standards in a sufficiently complex software project where coding idioms and mechanisms for implementing designs to achieve desired properties such as reliability, efficiency, and robustness are practiced with respect to legal and ethical considerations.										
					LO3	Undertake, as part of a team activity, an inspection of the source code and unit testing of the functional units of a sufficiently complex software project.										

SDF 104	SDF	Object-oriented Programming	SDF102	3	LO1	Compare and contrast procedural/functional approach to object-oriented programming approach.	E	E	E			E	I			
					LO2	Design, implement, test and debug programs using OOP concepts like abstraction, encapsulation, inheritance and polymorphism										
DS101	DS	Discrete Structures 1	ALTRIG	3	LO1	Perform the operations associated with Sets, Functions and Relations, and relate these operations to computer programming	I	I	I		I					
					LO2	Construct sound arguments in propositional and predicate logic by applying appropriate rules of inference given sample intelligent software										
					LO3	Construct valid mathematical proofs using mathematical induction, direct proof and proof by contradiction to simplify programs and prove program correctness										
DS102	DS	Discrete Structures 2	DS101	3	LO1	Solve real-world computing problems that require mapping to permutations, combinations of a set, and modular arithmetic	I	I	I		I					
					LO2	Compute the event probabilities using counting and Bayes Theorem of a sample computing problem										
					LO3	Solve equations involving recurrence and relate them to recursive algorithms										
PL101	PL	Programming Languages	SDF103	3	LO1	Reason about memory leaks, dangling-pointer dereferences, and the benefits and limitations of garbage collection through an understanding of programming language implementation and how memory is organized.	E	E	E					E		E
					LO2	Evaluate the appropriateness of the use of a programming language for implementing a particular application based on language features										
					LO3	Implement a simple interpreter or a portion of the language translation process such as a lexical analyzer, parser, code generator or optimizer										
AL101	AL	Algorithms and Complexity	DS101 SDF103	3	LO1	Use big O notation formally to give asymptotic upper bounds on time and space complexity of algorithms	E	E	E		E					
					LO2	Choose and apply the most appropriate algorithm design technique (divide and conquer, backtracking, greedy, dynamic programming) for solving problems										
					LO3	Describe the behavior and running time of various searching, sorting, and graph algorithms.										
AL102	AL	Automata Theory and Formal Languages	AL101	3	LO1	Design finite-state machines, regular expressions, context-free grammar, push-down automata and turing machines for modeling a given language; and define the classes P and NP and explain their significance to computing applications	E	E	E		E					
					LO2	Apply the concept of state machines in the design and implementation of software										

NC101	NC	Networks and Communicatio ns	SDF102	3	LO1	Implement a simple client-server socket-based application that meets the needs of an organization against security threats;	E	E	E	E	E			E	E
					LO2	Design and implement a simple reliable network protocol through the diagnosis and fixing of common network problems;									
					LO3	Compare and contrast the fixed and dynamic allocation techniques									
OS101	OS	Operating Systems	SDF103	3	LO1	Analyze the tradeoffs inherent in OS design	E	E	E	E		E		E	E
					LO2	Compare and contrast the algorithms used for processor scheduling and the different ways of allocating memory to tasks									
					LO3	Design and create concurrent programs considering synchronization issues									
AR101	AR	Architecture and Organization	DS101 SDF103	3	LO1	Design the basic building blocks of a computer: arithmetic-logic unit (gate-level), registers (gate-level), central processing unit (register transfer-level), memory (register transfer-level)	E	E	E						
					LO2	Write simple programs in assembly language.									
SP101	SP	Social Issues and Professional Practice 1	SE102	3	LO1	Argue the pros and cons of the design and implemention of computing solutions in education, industry and government, to name a few							E	E	E	E
					LO2	Evaluate professional, ethical and social issues of computing decisions									
SE101	SE	Software Engineering 1	IM101 SDF104	3	LO1	Discuss the difference between the waterfall-based models and agile-based models, and identify the strengths and weaknesses of these models	E	E	E	E	E	E	E	E	E
					LO1	Discuss the difference between the waterfall-based models and agile-based models and identify the strengths and weaknesses of these models									
					LO2	Extract user requirements, translate these to formal models, and present these using UML-based visualizations									
					LO3	Design an over-all architecture of the system, and justify its appropriateness									
					LO4	Translate program designs and specifications into actual program codes									
SE102	SE	Software Engineering 2	SE101	3	LO1	Improve an existing software by adopting an appropriate design pattern	D	D	D	D	D	D	D	D	D
					LO2	Translate program designs and specifications into actual program codes									
					LO3	Design test case documents applying good testing practices, run the existing program against these test cases, and report program defects properly									
					LO4	Update a software that requires defect fixing or has undergone some changes in specifications									

IAS101	IAS	Information Assurance and Security	IM101	2	LO1	Describe the set of controls and processes both technical and policy intended to protect and defend information and information systems by ensuring their availability, integrity, authentication, and confidentiality and providing for non-repudiation.		E		E	E			E	E	E
					LO2	Articulate the strengths and weaknesses associated with different approaches to security to the validity of current and past processes and data												
HCI101	HCI	Human Computer Interaction	SDF102	1	LO1	Develop appropriate user interfaces for domain specific applications		E		E	E	E	E	E	E			
					LO2	Evaluate the effectiveness of a design of an application or product in solving domain-specific problems												
THS101	THS	CS Thesis 1	4th Year Standing	3	LO1	Formulate the research objectives, scope and limitations, and evaluation metric for a chosen topic	D	D	D	D	D	D	D	D	D	D		
					LO2	Collect and compare related literature related to the topic												
					LO3	Propose an ethical and feasible software solution to the identified research problem that employs new designs, tools, and methodologies, as well as unique and useful enhancements, with creating a prototype software system in mind or with demonstrating that a certain theory / algorithm / design might work through exploratory and experimental research												
THS102	THS	CS Thesis 2	THS101	3	LO1	Collect pertinent data to support research objectives of the thesis	D	D	D	D	D	D	D	D	D	D		
					LO2	Design the architecture and components of the proposed software solution												
					LO3	Justify the proposed solution's feasibility and effectiveness to solve the computing problem												
PRC101	PRC	Practicum	3rd Standing	3	LO1	Analyze, design, implement, test, maintain, and/or document a software system as applied to a real-world problem, as part of a team in an actual company environment, thereby also developing personal and interpersonal working skills in the process	D	D	D	D	D	D	D	D	D	D		

Curriculum Map for the Bachelor of Science in Information Systems

Course Code	Course Title	Pre-Requisite Course	Units	Sample Learning Outcomes		IS01	IS02	IS03	IS04	IS05	IS06	IS07	IS08	IS09	IT10
CC101	Introduction to Computing	None	3	LO1	Explain fundamental principles, concepts and evolution of computing systems as they relate to different fields	I									
				LO2	Expound on the recent developments in the different computing knowledge areas						I			I	I
				LO3	Analyze solutions employed by organizations to address different computing issues									I	

CC102	Computer Programming 1	None	3	LO1	Design, implement, test, and debug a program, based on a given specification, that uses each of the following fundamental programming components: (1) primitive data types, (2) basic computation, (3) simple I/O, (4) conditional and iterative structures, (5) definition of functions and parameter passing, and(6) recursion	I	I	I	I	I					
				LO2	Analyze and simulate results of algorithms that may be implemented as a solution to a given problem										
CC103	Computer Programming 2	CC102		LO1	Design, implement, test, and debug a program, based on a given specification, that uses : (1) data structures arrays, stacks, queues, trees, strings, structures, linked list,and files, (2) conditional, iterative, and recursive constructs, and (3) standard libraries in the assigned programming language	I	I	I	I	I					
CC104	Data Structures and Algorithms Analysis	CC103	3	LO1	Design, implement, test and debug a program based on a given specifications that uses and implement abstract data types (stacks, queues, priority queues, sets, maps)	E	E		E						
				LO2	Argue strengths and weaknesses among multiple implementations for a problem (e g. on the aspects of iterative or recursive solutions and on the aspects of abstraction, encapsulation and information hiding)	E	E		E						
CC105	Information Management	CC104	3	LO1	Integrate business intelligence functions in the development of database systems in enterprises	E	E	E	I	I	E				
CC106	Application Development and Emerging Technologies	4TH Year Standing	3	LO1	Develop specifications for a software development effort that precisely articulates the functional requirements, expected execution paths, and the explicit use of cutting edge or emerging technologies, which includes hardware devices and software library APIs.	E	E	E	D	D	D				
				LO2	Select and use a defined coding, documentation writing, and licensing standards in a sufficiently complex software project where coding idioms and mechanisms for implementing designs to achieve desired properties such as reliability, efficiency, and robustness are practiced with respect to legal and ethical considerations										
				LO3	Undertake, as part of a team activity an inspection of the source code and unit testing of the functional units of a sufficiently complex software project										
IS101	Fundamentals of IS	CC101	3	LO1	Compare and identify the major technologies and applications of information systems in driving development and changes in enterprises	I	I	I	I	I	I				
IS102	Professional Issues in IS	CC101	3	LO1	Examine professional, ethical and moral challenges in computing and use of information systems and recommend courses of action.								E	D	E
				LO2	Apply/exhibit ethical thinking skills in analyzing and finding resolutions to computing issues										
IS103	IT Infrastructure and Network Technologies	CC101	3	LO1	Evaluate how IT infrastructure components are organized into infrastructure solutions in different organizational environments	D	E	E	E	D					

				LO2	Examine, test and evaluation web solutions as applied to business enterprise										
IS104	Systems Analysis and Design	2ND Year Standing	3	LO1	Use systems thinking to analyze business processes and identify problems and opportunites that can be solved and supported by technology solutions	D	D				E				
				LO2	Apply appropriate tools, methods, models/techniques in systems analysis and design	E	E	E	E	D	D	E			
				LO3	Develop and defend a project design proposal to different audiences.			D	D	E	D	E			
IS105	Enterprise Architecture	IS103	3	LO1	Examine and evaluate core concepts of data/information architecture used in existing data/information architecture designs		E	D		D	D				
IS106	IS Project Management 1	IS104		LO1	Examine the use of project management best practices in real-life projects	E	E	E	E	E	E	D			E
				LO2	Apply project management concepts, principles and tools in performing an actual IS project.										
IS107	IS Strategy Management and Acquisition	4TH Year Standing	3	LO1	Examine existing and emerging information technologies, the functions of IS and how it impacts organizational operations				D	D	D				
				LO2	Analyze how strategic decisions are made concerning acquiring IS resources and capabilities including the ability to evaluate the different sourcing options		D	D	E	E					
DM101	Organization and Management Concepts	CC101	3	LO1	Examine and Evaluate organizational structure policies and procedures and the information systems that support them	I	E	E					E	E	D
				LO2	Examine and Evaluate management lifecycle and the information systems that support them	I	E	E					E	E	D
DM102	Financial Management	DM101	3	LO1	Examine and Evaluate financial processes and reports and the information systems that support them	E	E	E	E	E		E			
DM103	Business Process Management	DM102	3	LO1	Use systems thinking in modeling and analyzing business processes		E	E	D	D	E				
				LO2	Rethink processes to simplify business operations		E	E	D	D	E				
DM104	Evaluation of Business Performance	DM103	3	LO1	Evaluate business performance applying the different evaluation tools consistent with quality management and continuous improvement		D	D			D				
				LO2	Develop quality metrics for assessment of customer satisfaction in all phases of life cycle.		D	D			D				
				LO3	Design a business performance management program for SMEs				D	D		E	E	E	
QUAM ET	Quantitative Methods	3rd Year Standing	3	LO1	Use appropriate mathematical tools for decision making.		D	D			D				
				LO2	Implement mathematical methods in IT solutions to problems.		D	D			D				

CAP101	Capstone Project 1	4TH Year Standing	3			D	D	D	D	D	D	D	D	D	D		
CAP102	Capstone Project 2	4TH Year Standing	3			D	D	D	D	D	D	D	D	D	D		
PRAC01	Practicum	4th Year Standing	3	LO1	Analyze, design, implement, test, maintain, and/or document a software system as applied to a real-world problem, as part of a team in an actual company environment, thereby also developing personal and interpersonal working skills in the process	D	D	D	D	D	D	D	D	D	D		

Curriculum Map for the Bachelor of Science in Information Technology

Course Code	Knowledge Area	Course Title	Pre-requisite	Units	Sample Learning Outcomes		IT01	IT02	IT03	IT04	IT05	IT06	IT07	IT08	IT09	IT10	IT11	IT12	IT13
CC101	ITF	Introduction to Computing	None	3	LO1	Explain fundamental principles, concepts and evolution of computing systems as they relate to different fields													
					LO2	Expound on the recent developments in the different computing knowledge areas			I				I			I	I	I	I
					LO3	Analyze solutions employed by organizations to address different computing issues													
CC102	PF	Computer Programming 1	None	3	LO1	Design, implement, test, and debug a program, based on a given specification, that uses each of the following fundamental programming components: (1) primitive data types, (2) basic computation, (3) simple I/O, (4) conditional and iterative structures, (5) definition of functions and parameter passing, and(6) recursion	I						I		I				
					LO2	Analyze and simulate results of algorithms that may be implemented as a solution to a given problem													
CC103	PF	Computer Programming2	CC102	3	LO1	Design, implement, test and debug a program, based on a given specification, that uses (1) data structures arrays, strings, structures, linked list,and files, (2) conditional, iterative, and recursive constructs, and (3) standard libraries in the assigned programming language	E	I			I		E		E	I			I
					LO2	Assess and recommend revisions to another programmer's code (1) regarding appropriateness of chosen data structure, (2) regarding appropriateness of chosen conditional and iterative constructs given a programming task, and (3)regarding thoroughness in applying procedural abstraction													

					LO3	Argue the costs and benefits of dynamic and static data structure implementations												
CC104	PF	Data Structures and Algorithms	CC103	3	LO1	Design, implement, test, and debug a program, based on a given specification, that uses and implements abstract data types (stacks, queues, priority queues, sets, maps)	I						I		I			
					LO2	Argue strengths and weaknesses among multiple implementations for a problem (i.e., on the aspects of iterative vs recursive solutions and on the aspects of abstraction encapsulation, and information hiding)												
CC105	IM	Information Management	CC103	3	LO1	Analyze an existing database system with respect to quality issues Reliability, scalability, efficiency, effectiveness and security	E	E	E	E	E	E	E	E		I		
					LO2	Design a database based on user requirements using a widely used modeling notation, and be able to use declarative query language to elicit information												
CC106	WS	Application Development and Emerging Technologies	IM101	3	LO1	Develop specifications for a software development effort that precisely articulates the functional requirements, expected execution paths, and the explicit use of cutting edge or emerging technologies, which includes hardware devices and software library APIs.	E	E	E	D	D	D						
					LO2	Select and use a defined coding, documentation writing, and licensing standards in a sufficiently complex software project where coding idioms and mechanisms for implementing designs to achieve desired properties such as reliability, efficiency, and robustness are practiced with respect to legal and ethical considerations												
					LO3	Undertake, as part of a team activity, an inspection of the source code and unit testing of the functional units of a sufficiently complex software project.												
MS102	MS	Quantitative Methods	MS101 and Statistics	3	LO1	Use appropriate mathematical tools for decision making		D	D			D						

					LO2	Implement mathematical methods in IT solutions to problems												
PF 101	PF	Object-oriented Programming	CC 103	3	LO1	Compare and contrast procedural/functional approach to object-oriented programming approach.	E	E			E	I	E		E	E		
					LO2	Design, implement, test and debug programs using OOP concepts like abstraction, encapsulation inheritance and polymorphism												
PF102	PF	Event-Driven Programming	CC10 4	3	LO1	Design, code, test and debug simple event-driven programs that respond to user events	E	E			E	I	E		E	E		
HCI101	HCI	Introduction to Human Computer Interaction	CC10 2	3	LO1	Analyze different user populations with regard to their abilities and characteristics for using both software and hardware products.		E	I	I	E	E	E					
					LO2	Evaluate the design of existing user interfaces based on the cognitive models of target user												
HCI102	HCI	Human and Computer Interaction 2		3	LO1	Develop prototypes interfaces for users with specific accessibility issues			E	E	E		E	I		E	E	
					LO2	Perform usability evaluation of an existing software based on general principles used in the heuristic evaluation, usability performance and preference metrics (learning, task time, task completion, and user satisfaction), and common usability guidelines and standards.												
IM101	IM	ADVANCED Database Systems	CC10 5	3	LO1	Examine the different techniques of warehousing and mining data that will support organizational decisions	E	E	E	E			E					
					LO2	Propose possibilities on how to improve a specific algorithm as may be applied to data warehousing and mining.												
PT101	PT	Platform Technologies	CC10 3	3	LO1	Recommend an appropriate operating system based on given system requirements		E	E	E	E	E						
					LO2	Plan and write a simple assembly-language program.												
					LO3	Perform a cost-benefit analysis for a proposed server solution												

NET101	NET	Networking 1	PT101	3	LO1	Describe data communications and network models, topologies, protocols, standards and architectures	E	E	E				E							
					LO2	Describe necessary hardware and components used to establish communication between multiple networks and analyze the effect of various topologies, applications and devices on network performance														
					LO3	Analyze routing algorithms, protocols, process routing tables and configure routers for proper orientation of an efficient network														
NET102	NET	Networking 2	NET101	3	LO1	Design, configure and deploy switches utilizing VLANs, trunking and port aggregation.	E	E	E			E	E			E	E			
					LO2	Implement multiple networks and connect them together, selecting routing and switching equipment for a given network application.														
					LO3	Implement load balancing in routers and switches														
IPT101	IPT	Integrative Programming and Technologies 1	PF101 and PT101	3	LO1	Design, develop and test a program that uses a messaging service that sends asynchronous messages across the network	E	E		E	E	E	E							
					LO2	Design, develop and test a program that uses SAX or DOM to parse an XML document, XSL and XSLT to transform a data stream from one format to another														
					LO3	Write, debug and test a script using an operating scripting language to facilitate the management of an operating system														
IPT102	IPT	Integrative Programming and Technologies 2	IPT101	3	LO1	Compare and contrast the different encrypting and decrypting techniques that ensures security of data	E	E				E	E							
					LO2	Recommend where an application language and a scripting language would be more appropriate and give a valid reason to support the selection														

SIA101	SIA	Systems Integration and Architecture 1	IPT101	3	LO1	Analyze the appropriateness of a decision to in-source or out-source IT services in a given situation	E	E	E	E		E	E	E	E		E	E				
					LO2	Create a testing environment and design a stress test using appropriate tools and techniques that impact system performance																
					LO3	Implement an enterprise integration middleware platform.																
SIA102	SIA	Systems Integration and Architecture 2	SIA101	3	LO1	Summarize and analyze the data from a usability test and recommend appropriate actions.	E	E	E	E		E	E	E	E		E	E				
					LO2	Construct an architectural model of a complex system using an architectural framework																
					LO3	Develop a component and demonstrate its integration into an existing environment																
SP101	SP	Social and Professional Issues	At least Junior Standing	3	LO1	Argue the pros and cons of the design and implemention of computing solutions in various organizations								E	E	E	E	E	E			
SP102	SP	Social and Professional Issues 2	SP101	3	LO1	Analyze ethical and legal issues that arise in information technology field to determine how to address them technically and ethically			E					E	E	E	E	E	E			
IAS101	IAS	Information Assurance and Security 1	SIA101	3	LO1	Examine the relationship between threats, vulnerabilities, countermeasures, attackes, compromises and remediation throughout the entire system life cycle		E	E				E					E	E			
					LO2	Explain the key factors involved in authentication and how they are used to verify identity and grant access to the system																
					LO3	Describe the legal and ethical considerations related to the handling and management of enterprise information assets																

IAS102	IAS	Information Assurance and Security 2	IAS101	3	LO1	Discuss policies and practices to systems integration and architecture to ensure secure system operation and information assurance.		E	E			E	E				E	E		
					LO2	Perform a vulnerability analysis of a system and explain how design, implementation, and installation of hardware and software contribute to vulnerabilities of the organization.														
					LO3	Propose strategies on how to counter attack threats														
WS101	WS	Web Systems and Technologies 1		3	LO1	Develop Web applications using HTML, XHTML XML client-side programming and other Web GUI technologies to create and validate documents, generate contents via programming and integrate digital libraries with other media contents	E	E	E	E	E		E						E	
					LO2	Set up a web server to support server-side processing in a secure fashion and identify common server-side configuration issues that affect securing.														
WS102	WS	Web Systems and Technologies 2	WS101	3	LO1	Deploy and serve media contents within web applications	E	E	E	E	E		E					E	E	
					LO2	Implement a website and integrate it with other IT Applications														
					LO3	Propose possible improvements in the implemented web application to enhance security / avoid vulnerabilities														
CAP101		Capstone Project and Research 1	IAS101 CC106	3	LO1	Formulate the project objectives, scope and limitations, and evaluation metric	D	D	D	D			D	D	D	D	D	D	D	
					LO2	Collect and compare literature related to the project														
					LO3	Propose an ethical and feasible IT solution to the identified problems in the project														
CAP102		Capstone Project and Research 2	CAP101	3	LO1	Implement the proposed IT Solution	D	D			D	D	D	D	D	D	D	D	D	
					LO2	Evaluate and interpret the performance results of the IT solution based on identified evaluation metrics														

					LO3	Recommend possible improvements in the IT Solution due to implementation issues															
SA101	SA	Systems Administration and Maintenance	IAS102	3	LO1	Justify how resources will be allocated for the various administrative domains				D		D	D				D	D		
					LO2	Formulate policies governing the use of IT Systems within the organization															
					LO3	Recommend measures on how to administer and maintain systems effectively															
					LO4	Modify configuration of an operating system to implement policy															
PRAC101		Practicum	IAS 101 CC 106	3	LO1	Analyze, design, implement, test, maintain, and/or document a software system as applied to a real-world problem as part of a team in an actual company environment thereby also developing personal and interpersonal working skills in the process	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D

Section 11 Sample Means of Curriculum Delivery

The graduate outcomes of the BSCS, BSIS and BSIT curricula are achieved through, but not limited to the following activities:

1. Lecture and Classroom Discussions
2. Programming Demonstrations
3. Guided Hands-on Programming Sessions
4. Guided Design and Development of Project Specifications
5. Independent Programming Assignments such as Machine Problems
6. Case Analysis and Case Studies
7. Capstone Projects for BSIS and BSIT, which involves Requirements Gathering, Design, and Implementation
8. Thesis for BSCS
9. Mentorship and Monitored Internships

Section 12 Sample Syllabi for Selected Core Courses

INTRODUCTION TO COMPUTING

Prerequisite : None
Type of Course : Lecture
Units : 3

Course Description:

This course provides an overview of the Computing Industry and Computing profession, including Research and Applications in different fields; an Appreciation of Computing in different fields such as Biology, Sociology, Environment and Gaming; an Understanding of ACM Requirements; an Appreciation of the history of computing; and Knowledge of the Key Components of Computer Systems (Organization and Architecture), Malware, Computer Security, Internet and Internet protocols, HTML4/5 and CSS.

Learning Outcomes:

By the end of the course, students should be able to:

LO1. Explain fundamental principles, concepts and evolution of computing systems as they relate to different fields
LO2. Expound on the recent developments in the different computing knowledge areas
LO3. Analyze solutions employed by organizations to address different computing issues

Each of these LOs addresses the Degree Graduate Outcomes as follows:

- articulate and discuss the latest developments in the specific field of practice. (Philippine Qualifications Framework (PQF) level 6 descriptor) (Graduate Outcomes: CS10, IS10, IT13)
- effectively communicate orally and in writing using both English and Filipino (Graduate Outcomes: CS08, IS08, IT10)
- act in recognition of professional, social, and ethical responsibility (Graduate Outcomes:CS09, IS09, IT12)
- apply computing and other knowledge domains to address real-world problems (Graduate Outcomes: CS01, IS01, IT01)
- utilize modern computing tools (Graduate Outcomes: CS06, IS06, IT07)

Major Course Outputs:

As evidence of attaining the above learning outcomes, students are required to do and submit the following during the indicated dates of the term. The rubrics for these outputs are provided.

Learning Outcome	Required Output	Due Date
LO1/ LO2	MCO1: A case report on Information Technology best practices in various applications in IT industry.	
LO3	MCO2: Evaluation report on IT solutions employed by an organization covering various IT issues.	

Other Requirements and Assessments:

Aside from the major course outputs above, this course has one other summative assessment: a cumulative final exam. In addition, there are formative assessments of two types: departmental exams and graded class activities. Graded class activities include (but not limited to) recitation, seatwork, assignments and reports.

Grading System:

To pass this course, one must accumulate at least 60 points through the course requirements discussed above. The maximum points that a student can obtain through each requirement are shown below.

Requirement/Assessment Task	Maximum Points
2 Major Exams	20
Final Exam	15
Case Studies and Reports	50
Class participation, Seatwork	15
TOTAL	100

Learning Plan:

<table>
<tr><th>LO</th><th>Topics
and Readings</th><th>Class schedule
[Weeks]</th><th>Learning Activities</th></tr>
<tr><td rowspan="3">LO1</td><td>Industry in the Profession</td><td rowspan="3">Weeks 1 – 3</td><td rowspan="3">• Discussion should include (but not limited to) the following:
o professions and careers in the Computing field
o Computing domains
o Computing disciplines
o Computing Knowledge Areas
• Case Studies
• Reading Assignments</td></tr>
<tr><td>Appreciation of Computing in Different Fields</td></tr>
<tr><td>Different Specializations</td></tr>
<tr><td rowspan="7">LO2</td><td>Evolution of Computing</td><td>Week 4</td><td rowspan="7">Case Studies
Demonstration
Reading Assignments</td></tr>
<tr><td>Key Components of a Computer System, Operating Systems</td><td>Week 5-6</td></tr>
<tr><td colspan="2">• Exam 1
Information Technology concepts covering IT Professions and Careers, IT Domains and IT Disciplines, History of Computing, Computer System and Operating Systems</td></tr>
<tr><td>Malware</td><td>Week 7</td></tr>
<tr><td>Computer Security</td><td>Week 8</td></tr>
<tr><td>Networks, Internet and Internet Protocols</td><td>Weeks 9-10</td></tr>
<tr><td colspan="2">• Exam 2
Information Technology concepts covering Malware, Computer Security, Networks, Internet and Internet Protocols</td></tr>
</table>

LO	Topics and Readings	Class schedule [Weeks]	Learning Activities
	HTML and CSS	Weeks 11-12	
	Computer Systems (Organization and Architecture	Weeks 13-14	
	Final Exam		

Text / Materials :

References :

Cashman, S. & Vermaat, M.E. (2014). *Discovering Computers.* Cengage Learning

Note: Include books published in the last 3 years.

APPLICATIONS DEVELOPMENT AND EMERGING TECHNOLOGIES

Course Name : [CC106] Applications Development and Emerging Technologies
Course Credits : 3 units (2 units lecture, 1 unit laboratory)
Contact Hours : 5 hours / week (2 hours lecture, 3 hours laboratory)
Pre-Requisite : Computer Programming 2

Description : Development of applications using web, mobile, and emerging technologies with emphasis on requirements management, interface design, usability, testing, deployment, including ethical and legal considerations.

Learning Outcomes:

By the end of the course, students should be able to:

LO1. Develop specifications for a software development effort that precisely articulates the functional requirements, expected execution paths, and the explicit use of cutting edge or emerging technologies, which includes hardware devices and software library APIs.

LO2. Select and use a defined coding, documentation writing, and licensing standards in a sufficiently complex software project where coding idioms and mechanisms for implementing designs to achieve desired properties such as reliability, efficiency, and robustness are practiced with respect to legal and ethical considerations.

LO3. Undertake, as part of a team activity, an inspection of the source code and unit testing of the functional units of a sufficiently complex software project.

Course Outline:

1. Overview of software and hardware technologies
2. Requirements Analysis and Modeling
3. Design Principles and Patterns
4. Prototyping and Quality Assurance
5. Software Testing and Deployment
6. Ethical and Legal Considerations

Major Course Outputs:

As evidence of attaining the above learning outcomes, students are required to do and submit the following during the indicated dates of the term. The rubrics for these outputs are provided.

Learning Outcome	Required Output	Due Date
LO1	MCO1: A detailed specifications of a sufficiently complex software system that explicitly use cutting edge or emerging technologies. MCO2: A rigorous set of test data and sequence of input operations, expected results or program behavior, and the actual results or program behavior designed to comprehensively test the functional and operational aspects of the software project.	
LO2	MCO3: A documented evaluation and feedback on the software source code.	
LO3	MCO4: A documented evaluation of the software project with respect to software documentation, regression tests, and actual user feedback.	

Other Requirements and Assessments:

Presentations of the outputs are also required.

Grading System:

To pass this course, one must accumulate at least ___ points through the course requirements discussed above. The maximum points that a student can obtain through each requirement are shown below.

Requirement/Assessment Task	Maximum Points
Software Requirements, Design, and Execution Plan Software Implementation, Test, and Soft Deployment Class Presentations	
TOTAL	100

Learning Plan:

Note: The HEI may choose the cutting edge or emerging technology to use.

Rubrics:

Criteria	Exemplary 4	Acceptable 3	Developing 2	Beginning 1	No Output 0
Program Correctness	The application meets all the requirements specified in the project specification. The code is syntactically and logically correct for all cases. Implementation of the program follows the indicated guidelines and does not violate indicated restrictions. The implementation also exhibits appropriate use of programming constructs.	The code works for typical input, but fails for minor special cases; the major requirements are met, though some minor ones are not. Some Implementation of the program violates indicated restrictions.	The code sometimes fails or typical input. Many parts of the program Implementation violate indicated restrictions and some parts of the solution are not implemented using appropriate programming constructs.	The code often fails, even for typical input. Most indicated restrictions were violated.	Program that does not run and /or implemented incorrectly (based on specifications and restrictions) automatically gets 0 for this course output.
Effective Communication / Concept Understanding	Answers to questions are correct, reasonable, and reflective of the code. The justifications provided are sound.	Answers to questions are correct, but some justifications provided are weak.	Answers to questions are correct, but cannot justify solution (e.g., solution via trial and error, rather than proper understanding and application of concepts).	Correct understanding of the problem, but was unable to explain workings of code provided.	Failure to explain and justify workings of the code submitted will automatically merit 0 for this course output.
Readability	The program conforms to a coding standard that promotes code readability. Internal documentation is comprehensive.	Minor code formatting does not exhibit consistency in coding standard.	Not all functions / program features have proper internal documentation	Minimal internal documentation and code readability.	No internal documentation and code is not readable.

References :

1. Erich Gamma, Richard Helm, Ralph Johnson, and John Vlissides, Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley, 1994.
2. Stephen G. Kochan, Programming in Objective-C 2.0, Addison-Wesley, 2009
3. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly Media, 2009.
4. Wei-Meng Lee, Beginning Android Tablet Application Development, Wrox, 2011.
5. Stephen Fishman JD, Legal Guide to Web and Software Development, Nolo, 2007.

Note: Include books published in the last 3 years.

Section 12 Sample Performance Indicators (rubrics-1 subject only)

Criteria	Exemplary 4	Acceptable 3	Developing 2	Beginning 1
Knowledge	Descriptions of scientific terms, facts, concepts, principles, theories and methods are complete and correct	Descriptions of scientific terms, facts, concepts, principles, theories and methods are mostly complete and correct	Descriptions of scientific terms, facts, concepts, principles, theories and methods are somewhat complete and correct.	Descriptions of scientific terms, facts, concepts, principles, theories and methods are minimally present or correct
Application	Applications are thorough, appropriate, and accurate.	Applications are mostly thorough, appropriate, and accurate.	Applications are somewhat, appropriate, and accurate.	Applications are minimally appropriate and accurate.
Communication	Some of the written, oral and/or visual communication is organized and effective	Some of the written, oral and/or visual communication is organized and effective	Some of the written, oral and/or visual communication is organized and effective.	Little of the written, oral and/or visual communication is organized and effective.

Source: http://www.isbe.net/ils/science/pdf/rubric.pdf

ARTICLE VI
REQUIRED RESOURCES

Section 13 Administration

13.1 Composition - A well-organized and competent staff and faculty shall administer the implementation of these programs and should meet the requirements set by the Commission.

13.2 A Higher Education Institution (HEI) offering any of these programs shall have a full time academic administrator for each program. This administrator can be a Dean, Department Head, Director, Coordinator or equivalent depending on the organizational structure of the HEI.

13.3 General Qualifications of the Program Administrator - The Administrator of these programs must possess any one of the following:

A. Bachelor of Science in Computer Science Program

a. Doctorate degree in Computer Science.

b. Master's degree in Computer Science, plus:

- at least three (3) years of CS work, CS consultancy, CS research experience, or tertiary level CS teaching experience, within the last five (5) years

c. At least a master's degree in a CS allied program plus:

- completion of Bachelor's degree in Computer Science; or
- completion of all coursework requirements for a master's degree in CS;

and

- at least three (3) years of CS work, CS consultancy, CS research experience, or tertiary level CS teaching experience, within the last five (5) years.

d. A doctorate degree in a CS allied program plus:

- at least ten (10) years of CS work, CS consultancy, CS research experience, or tertiary level CS teaching experience, within the last twelve (12) years.

B. Bachelor of Science in Information Systems and Bachelor of Science in Information Technology Programs

a. Doctorate degree in CS, IS, or IT.

b. Master's degree in CS, IS, or IT plus:

- at least three (3) years of computing work, computing consultancy, computing research experience, or tertiary level teaching experience in computing within the last five (5) years.

c. At least a master's degree in IS/IT allied programs, Engineering, or Mathematics plus:

- completion of Bachelor's degree in CS, IS, or IT; or
- coursework requirements for a master's degree in CS, IS, or IT;

and

- at least three (3) years of computing work, computing consultancy. computing research experience, or tertiary level teaching experience in computing within the last five (5) years.

d. A doctorate degree in IS/IT allied programs, Engineering, or Mathematics plus:

- at least ten (10) years of computing work, computing consultancy, computing research experience or tertiary level teaching experience in computing, within the last twelve (12) years;

13.4 General Functions and Responsibilities of the Program Administrator - The general functions and/or responsibilities of the Program Administrator should be as follow, thus:

13.4.1 To lead in strategic planning and management, including the formulation and implementation of the faculty development program;

13.4.2 To assist in the formulation of institutional policies;

13.4.3 To exercise overall supervision of all academic and non-academic personnel of the college or department;

13.4.4 To coordinate with the office concerned with student services;

13.4.5 To lead research and extension activities among faculty and students, including technology innovation and commercialization activities;

13.4.6 To oversee the formation, implementation and evaluation of plans and programs for development and the supervision/coordination of activities and services for the advancement of goals and objectives of the program;

13.4.7 To help enforce the concerned HEI's rules and the laws affecting education, and the procedures, policies, rules and regulations promulgated under authority of or as adopted by the Commission and/or the HEI;

13.4.8 To exercise educational leadership and accountability over the following:

13.4.8.1 assignment of academic load to faculty members, including appointment of faculty advisers;

13.4.8.2 appointment, promotion, retirement, termination of and disciplinary actions against faculty members and non-teaching personnel, subject to the HEI's policies and procedures;

13.4.9 To undertake periodic curriculum review, revision, and development with the assistance of the faculty members in the degree program concerned; and

13.4.10 To prepare course offerings, institute methodologies of instruction, adopt and recommend appropriate instructional and reference materials, and recommend books to add to the collection of the library.

13.4.11 To initiate and monitor development of academic and industrial linkages, extension and outreach programs, and career and internship placement programs;

13.4.12 To ensure the attainment of graduate outcomes through monitoring of graduates, and regular consultation with alumni and industry partners. This may be done through the creation of an industry advisory board.

Section 14 Faculty

14.1 Faculty Composition

14.1.1 There should be at least three (3) full time faculty members per program, one of whom could be the dean/program head/coordinator.

14.1.2 At least forty percent (40%) of CS, IS, and IT core and professional courses should be taught by full-time CS, IS, and IT faculty members. There shall be a career development and tenure track for full time faculty members.

14.1.3 For the Computer Science Program, at least sixty percent (60%) of CS professional courses should be taught by CS degree holders. At least thirty percent (30%) of all full-time CS faculty members should have a graduate degree in Computer Science.

14.1.4 For the Information Systems and Information Technology Programs, at least sixty percent (60%) of IS and IT professional courses should be taught by degree holders in either IS or IT program. At least thirty percent (30%) of all full-time IS and IT faculty members should have a graduate degree in either CS, IS or IT.

14.1.5 There shall be faculty members with industry experience within the last two (2) years. These may be full-time or part-time faculty members.

14.1.6 HEIs offering CS, IS or IT programs are strongly encouraged to have faculty members with doctorate degrees in CS, IS, IT or allied fields.

14.1.7 HEIs offering CS, IS or IT programs are strongly encouraged to have faculty members who actively do research and development work in CS, IS or IT, and who publish regularly in refereed journals and proceedings. Likewise, the faculty members are also encouraged to

join and actively participate in computing related professional organization(s).

14.2 Qualifications of Faculty

A. Bachelor of Science in Computer Science

A CS faculty should possess at least one (1) of the following qualifications:

14.2.1 At least a baccalaureate degree in CS, IS, or IT.

14.2.2 At least a baccalaureate degree in any allied program or at least a master's degree in a Science, Technology, Engineering, and Mathematics (STEM) field plus any of the following:

14.2.2.1 Completion of coursework requirements for a master's or doctorate degree in a CS program; or

14.2.2.2 At least three (3) years experience in the IT profession such as technical administration, systems design, applications programming or equivalent or computing research within the last 5 years.

14.2.3 At least a baccalaureate degree with an international IT certification to teach professional courses specific to that certification.

B. Bachelor of Science in Information Systems and Bachelor of Science in Information Technology

An IS or IT faculty should possess at least one (1) of the following qualifications:

14.2.1 At least a baccalaureate degree in CS, IS, or IT.

14.2.2 At least a baccalaureate degree in any allied program or at least a master's degree in a STEM field plus any of the following:

14.2.2.1 Completion of coursework requirements for a master's or doctorate degree in a CS, IS, or IT program.

14.2.2.2 At least three (3) years computing work or consultancy or computing research experience or tertiary level teaching experience in computing, within the last five (5) years

14.2.3 At least a master's degree in Accountancy, Business, and Management (ABM) program with adequate exposure to

computing through coursework or thesis/projects plus at least one of the following:

a. completion of coursework requirements for a master's degree in any computing program; or

b. at least three (3) years of computing work or consultancy or computing research experience or tertiary level teaching experience in computing, within the last five (5) years;

14.2.4 At least a baccalaureate degree with an international IT certification to teach professional courses specific to that certification.

14.2.5 Faculty members deemed to be qualified in an appropriate business program may teach business domain courses in the IS program within their specialization.

14.3 Load

14.3.1 Assignment - The regular load of a CS, IS, and IT faculty member is at most twenty-four (24) units or thirty (30) contact hours per week whichever is lesser, inclusive of lecture and laboratory. Overload should not exceed six (6) hours per week. There should not be more than four (4) preparations per term.

14.3.2 Teaching Load - As a general rule, in case the Dean has to teach, his or her teaching load should not exceed nine (9) contact hours per week. This load takes into consideration the functions of the Dean. For the department chair, his/her teaching load should not exceed twelve (12) contact hours.

14.3.3 Consultation Hours - Each full time faculty member shall render at least four (4) hours per week for student consultation. This should be outside of the regular contact hours.

14.4 Employment Status – A full-time faculty member should render at least twenty-four (24) hours in residence per week as certified by the HEI, have a minimum contract of one (1) year in the college/department and must not be employed full time elsewhere.

14.5 Faculty Support

14.5.1 Faculty Development Program - The college/department should have a written comprehensive faculty development program. There shall be a specific budget allocation to implement such program. HEIs are enjoined to send full-time faculty members to participate in various activities of computing professional organizations. There shall also be clear guidelines on ranking and promotion of faculty members up to professor level.

14.5.2 Facilities - The HEI should provide office space, computers with Internet connections and printers for faculty and administrators. There should be one (1) computer for every three (3) full-time equivalent faculty members

and one (1) for every administrator. Consultation areas for student and faculty are also required.

Section 15 Library

15.1 Librarian(s) - HEIs offering the CS, IS, and IT programs should have at least one (1) full-time licensed librarian with at least one (1) year appointment. The librarian(s) shall participate in faculty meetings and activities and serve as (a) member(s) of the educational program planning committee. The librarian(s) should work closely with the Dean or Department Chair in collection development for the CS, IS, and IT programs.

The librarian(s) should be encouraged to join recognized librarian societies and associations for professional development.

There should be at least one (1) librarian/staff for every five hundred (500) students or fraction thereof.

15.2 Book Collection. - The library collection of the HEI should meet the following requirements, namely:

15.2.1 To support HEI's curricular needs and to provide enough books for students, its library should have at least five (5) titles per professional course, at least one (1) of which has been published within the last five (5) years. The total number of volumes per course should be such that, there should be one (1) volume for every ten (10) students enrolled (e.g. if there are 100 students enrolled in the course Introduction to Computing, then there should be 10 volumes of books on Introduction to Computing of which 5 titles should be distinct). Book holdings should preferably include more reference books and textbooks rather than vendor specific technology books. e-Books should also be counted to satisfy this requirement.

15.2.2 For initial offering, the minimum volumes of books covering first to third year courses are required to be found in the library. For program recognition, an HEI should have the required number of books in all four-year levels.

15.2.3 The library should include significant holdings of up-to-date computer magazines, journals and periodicals that are published locally and internationally. These include at least two (2) publications per program. The HEI should have current subscription to the journals and magazines. Paid online / digital subscriptions to at least twenty (20) journal titles are allowed as substitute for journals and magazines provided that they can be readily accessed and printed by faculty, students and staff.

15.2.4 The library must provide Internet terminals for access to electronic materials.

15.2.5 The library must provide access (with capability to read or print) to electronic library materials such as CD-ROMs and electronic subscriptions. These are considered as additional library holdings beyond the minimum requirements.

15.2.6 The library facilities may be augmented by providing Learning Commons.

15.3 Space Requirements. - The library should have a seating capacity of at least five percent (5%) of the total students enrolled and a minimum floor area of at least two (2) sqm per seat. This may include spaces provided as Learning Commons.

Section 16 Laboratory and Physical Facilities

16.1 **Classroom Requirements**. There should be at least one classroom per one hundred fifty (150) students enrolled. Preferably, there should be no more than 50 students in a class. In case of large classes with more than 50 students, preferably, there should be separate discussion classes with at most 50 students each.

16.2 **Laboratory Requirements**. The number of terminals dedicated for computing students should be at least 1/5 of the total number of computing students. This is to allow each student to have enough individual hands-on computer time per week. The computer-to-student ratio in a laboratory class should be 1:1.

In addition to teaching facilities, the HEI must provide internet access for the students and faculty members. All computer laboratories must have Internet Access. The minimum dedicated bandwidth must be at least 4Mbps. There should be at least 4Mbps per 500 students. Students must also have access to wifi and to a learning management system.

The required computer hardware and software should be able to respond to the objectives of the courses in the curriculum. They should conform to generally accepted industry standards and be capable of providing training in multiple platforms. There should also be equipment for courses that require specific hardware such as routers and switches. Only licensed software, including free and open source software, may be installed.

16.3 **Audio Visual Facilities.** Every laboratory must be equipped with projection equipment or large display to demonstrate digital content. In addition, projectors must also be available for use in lecture rooms. Large lecture halls must be equipped with sound systems.

ARTICLE VII
COMPLIANCE OF HEIs

Using the **CHED Implementation Handbook for OBE and ISA** as reference, a HEI shall develop the following items which will be submitted to CHED when they apply for a permit for a new program or the approval of the transformation of existing programs to outcomes-based framework:

Section 17 The complete set of program outcomes, including its proposed additional program outcomes.

Section 18 Its proposed **curriculum** and its justification including a curriculum map.

Section 19 Proposed **performance indicators** for each outcome. Proposed measurement system for the level of attainment of each indicator.

Section 20 Proposed **outcomes-based syllabus** for each course.

Section 21 Proposed system of program assessment and evaluation

Section 22 Proposed system of program **Continuous Quality Improvement (CQI).**

ARTICLE VIII
PROVISIONS FOR K-12 IMPLEMENTATION

Section 23 Revised General Education (GE)

When the new GE curriculum will take effect in AY 2018-2019, as provided in CMO 20, s. 2013 entitled "General Education Curriculum: Holistic Understandings, Intellectual and Civic Competencies", the 54 units GE requirements will be reduced to a minimum of 36 units.

The balance of 18 units may be replaced by professional/ domain courses in each of the three (3) programs (CS, IS and IT) as long as the minimum total number of units is satisfied as articulated in Section 8.1.

ARTICLE IX
TRANSITORY, REPEALING AND EFFECTIVITY CLAUSE

Section 24 Transitory Provision

HEIs that have been granted permit or recognition are hereby given one (1) year from the date of effectivity hereof to fully comply with all the requirements as stipulated in this CMO, including both the changes to the new curriculum and transformation to OBE. Compliance to these requirements shall also be required to State Universities and Colleges (SUCs) and Local Colleges and Universities (LCUs).

Section 25 Repealing Clause

All pertinent rules and regulations or parts thereof that are inconsistent with the provisions of these policies, standards, and guidelines are hereby repealed or modified accordingly.

Section 26 Effectivity Clause

This CMO shall be effective beginning SY 2016-2017 after publication in the Official Gazette or in a newspaper of general circulation.

Quezon City, Philippines, August 3, 2015

FOR THE COMMISSION:

PATRICIA B. LICUANAN, Ph.D.
Chairperson

ANNEX A

GUIDELINES

UNDERGRADUATETHESIS / CAPSTONE PROJECTS FOR COMPUTING PROGRAMS

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ARTICLE I
INTRODUCTION

Section 1 Rationale and Background

The Commission on Higher Education has approved programs for Computer Science, Information Technology and Information Systems. These shall henceforth be referred to as Computing Programs. This shall also include any programs that may be endorsed by the Technical Panel for Information Technology Education (TPITE), and subsequently approved by CHED.

The Thesis / Capstone Project are required for candidates for graduation in all Computing Programs. Both the thesis and capstone projects are terminal project requirements that would not only demonstrate a student's comprehensive knowledge of the area of study and research methods used but also allow them to apply the concepts and methods to a specific problem in their area of specialization.

BS Computer Science students are required to complete a thesis that is focused on the theories and concepts of computing in the form of a scientific work.

BS Information Systems students must complete a project in the form of a business application development, or an Information Systems plan.

BS Information Technology students must complete a capstone project in the form of an IT application, a Multimedia Systems development, or an IT Management project.

It is expressly understood that Computing Thesis and Capstone projects need not require surveys, statistics, and descriptive methods, unless appropriate.

HEIs are required to include thesis and capstone projects in their curricula. The Policies and Standards for Undergraduate Thesis intends to serve as a guide for administrators, faculty and students

alike in determining what are allowable standards or capstone projects in the context of undergraduate studies in Computing.

ARTICLE II
THESIS / CAPSTONE PROJECTS SPECIFICATIONS

Section 2 Definitions

2.1 A **Thesis** is a technical report on a systematic investigation of a problem that can be solved using Computing. It may include a solution, an approximate or partial solution, a scientific investigation, or the development of results leading to the solution of the problem.

2.1.1 A Computer Science thesis must be anchored on Computer Science principles.

2.2 A **Capstone Project** is an undertaking appropriate to a professional field. It should significantly address an existing problem or need.

2.2.1 An Information Technology Capstone Project focuses on the infrastructure, application, or processes involved in introducing a Computing solution to a problem.

2.2.2 An Information Systems Capstone Project focuses on business processes and the implications of introducing a Computing solution to a problem.

Section 3 Scope of the Theses / Capstone Projects

The Thesis or Capstone Project should integrate the different courses, knowledge, and competencies learned in the curriculum. Students are encouraged to produce innovative results, generate new knowledge or theories, or explore new frontiers of knowledge or application areas.

For Computer Science, theses involving the development of the software systems should involve algorithm-based research and development founded on Computer Science principles. This should be reflected in the final report.

For Information Technology Capstone Projects, recommended infrastructure and its implications on other systems should be clearly specified in the final report with the introduction of the project.

For Information Systems Capstone Projects, changes in process and information flow and/or information policies with the introduction of the system should be clearly specified in the final report.

The thesis/capstone project adviser should determine the appropriate complexity level of the specific problem being addressed and the proposed solution, considering the duration of the project, the composition of the team, and the resources available.

Section 4 Suggested Areas for Theses / Capstone Projects

Following is a list of some suggested areas per program. The specific areas identified for each degree program may also be considered for the other computing degree programs, depending on the scope, limitations, and approach and following the principles stated in preceding sections.

4.1 Computer Science

4.1.1 Current Computer Science Topics

- Software Development and Theory
- Mobile Computing Systems
- Software Extensions or Plug-ins
- Expert Systems and Decision Support Systems
- Systems Software (software tools/utilities, interpreters, simulators, compilers, security aspects)
- Intelligent Systems
- Game Development
- Computer Vision
- Image / Signal Processing
- Natural Language Processing
- Pattern Recognition and Data Mining
- Bioinformatics
- Graphics Applications
- Cloud Computing
- Parallel Computing
- Embedded Systems
- Emerging Technologies

4.1.2 Foundations of Computer Science

- Automata and Formal Languages
- Data Structures and Algorithm Design and Analysis
- Web Semantics
- Coding Theory
- Programming Languages
- Visualization Systems
- Computer and Architecture
- Modeling and Simulation

4.1.3 Human-Computer Interaction

- Usability
- Affective Computing
- Emphatic Computing

4.2 Information Systems

4.3.1. Software Development

- Software Customization
- Information Systems development for actual client
- Web Applications Development
- Mobile Computing Systems

4.3.2. IS Planning

- Enterprise Resource Plan
- Information Systems Strategic Plan

4.3.3. Analysis and Design of a sufficiently complex business system

4.3 Information Technology

4.2.1 Software Development

- Software Customization
- Information Systems Development for an actual client (with pilot testing)
- Web Applications Development (with at least alpha testing on live servers)
- Mobile Computing Systems

4.2.2 Multimedia Systems

- Game Development
- e-Learning Systems
- Interactive Systems
- Information Kiosks

4.2.3. Network Design and Implementation and Server Farm Configuration and Management

4.2.4. IT Management

- IT Strategic Plan for sufficiently complex enterprises
- IT Security Analysis, Planning and Implementation

Section 5 Thesis / Project Duration

Students should be given ample time to finish their project. Two (2) to three (3) terms or semesters should be prescribed in the curriculum for BS Computer Science students to complete their theses and one (1) to three (3) terms or semesters for BS Information Technology and BS in Information Systems students to complete their Capstone Projects.

The maximum number of units that may be required for Thesis or Capstone Projects is nine (9) units.

Grading systems and possible honoraria rates for thesis/capstone project are left to the discretion of the HEI, provided that such policies are not grossly disadvantageous to the students, and provided further that such policies are documented and approved by the proper HEI authorities.

Section 6 Composition of Thesis / Project Groups

Students should preferably work in teams of two (2) to four (4) members depending on the complexity of the project. The adviser should be able to determine whether the team can complete the project on time.

Multidisciplinary teams are also encouraged, provided that team members prepare separate documentations per program.

Section 7 Adviser / Panel Composition

7.1 Panel Composition

The project is prepared under the guidance of an adviser and presented and accepted by a Panel composed of at least 3 members that includes the adviser.

7.2 Adviser / Panel Qualifications

The adviser must have completed a computing project successfully beyond the bachelor's degree project. As much as possible, the adviser should be a full-time faculty member of the HEI. Otherwise a full-time faculty co-adviser is required.

Advisers and Panel Members should have a degree in a Computing or allied programs, or must be domain experts in the area of study. At least one of the panel members must have a master's degree in Computing (preferably in the same field as

the thesis or project) or allied program. For IT and IS, at least one of the panel members should preferably have industry experience.

The adviser must be able to guide the students throughout the whole project life cycle, including the thesis/capstone project defense and possible project deployment.

Faculty advisers should preferably handle at most five projects at one time, and in no case should exceed ten (10) projects. Panel members should preferably be limited to at most ten (10) projects and in no case should this exceed twenty projects in one semester, counting all projects in all HEIs.

In case of the participation of an external client, then the organization for which the project is intended should be represented as much as possible.

Section 8 Presentation of the Thesis or capstone Projects

Thesis and Capstone project must be presented in a public forum. This forum may be an international, national, regional, or school-based conference, meeting, or seminar that is announced and open to interested parties. This may be separate from the presentation before the Panel mentioned in Section 6. A school-based colloquium organized for this purpose would suffice to satisfy this requirement. Presentation in a public forum, such as the National Conference on IT Education (NCITE) of PSITE, is encouraged.

ARTICLE III
THE THESIS / PROJECT FORMAT

Section 9 Suggested Documentation Template / Format

Upon completion of the Thesis or Capstone Project, the students shall be required to submit copies of documentation of their work by team. This may be in the form of a research report in journal article format such as ACM or IEEE Format, a bound technical report, or comprehensive electronic documentation. The format is left to the discretion of the HEI.

9.1. Computer Science Thesis

9.1.1. Sample Outline for Thesis involving Foundations of Computer Science

Title Page
Abstract

Table of Contents
List of Figures, List of Tables, List of Notations
Introduction
- Background of the problem
- Statement of the problem
- Objectives
- Significance

Scope and Limitations
Related Literature
Theoretical Background
- include comprehensive discussion on theorems, definitions, fundamental algorithms , mathematical models/formula

Proposed Solution to the Problem
Results and Discussion, includes theoretical proof, verification, or evidence
Conclusions and Recommendations

Appendices may include the following
- Relevant Source Code, where applicable
- Source Data, where applicable
- One-page Curriculum Vitae per team member

9.1.2. Sample Outline for Thesis involving Software Development

Title Page
Abstract or Executive Summary
Table of Contents
List of Figures, List of Tables, List of Notations
Introduction
- Project Context
- Purpose and Description
- Objectives
- Scope and limitations

Related Literature
Technical Background
- Include in-depth discussion on relevant technical aspects of the project

Design and Methodology
- Include discussion on conceptual design / system architecture/ block diagrams and algorithms

Results and Discussion
Conclusions and Recommendations

Appendices may include the following
- Relevant Source Code
- Evaluation Tool or Test Documents
- Sample input/output/Reports

- Users Guide
- One-Page Curriculum Vitae per team member

9.1.3. ACM Journal Article Format

9.2. Information Technology and Information Systems Capstone Projects

9.2.1 Sample Outline for IS Plans

The IS Plan may follow any of the established frameworks, such as that of the National Computer Center.

9.2.2 Sample Outline for Capstone Projects

Title Page
Executive Summary
Table of Contents
List of Figures, List of Tables, List of Notations
Introduction
- Project Context
- Purpose and Description
- Objectives
- Scope and limitations

Review of Related Literature/Systems
Technical Background
Methodology, Results and Discussion
- Requirements Analysis
- Requirements Documentation
- Design of Software, Systems, Product, and/or Processes
- Development and Testing, where applicable
- Description of the Prototype, where applicable
- Implementation Plan (Infrastructure/Deployment) where needed
- Implementation Results, where applicable

Recommendations

Appendices may include the following
- Relevant Source Code
- Evaluation Tool or Test Documents
- Sample input/output/Reports
- Users Guide
- Process/Data/Information Flow
- Screen layouts
- Test Results
- Sample Generated Outputs
- Pictures showcasing the data gathering, investigation done (e.g. floor plan, layout, building, etc.)
- One-Page Curriculum Vitae per team member

ARTICLE IV
INTELLECTUAL PROPERTY RIGHTS

Section 10 Intellectual Property (IP) Rights

All Thesis and Projects must not infringe on existing IP. All prior works, including open source, open content, and creative commons content, shall be properly cited.

Copyright and other Intellectual Property Rights arising from the Thesis or Capstone Project shall be bound by the IP Policies of the HEI, provided that any such policies shall not be grossly disadvantageous to the creators of IP.