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

CHED MEMORANDUM ORDER
No. 13
Series of 2008

SUBJECT : POLICIES AND STANDARDS (PS) FOR THE DEGREE OF BACHELOR OF SCIENCE IN COMPUTER ENGINEERING (BSCpE)

In accordance with the pertinent provisions of Republic Act (RA) No. 7722, otherwise known as the "Higher Education Act of 1994," and by virtue of Resolution No. 143-2008 of the Commission *EN BANC* dated March 24, 2008 and for the purpose of rationalizing the computer engineering education in the country, the following policies and standards shall hereby be adopted and promulgated by the Commission.

ARTICLE I -INTRODUCTION

Section 1. Rationale

Computer Engineering is a profession that applies engineering principles and methodologies in the analysis, design, implementation and management of hardware, software and the integration of both.

The herein Policies and Standards (PS) have been reviewed in accordance with recently approved CMO, industry needs, latest trends and technology in the field of computer engineering. This PS emerged as a result of consolidated effort of the academe, industry and other concerned agencies.

ARTICLE II -AUTHORITY TO OPERATE

Section 2. All private higher education institutions (PHEIs) intending to offer Bachelor of Science in Computer Engineering must first secure proper authority from the Commission in accordance with existing rules and regulations. State Universities and Colleges (SUCs), and Local Colleges and Universities (LCUs) should likewise strictly adhere to the provisions in this policies and standards.

ARTICLE III - PROGRAM SPECIFICATION

Section 3. Degree Name

The degree program herein shall be called **BACHELOR OF SCIENCE IN COMPUTER ENGINEERING (BSCpE).**

Section 4. Program Description

4.1 Objectives

4.1.1 General Objectives

To prepare the students for professional engineering career who will effectively and efficiently meet the scientific, technological and various needs of business, industries and communities in the

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global economy. Aside from their professional knowledge and skills, the graduates must also possess strong foundation in the physical and basic engineering sciences as well as in human relations to enable them to meet the challenges being brought about by the rapid technological developments.

4.1.2 Specific objectives

The Graduates of the BSCpE program must be:

4.1.2.1 prepared to undertake research and development.
4.1.2.2 able to conduct systems analysis, perform system design and development and implement project management
4.1.2.3 able to provide appropriate technical support
4.1.2.4 able to conduct personnel development
4.1.2.5 able to engage in continuing professional development
4.1.2.6 able to engage in technopreneurship and practice professional ethics.

4.2 Program Outcomes

The BSCpE program must produce graduates possessing the following:

a. An ability to apply knowledge of mathematics, sciences, and engineering sciences to the practice of computer engineering.
b. An ability to design and conduct experiments as well as analyze and interpret data.
c. An ability to design a system to meet desired needs.
d. An ability to work effectively in multi-disciplinary and multi-cultural teams.
e. An ability to identify, formulate, and solve computer engineering problems.
f. An understanding of professional and ethical responsibility.
g. An ability to communicate effectively in verbal and non-verbal communication.
h. A broad education necessary to understand impact of engineering solutions in a global/societal context.
i. An ability to engage in life-long learning and to keep current of the development in a specific field of specialization.
j. Knowledge of contemporary issues.
k. An ability to use appropriate techniques, skills, and modern tools necessary for computer engineering practice to be locally and globally competitive.
l. An ability to apply acquired computer engineering knowledge and skills for national development.

4.3 Field of Specialization

The field of specialization includes the following but not limited to:

4.3.1 Microelectronics
4.3.2 Embedded Systems

4.3.3 Software Development
4.3.4 System and Network Administration

4.4 Specific Professions/ Careers/ Occupations or trades that the graduates may go into

4.4.1 Project engineer/ manager
4.4.2 Network systems administrator/manager
4.4.3 Data communications engineer
4.4.4 Systems engineer/developer/manager
4.4.5 Systems analyst/designer
4.4.6 Technical Support engineer/ manager
4.4.7 Quality Assurance engineer/ manager
4.4.8 Test Engineer
4.4.9 Technopreneur
4.4.10 Educator
4.4.11 Researcher

Section 5. Allied Programs

The BSCpE allied programs are the following:
5.1 Electronics and Communications Engineering / Electronics Engineering
5.2 Electrical Engineering
5.3 Computer Science
5.4 Information Technology
5.5 Information System / Information Management

These programs are those that may be considered as equivalent to the program for the purpose of determining qualifications of the faculty.

ARTICLE IV-COMPETENCY STANDARDS

Section 6. This section defines the entry-level competency standards, knowledge, attitudes, values and skills applicable to the BS Computer Engineering graduate, which are contained in **ANNEX I** of this Memorandum.

ARTICLE V- CURRICULUM

Section 7. Curriculum Description

7.1 The BS Computer Engineering program has a total of **210** credit units. The program comprised of the general education, technical courses, professional courses, allied courses, technical elective courses and on-the-job-training.
7.2 The general education - B courses are in accordance with the requirements of the CHED Memorandum Order No. 59, s. 1996- The New General Education Curriculum (GEC-B)
7.3 The technical courses comprised of the Mathematics with a total of **26** units, the Natural/Physical Sciences with a total of **12** units and the Basic Engineering Sciences with a total of **21** units.

7.4 There must be at least **23** professional courses with a total of **70** units and **3** technical elective courses with a total of **9** units.

7.5 There must be at least **5** allied courses with a total of **19** units.

Section 8. Curriculum Outline

Classification/ Field / Course	Minimum no. of hours / week		Minimum Credit Units
	Lecture	Lab	
I. TECHNICAL COURSES			
A. Mathematics			
College Algebra	3	0	3
Advanced Algebra	2	0	2
Plane and Spherical Trigonometry	3	0	3
Analytic Geometry	2	0	2
Solid Mensuration	2	0	2
Differential Calculus	4	0	4
Integral Calculus	4	0	4
Differential Equations	3	0	3
Probability and Statistics	3	0	3
Sub-Total	**26**	**0**	**26**
B. Natural/Physical Sciences			
General Chemistry	3	3	4
Physics 1	3	3	4
Physics 2	3	3	4
Sub-Total:	**9**	**9**	**12**
C. Basic Engineering Sciences			
Engineering Drawing	0	3	1
Computer Aided Drafting	0	3	1
Computer Fundamentals and Programming	0	6	2
Statics of Rigid Bodies	3	0	3
Dynamics of Rigid Bodies	2	0	2
Mechanics of Deformable Bodies	3	0	3
Engineering Economy	3	0	3
Engineering Management	3	0	3
Environmental Engineering	2	0	2
Safety Management	1	0	1
Sub-Total:	**17**	**12**	**21**
D. Allied Courses			
Circuits 1	3	3	4
Circuits 2	3	3	4
Electronics Devices and Circuits	3	3	4
Electronics Circuits Analysis and Design	3	3	4
Entrepreneurship	3	0	3
Sub-total	**15**	**12**	**19**

E. Professional Courses			
Advanced Engineering Mathematics for CpE	3	0	3
Discrete Math	3	0	3
Computer Engineering Drafting and Design	0	3	1
Control Systems	3	3	4
Computer System Architecture	3	3	4
Computer System Organization with Assembly Language	3	3	4
Principles of Communication	3	0	3
Data Communications	3	0	3
Computer Networks	3	3	4
Data Structures and Algorithms Analysis	3	3	4
Operating Systems	3	3	4
System Analysis Design	2	3	3
Engineering Ethics & Computer Laws	2	0	2
Computer Hardware Fundamentals	0	3	1
Advanced Logic Circuit	3	3	4
Logic Circuits Switching Theory	3	3	4
Digital Signal Processing	3	3	4
Object Oriented Programming	2	3	3
Microprocessor System	3	3	4
Design Project 1 (Methods of Research)	2	0	2
Design Project 2 (Project Implementation)	0	6	2
Software Engineering	3	0	3
Seminars and Field Trips	0	3	1
Sub-total	**53**	**51**	**70**
F. Technical Electives **(Please refer to Suggested Electives)**			
Elective 1			3
Elective 2			3
Elective 3			3
Sub-total			**9**
On-the-Job Training (OJT)		**240**	
II. NON - TECHNICAL COURSES			
A. Social Sciences			
Social Science 1	3	0	3
Social Science 2	3	0	3
Social Science 3	3	0	3
Social Science 4	3	0	3
Sub-Total:	**12**	**0**	**12**
B. Humanities			
Humanities 1	3	0	3
Humanities 2	3	0	3
Humanities 3	3	0	3
Sub-Total:	**9**	**0**	**9**
C. Languages			
English 1	3	0	3

English 2	3	0	3
English 3 (Technical Communication)	3	0	3
Filipino 1	3	0	3
Filipino 2	3	0	3
Sub-Total:	**15**	**0**	**15**
D. Mandated Course			
Life and Works of Rizal	3	0	3
Sub-Total:	**3**	**0**	**3**
E. Physical Education			
P.E. 1			2
P.E. 2			2
P.E. 3			2
P.E. 4			2
Sub-Total:			**8**
F. National Training Service Program			
NSTP 1			3
NSTP 2			3
Sub-Total:			**6**
GRAND TOTAL	**159**	**84**	**210**

Suggested Electives:

Track 1: Embedded Systems

Embedded Systems	3	0	3
Microelectronics	3	0	3
Instrumentation and Control	3	0	3

Track 2: Microelectronics

IC Fabrication	3	0	3
Microelectronics	3	0	3
Test and Quality Assurance	2	0	2

Track 3: Information Technology

Online Technology	2	3	3
Management and Information System	3	3	3
Emerging Technology	3	0	3

Track 4: Software Development

Database Management System	2	3	3
Management and Information System	3	0	3
Project Management	3	0	3

SUMMARY

Classification/ Field / Course	Total No. of Hours / week		Minimum Credit Units
	Lecture	Lab	
I. TECHNICAL COURSES			
A. Mathematics	26	0	26
B. Natural/Physical Sciences	9	9	12
C. Basic Engineering Sciences	17	12	21
D. Allied Courses	15	12	19
E. Professional Course	53	51	70
F. Technical Electives			9
Sub-Total	**120**	**84**	**157**
II. NON- TECHNICAL			
A. Social Sciences	12	0	12
B. Humanities	9	0	9
C. Languages	15	0	15
D. Life and Works of Rizal	3	0	3
Sub-Total	**39**	**0**	**39**
Total Technical & Non-Technical Courses	**159**	**84**	**196**
Physical Education			8
NSTP			6
GRAND TOTAL (Including P.E. and NSTP)	**159**	**84**	**210**

Section 9. Relationship of the Courses to the Program Outcomes

The relationships of the identified courses in section 8 to the identified program outcomes in section 4-4.2 are contained in **ANNEX II** of this Memorandum.

Section 10. Sample/ Model program of study

The institution may enrich the sample/model program of study depending on the needs of the industry, provided that all prescribed courses required in the curriculum outline are offered and pre-requisite and co-requisite are observed.

FIRST YEAR

1st Year – First Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
College Algebra	3	0	3	None
Plane and Spherical Trigonometry	3	0	3	None
General Chemistry	3	3	4	None
Engineering Drawing	0	3	1	None
English 1	3	0	3	None
Filipino 1	3	0	3	None
Humanities 1	3	0	3	None
Physical Education I			2	None
NTSP 1			3	None
TOTAL	**18**	**6**	**25**	

1st Year – Second Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Advanced Algebra	2	0	2	College Algebra
Analytic Geometry	2	0	2	College Algebra, Plane and Spherical Trigonometry
Solid Mensuration	2	0	2	Plane and Spherical Trigonometry, College Algebra
Computer Hardware Fundamentals	0	3	1	None
Physics 1	3	3	4	College Algebra, Plane and Spherical Trigonometry
English 2	3	0	3	English 1
Filipino 2	3	0	3	Filipino 1
Physical Education 2			2	PE 1
NTSP 2			3	NSTP 1
TOTAL	**15**	**6**	**22**	

SECOND YEAR

2nd Year – First Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Discrete Math	3	0	3	College Algebra
Differential Calculus	4	0	4	Advanced Algebra, Analytic Geometry, Solid Mensuration
Computer Fundamentals and Programming	0	6	2	2nd Year Standing
Physics 2	3	3	4	Physics 1
English 3 (Technical Communication)	3	0	3	English 2
Social Science 1	3	0	3	None
Physical Education 3			2	None
TOTAL	**16**	**9**	**21**	

2nd Year – Second Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Probability and Statistics	3	0	3	College Algebra
Data Structures and Algorithm Analysis	3	3	4	Computer Fundamentals and Programming
Integral Calculus	4	0	4	Differential Calculus
Humanities 2	3	0	3	Humanities 1
Physical Education 4			2	None
Social Science 2	3	0	3	None
TOTAL	**16**	**3**	**19**	

THIRD YEAR

3rd Year – First Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Computer Aided Drafting	0	3	1	3rd year standing
Engineering Economy	3	0	3	3rd year standing
Circuits 1	3	3	4	Physics 2, Integral Calculus
Electronics Devices and Circuits	3	3	4	Physics 2, Integral Calculus
Differential Equations	3	0	3	Integral Calculus
Computer System Organization with Assembly Language	3	3	4	Data Structures and Algorithms Analysis
Statics of Rigid Bodies	3	0	3	Physics 1, Integral Calculus
TOTAL	**18**	**12**	**22**	

3rd Year – Second Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Mechanics of Deformable Bodies	3	0	3	Statics of Rigid Bodies
Electronics Circuits Analysis and Design	3	3	4	Electronics Devices and Circuits
Logic Circuits Switching Theory	3	3	4	Electronics Devices and Circuits
Circuits 2	3	3	4	Circuits 1
Advance Engineering Mathematics for CpE	3	0	3	Differential Equations
Computer Engineering Drafting and Design	0	3	1	3rd Year Standing
Dynamics of Rigid Bodies	2	0	2	Statics of Rigid Bodies
TOTAL	**17**	**12**	**21**	

FOURTH YEAR

4th Year – First Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Engineering Management	3	0	3	3rd Year Standing
Environmental Engineering	2	0	2	General Chemistry
Safety Management	1	0	1	3rd year standing
Advanced Logic Circuit	3	3	4	Logic Circuits Switching Theory
Digital Signal Processing	3	3	4	Advanced Engineering Mathematics for CpE
Principles of Communication	3	0	3	Circuits 2, Electronics Circuits Analysis and Design
Control Systems	3	3	4	Circuits 2, Electronics Circuits Analysis and Design
TOTAL	**18**	**9**	**21**	

4th Year – Second Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Operating Systems	3	3	4	Computer System Organization with Assembly Language
Computer System Architecture	3	3	4	Computer System Organization with Assembly Language, Advanced Logic Circuit
Data Communications	3	0	3	Principles of Communication
Microprocessor System	3	3	4	Logic Circuits Switching Theory, Computer System Organization with Assembly Language
Social Science 3	3	0	3	None
Elective 1*			3	None
TOTAL	**15**	**9**	**21**	

FIFTH YEAR

5th Year – First Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Design Project 1 (Methods of Research)	2	0	2	Microprocessor System
Computer Networks	3	3	4	Data Communications
Object Oriented Programming	2	3	3	Data Structures and Algorithms Analysis
Engineering Ethics & Computer Laws	2	0	2	5th year standing
Software Engineering	3	0	3	Data Structures and Algorithms Analysis
Elective 2*			3	None
TOTAL	**12**	**6**	**17**	

5th Year – Second Semester

Courses	No. of Hours		Units	Prerequisites
	Lec	Lab		
Design Project 2 (Project Implementation)	0	6	2	Design Project 1
Entrepreneurship	3	0	3	5th year standing
System Analysis and Design	2	3	3	Data Structures and Algorithm Analysis, Object-Oriented Programming
Seminars and Field Trips	0	3	1	5th year standing
Life and Works of Rizal	3	0	3	None
Humanities 3	3	0	3	None
Social Science 4	3	0	3	None
Elective 3*			3	None
TOTAL	**14**	**12**	**21**	

OJT **240 hours** Please refer to guidelines stated in Section 12

* Please refer to the list of suggested electives

Section 11 **Thesis/ Research/ Project Requirements**

Suggested topics maybe any of the following:

11.1 Applications of the different fields of specialization as listed in section 4.3

11.2 Industry-based projects related to computer engineering fields

11.3 Socio-economic projects related to computer engineering fields

Section 12 **On-The-Job Training/ Practicum Requirements**

12.1 The computer engineering practice (OJT) comprised of 240 hours and shall be taken:

12.1.1 upon completion of at least 75% of the total required units of the program.

12.1.2 during summer provided no academic subjects enrolled.

12.1.3 during regular term provided that the maximum academic unit is 12.

12.2 There shall be a qualified practicum coordinator designated to facilitate the placement of the students.

12.3 The Department Chair / Head / Practicum coordinator shall monitor the OJT activities in conformity with the course objective.

ARTICLE VI -COURSE SPECIFICATIONS

Section 13 The course specifications for the BS Computer Engineering program are contained in **ANNEX III** of this Memorandum. **ANNEX IV** shall contain the summary of the laboratory requirements.

ARTICLE VII - GENERAL REQUIREMENTS

Section 14 The following general requirements for the BS Chemical Engineering program, contained in **CMO No. 25, s. 2005, otherwise known as "Revised Policies, Standards and Guidelines (PSG) for Engineering Education"**, shall be complied with:

1. Instructional Program Quality
2. Research
3. Community Involvement
4. Administration and Support

ARTICLE VIII - TRANSITORY PROVISION

Section 15 HEIs that have been granted permit or recognition for Bachelor of Science in Computer Engineering degree program are hereby given a non-extendable period of four (4) years from the date of effectivity thereof, within which to fully comply with. State Universities and Colleges (SUCs) and Local Colleges and Universities (LCUs) shall all comply with the requirements herein set forth.

Student currently enrolled in the Bachelor of Science in Computer Engineering program shall be allowed to graduate under the old curriculum. However, students enrolling for the abovementioned program beginning school year 2008-2009 shall be covered by this CMO.

ARTICLE IX - SANCTIONS

Section 16 For violations of this Order, the Commission may impose such administrative sanction as it may deem appropriate pursuant to the pertinent provisions of Republic Act No. 7722, in relation to Section 69 of BP 232 otherwise known as the Higher Education Act of 1982, and Sections 24 and 101 of the Manual of Regulations for Private Schools (MRPS), and other related laws.

ARTICLE X – SEPARABILITY AND REPEALING CLAUSE

Section 17 Any provision of this Order, which may hereafter be held invalid, shall not effect the remaining provisions.

Section 18 All issuances, including but not limited to CMO No. 49, s. 1997, **and CMO 34, s. 2001** and/ or any part thereof inconsistent herewith, are deemed repealed or modified accordingly.

ARTICLE XI- EFFECTIVITY CLAUSE

Section 19 This CMO shall take effect starting 1st semester of SY 2008-2009, after publication in an official gazette or in a newspaper of general circulation.

Section 20 An educational institution applying to offer the new BSCpE program shall likewise comply with all the provisions of this CMO.

Pasig City, Philippines _____

For the Commission:

ROMULO L. NERI
Chairman

CHED-EXECUTIVE OFFICE
THI
APR 15 2008
BY: DARLYN
TIME: 4:05 PM

BACHELOR OF SCIENCE IN COMPUTER ENGINEERING

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F. Technical Electives

II. NON- TECHNICAL COURSES

TECHNICAL PANEL FOR ENGINEERING, TECHNOLOGY AND ARCHITECTURE

PROFILE OF DUTIES AND COMPETENCIES OF A COMPUTER ENGINEER

Duties	Competencies /Skills/ Tasks					
1. Undertake Relevant Research and Development	1.1 Use appropriate mix of hardware/software to meet needs	1.2 Facilitates interoperability of diverse systems	1.3 Engage in new product development (hardware/ software, firmware)	1.4 Produce good documentation and Technical Manual		
2. Conduct Systems Analysis	2.1 Identify and analyze the problem	2.2 Gather data	2.3 Assess needs of some sectors	2.4 Analyze business Processes and requirements for the system architecture	2.5 Evaluate customer requirements	2.6 Evaluate performance of computing devices, equipment, computing infastructure or services
	2.7.a. Impact of engineering problems to environment	2.7.b. Evaluate Risk.	2.8 Conduct quality assurance	2.9 Authors solutions framework		
3. Perform System Design and Development	3.1 Design/develop appropriate computing solutions to problems	3.2 Design system and architecture infastructure	3.3 Design for minimal downtime	3.4 Builds and manage data warehouse, web presence		
4. Implement Project Management	4.1 Prepare project plan	4.2 Develop implementation plan	4.3 Schedule tasks/allocate resources	4.4 Manage project (Hardware/Software) development	4.5 Testing products	4.6 Develop end--of-life strategy
5. Provide Appropriate Technical support	5.1 Provides help desk and technical support	5.2 Troubleshoot, repairs and restores hardware/software/ and network	5.3 Manage and Maintain the system - Network Security - Hardware/Software			

PROFILE OF DUTIES AND COMPETENCIES OF A COMPUTER ENGINEER

Duties	Competencies /Skills/ Tasks					
6. Conduct Personnel Development	6.1 Conduct Customer training	6.2 Train personnel	6.3 Supervise people	6.4 Performance appraisal of personnel	6.5 Teach future CpE	
7. Engage in Continuing Professionl Development	7.1 Gain knowledge of contemporary issues	7.2 Engage in lifelong learning	7.3 Achieves global certification			
8. Engage in Technopreneurship	8.1 Market products or services					
9. Practice Professional Ethics	9.1 Make ethical decisions					
*** Conduct Quality Assurance in all processes**						

Computer Engineer - is a professional who effectively and eficiently meets the scientific, technologygal and various needs of bussiness, industries and communities in the global economy by developing processes and by applying engineering principles and methodologies in the nalysis, design, implemenhtation and management of hardware, its underlying software, nd the integration of both

PROGRAM OUTCOMES OF THE BS IN COMPUTER ENGINEERING (BSCpE)

Column Legend:

Letter	Program Outcomes
a	An ability to apply knowledge of mathematics, sciences, and engineering sciences to the practice of computer engineering.
b	An ability to design and conduct experiments as well as analyze and interpret data.
c	An ability to design a system to meet desired needs.
d	An ability to work effectively in multi-disciplinary and multi-cultural teams.
e	An ability to identify, formulate, and solve computer engineering problems.
f	An understanding of professional and ethical responsibility.
g	An ability to communicate effectively in verbal and non-verbal communication.
h	A broad education necessary to understand impact of engineering solutions in a global/societal context.
i	An ability to engage in life-long learning and to keep current of the development in a specific field of specialization.
j	Knowledge of contemporary issues.
k	An ability to use appropriate techniques, skills, and modern tools necessary for computer engineering practice to be locally and globally competitive.
l	An ability to apply acquired computer engineering knowledge and skills for national development.

Key: [ ] Very little or no emphasis [x] Some, moderate, or substantial emphasis

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
I. TECHNICAL COURSES												
A. Mathematics												
College Algebra	X	X			X							X
Advanced Algebra	X	X			X							X
Plane and Spherical Trigonometry	X	X			X							X
Analytic Geometry	X	X			X							X
Solid Mensuration	X	X			X							X
Differential Calculus	X	X			X							X
Integral Calculus	X	X			X							X
Differential Equations	X	X			X							X
Probability and Statistics	X	X			X						X	X
B. Natural/Physical Sciences												
General Chemistry	X	X			X							X
Physics 1	X	X			X							X
Physics 2	X	X			X							X
C. Basic Engineering Sciences												
Engineering Drawing	X	X	X		X							X
Computer Aided Drafting	X	X	X		X			X			X	X

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
Computer Fundamentals and Programming	X	X	X		X						X	X
Statics of Rigid Bodies	X				X							X
Dynamics of Rigid Bodies	X				X							X
Mechanics of Deformable Bodies	X				X							X
Engineering Economy	X				X			X				X
Engineering Management	X				X	X		X				X
Environmental Engineering	X				X	X		X				X
Safety Management	X				X	X		X				X
D. Allied Courses												
Electrical Circuits 1	X	X	X		X						x	X
Electrical Circuits 2	X	X	X		X						x	X
Electronics 1	X	X	X		X						x	X
Electronics 2	X	X	X		X						x	X
Entrepreneurship	X			X	X	X		X	X	X	X	X
E. Professional Courses												
Advanced Engineering Mathematics for CpE	X	X			X						x	X
Discrete Math	X	X			X						x	X
Computer Engineering Drafting and Design	X	X	X		X						X	X
Control Systems	X	X	X		X						X	X
Computer System Architecture	X	X	X		X						X	X
Computer System Organization with Assembly Language	X	X	X		X						X	X
Principles of Communication	X	X			X						X	X
Data Communications	X	X	X		X						X	X
Computer Networks	X	X	X		X						X	X
Data Structures and Algorithms Analysis	X	X			X						X	X
Operating Systems	X	X	X		X						X	X
System Analysis and Design	X	X	X	X	X	X	X	X	X	X	X	X
Engineering Ethics & Computer Laws	X			X		X		X		X		X
Computer Hardware Fundamentals	X	X			X						X	X
Advanced Logic Circuit	X	X	X		X						X	X
Logic Circuit Switching Theory	X	X	X		X						X	X
Digital Signal Processing	X	X	X		X						X	X
Object Oriented Programming	X	X	X		X						X	X
Microprocessor System	X	X	X		X						X	X
Design Project 1 (Methods of Research)	X	X	X	X	X	X	X	X	X	X	X	X
Design Project 2 (Project Implementation)	X	X	X	X	X	X	X	X	X	X	X	X
Software Engineering	X		X		X						X	X
Seminars and Field Trips						X	X	X		X		X

Courses	Relationship to Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
F. Technical Electives												
Elective 1	X				X					X	X	X
Elective 2	X				X					X	X	X
Elective 3	X				X					X	X	X
II. NON-TECHNICAL COURSES												
Social Science 1, 2, 3, 4				X		X	X			X		
Humanities 1, 2, 3				X		X	X			X		
English 1, 2, 3							X			X		
Filipino 1, 2							X			X		
Life and Works of Rizal				X			X			X		
P.E. 1, 2, 3, 4				X						X		
NSTP 1,2				X		X				X		

COURSE SPECIFICATION
Bachelor of Science in Computer Engineering (BSCpE)

I. TECHNICAL COURSES

A. MATHEMATICS

Course Name	**COLLEGE ALGEBRA**
Course Description	Algebraic expressions and equations; solution sets of algebraic equations in one variable: linear, quadratic, polynomial of degree *n*, fractional, radical equations, quadratic in form, exponential and logarithmic equations; decomposition of fractions into partial fractions; solution sets of systems of linear equations involving up to three variables.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Operate and simplify algebraic expressions; 2. Determine the solution sets of all types of algebraic equations, exponential and logarithmic equations; and inequalities; 3. Use the manipulative and analytical skills acquired in Objectives 1 to 2 to solve word problems; and 4. Identify the domain and range of a given relation/function.
Course Outline	1. The Set of Real Numbers 1.1. Integer Exponents 1.2. Polynomials, Operations, Special Products 1.3. Binomial Expansion (Binomial Theorem) 1.4. Factoring Polynomials 2. Rational Expressions 2.1. Rules of Exponents; Simplification of Rational Expressions; Operations on Rational Expressions 2.2. Properties of Radicals; Simplification of Radicals 2.3. Operations on Radicals 2.4. Complex Numbers 3. Equations in One Variable 3.1. Linear Equations; Literal Equations 3.2. Quadratic Equations in One Variable 3.3. Word Problems 3.4. Other Equations in One Variable: Radical, Fractional, Quadratic in Form 3.5. Polynomial Equation of Degree *n* 4. Functions 4.1. Inverse Functions 4.2. Exponential and Logarithmic Functions

	4.3. Exponential and Logarithmic Equations 5. Systems of Linear Equations (by Elimination Methods) 6. Decomposition of Rational Expressions into Partial Fractions
Laboratory Equipment	None

Course Name	**ADVANCED ALGEBRA**
Course Description	Matrices and determinants; arithmetic and geometric series; solution sets of different types of inequalities and systems involving quadratics; solution of linear equations using determinants and matrices.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Determine the solution sets of inequalities; 2. Determine the solution sets of systems involving quadratics; 3. Use the manipulative and analytical skills acquired in Objective 2 to solve word problems; 4. Operate and manipulate matrices and determinants; 5. Solve systems of linear equations using matrices and determinants; and 6. Determine the indicated sum of the elements in an arithmetic and geometric sequence.
Course Outline	1. Inequalities 1.1. Linear, Quadratic, and Polynomial Inequality 1.2. Linear Inequalities with Absolute Value 2. Ratio, Proportion, and Variation 3. Determinants 3.1. Expansion by Minors 3.2. Solution of Linear Systems by Cramer's Rule 4. Matrices 4.1. Identity Matrix 4.2. Cofactor Matrix 4.3. Transpose of a Matrix 4.4. Adjoint Matrix 4.5. Inverse of a Matrix 4.6. Algebra on Matrices (Sum and Difference, Scalar Multiplication, Matrix Multiplication) 4.7. Solution of Linear Systems Using Matrices 5. Sequence and Series 5.1. Arithmetic and Geometric Means 5.2. Arithmetic and Geometric Sequences 5.3. Arithmetic and Geometric Series 5.4. Infinite Series 6. Combinatorial Mathematics

	6.1. Sequences 6.2. The Factorial of a Number 6.3. Fundamental Principles of Counting, Permutation, and Combination 6.4. Binomial Theorem 6.5. Mathematical Induction
Laboratory Equipment	None

Course Name	**PLANE AND SPHERICAL TRIGONOMETRY**
Course Description	Trigonometric functions; identities and equations; solutions of triangles; law of sines; law of cosines; inverse trigonometric functions; spherical trigonometry
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Define angles and how they are measured; 2. Define and evaluate each of the six trigonometric functions; 3. Prove trigonometric functions; 4. Define and evaluate inverse trigonometric functions; 5. Solve trigonometric equations; 6. Solve problems involving right triangles using trigonometric function definitions for acute angles; and 7. Solve problems involving oblique triangles by the use of the sine and cosine laws.
Course Outline	1. Trigonometric Functions 1.1. Angles and Measurement 1.2. Trigonometric Functions of Angles 1.3. Trigonometric Function Values 1.4. The Sine and Cosine of Real Numbers 1.5. Graphs of the Sine and Cosine and Other Sine Waves 1.6. Solutions of Right Triangle 2. Analytic Trigonometry 2.1. The Eight Fundamental Identities 2.2. Proving Trigonometric Identities 2.3. Sum and Difference Identities 2.4. Double-Measure and Half-Measure Identities 2.5. Inverse Trigonometric Functions 2.6. Trigonometric Equations 2.7. Identities for the Product, Sum, and Difference of Sine and Cosine 3. Application of Trigonometry 3.1. The Law of Sines 3.2. The Law of Cosines 4. Spherical Trigonometry

	4.1. Fundamental Formulas 4.2. Spherical Triangles
Laboratory Equipment	None

Course Name	**ANALYTIC GEOMETRY**
Course Description	Equations of lines and conic sections; curve tracing in both rectangular and polar coordinates in two-dimensional space.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	College Algebra Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Set up equations given enough properties of lines and conics; 2. Draw the graph of the given equation of the line and the equation of the conic section; and 3. Analyze and trace completely the curve, given their equations in both rectangular and polar coordinates, in two-dimensional space.
Course Outline	1. Plane Analytic Geometry 1.1. The Cartesian Planes 1.2. Distance Formula 1.3. Point-of-Division Formulas 1.4. Inclination and Slope 1.5. Parallel and Perpendicular Lines 1.6. Angle from One Line to Another 1.7. An Equation of a Locus 2. The Line 2.1. Point-Slope and Two-Point Forms 2.2. Slope-Intercept and Intercept Forms 2.3. Distance from a Point to a Line 2.4. Normal Form 3. The Circle 3.1. The Standard Form for an Equation of a Circle 3.2. Conditions to Determine a Circle 4. Conic Sections 4.1. Introduction 4.2. The Parabola 4.3. The Ellipse 4.4. The Hyperbola 5. Transformation of Coordinates 5.1. Translation of Conic Sections 6. Curve Sketching 6.1. Symmetry and Intercepts 6.2. Sketching Polynomial Equations 6.3. Asymptotes (Except Slant Asymptotes)

	6.4. Sketching Rational Functions 7. Polar Coordinates 7.1. Polar Coordinates 7.2. Graphs in Polar Coordinates 7.3. Relationships Between Rectangular and Polar Coordinates
Laboratory Equipment	None

Course Name	**SOLID MENSURATION**
Course Description	Concept of lines and planes; Cavalieri's and Volume theorems; formulas for areas of plane figures, volumes for solids; volumes and surfaces areas for spheres, pyramids, and cones; zone, sector and segment of a sphere; theorems of Pappus.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	College Algebra, Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Compute for the area of plane figures; 2. Compute for the surface areas and volumes of different types of solids; and 3. Determine the volumes and surface areas of solids using other methods such as the theorems of Pappus.
Course Outline	1. Plane Figures 1.1. Mensuration of Plane Figures 2. Lines and Planes in Space 2.1. Typical Proofs of Solid Geometry 2.2. Angles 3. Solids for which V = Bh 3.1. Solid Sections 3.2. Cubes 3.3. Rectangular Parallelopiped 3.4. Cavalieri's Theorem 3.5. Volume Theorem 3.6. Prism 3.7. Cylindrical Surface 3.8. Cylinder (Circular and Right Circular) 4. Solids for which V = ⅓Bh 4.1. Pyramids 4.2. Similar Figures 4.3. Cones 4.4. Frustum of Regular Pyramid 4.5. Frustum of Right Circular Cone 5. Sphere 5.1. Surface Area and Volume 5.2. Zone

	3.7. Unbounded Functions 4. The Derivative 4.1. Notion of the Derivative 4.2. Definition 4.3. Determination of the Derivative by Increments 4.4. Differentiation Rules 5. The Slope 5.1. Definition of Slope as the Derivative of a Function 5.2. Determination of the Slope of a Curve at a Given Point 6. Rate of Change 6.1. Average Rate of Change 6.2. Instantaneous Rate of Change 7. The Chain Rule and the General Power Rule 8. Implicit Differentiation 9. Higher-Order Derivatives 10. Polynomial Curves 10.1. Generalities About Straight Lines 10.2. Tangents and Normal to Curves 10.3. Extrema and the First Derivative Test 10.4. Concavity and the Second Derivative Test 10.5. Points of Inflection 10.6. Sketching Polynomial Curves 11. Applications of the Derivative: Optimization Problems 12. Applications of the Derivative: Related Rates 13. The Differential 13.1. Definition 13.2. Applications of the Differential—Comparison of Δx and dx 13.3. Error Propagation 13.4. Approximate Formulas 14. Derivatives of Trigonometric Functions 14.1. Elementary Properties 14.2. Definition 14.3. Graphs of Trigonometric Functions 14.4. Applications 15. Derivatives of Inverse Trigonometric Functions 15.1. Elementary Properties 15.2. Definition 15.3. Graphs of Inverse Trigonometric Functions 15.4. Applications 16. Derivatives of Logarithmic and Exponential Functions 16.1. Elementary Properties 16.2. Definition 16.3. Graphs of Logarithmic and Exponential Functions 16.4. Applications 17. Derivatives of Hyperbolic Functions 17.1. Elementary Properties 17.2. Definition 17.3. Graphs of Hyperbolic Functions 17.4. Applications 18. Solution of Equations 18.1. Newton's Method of Approximation 18.2. Newton-Raphson Law 19. Transcendental Curve Tracing 19.1. Logarithmic and Exponential Functions

	20. Parametric Equations 21. Partial Differentiation
Laboratory Equipment	None

Course Name	**INTEGRAL CALCULUS**
Course Description	Concept of integration and its application to physical problems such as evaluation of areas, volumes of revolution, force, and work; fundamental formulas and various techniques of integration applied to both single variable and multi-variable functions; tracing of functions of two variables.
Number of Units for Lecture and Laboratory	4 units lecture
Number of Contact Hours per Week	4 hours lecture
Prerequisite	Differential Calculus
Course Objectives	After completing this course, the student must be able to: 1. Properly carry out integration through the use of the fundamental formulas and/or the various techniques of integration for both single and multiple integrals; 2. Correctly apply the concept of integration in solving problems involving evaluation of areas, volumes, work, and force; 3. Sketch 3-dimensional regions bounded by several surfaces; and 4. Evaluate volumes of 3-dimensional regions bounded by two or more surfaces through the use of the double or triple integral.
Course Outline	1. Integration Concept / Formulas 1.1. Anti-Differentiation 1.2. Simple Power Formula 1.3. Simple Trigonometric Functions 1.4. Logarithmic Function 1.5. Exponential Function 1.6. Inverse Trigonometric Functions 1.7. Hyperbolic Functions 1.8. General Power Formula 1.9. Constant of Integration 1.10. Definite Integral 2. Integration Techniques 2.1. Integration by Parts 2.2. Trigonometric Integrals 2.3. Trigonometric Substitution 2.4. Rational Functions 2.5. Rationalizing Substitution 3. Application 3.1. Improper Integrals 3.2. Plane Area 3.3. Areas Between Curves 4. Other Applications 4.1. Volumes

	4.2. Work 4.3. Hydrostatics Pressure and Force 5. Surfaces Multiple Integral as Volume 5.1. Surface Tracing: Planes 5.2. Spheres 5.3. Cylinders 5.4. Quadratic Surfaces 5.5. Double Integrals 5.6. Triple Integrals 6. Multiple Integral as Volume 6.1. Double Integrals 6.2. Triple Integrals
Laboratory Equipment	None

Course Name	**DIFFERENTIAL EQUATIONS**
Course Description	Differentiation and integration in solving first order, first-degree differential equations, and linear differential equations of order *n*; Laplace transforms in solving differential equations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Solve the different types of differential equations; and 2. Apply differential equations to selected engineering problems.
Course Outline	1. Definitions 1.1. Definition and Classifications of Differential Equations (D.E.) 1.2. Order Degree of a D.E. / Linearity 1.3. Solution of a D.E. (General and Particular) 2. Solution of Some 1st Order, 1st Degree D.E. 2.1. Variable Separable 2.2. Homogeneous 2.3. Exact 2.4. Linear 2.5. Equations Linear in a Function 2.6. Bernoulli's Equation 3. Applications of 1st Order D.E. 3.1. Decomposition / Growth 3.2. Newton's Law of Cooling 3.3. Mixing (Non-Reacting Fluids) 3.4. Electric Circuits 4. Linear D.E. of Order *n* 4.1. Standard Form of a Linear D.E. 4.2. Linear Independence of a Set of Functions

	4.3. Differential Operators 4.4. Differential Operator Form of a Linear D.E. 5. Homogeneous Linear D.E. with Constant Coefficients 5.1. General Solution 5.2. Auxiliary Equation 6. Non-Homogeneous D.E. with Constant-Coefficients 6.1. Form of the General Solution 6.2. Solution by Method of Undetermined Coefficients 6.3. Solution by Variation of Parameters
Laboratory Equipment	None

Course Name	**PROBABILITY AND STATISTICS**
Course Description	Basic principles of statistics; presentation and analysis of data; averages, median, mode; deviations; probability distributions; normal curves and applications; regression analysis and correlation; application to engineering problems.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Define relevant statistical terms; 2. Discuss competently the following concepts: 2.1. Frequency distribution 2.2. Measures of central tendency 2.3. Probability distribution 2.4. Normal distribution 2.5. Inferential statistics 3. Apply accurately statistical knowledge in solving specific engineering problem situations.
Course Outline	1. Basic Concepts 1.1. Definition of Statistical Terms 1.2. Importance of Statistics 2. Steps in Conducting a Statistical Inquiry 3. Presentation of Data 3.1. Textual 3.2. Tabular 3.3. Graphical 4. Sampling Techniques 5. Measures of Central Tendency 5.1. Mean 5.2. Median 5.3. Mode 5.4. Skewness and Kurtosis 6. Measures of Variation

	6.1. Range 6.2. Mean Absolute Deviation 6.3. Variance 6.4. Standard Deviation 6.5. Coefficient of Variation 7. Probability Distributions 7.1. Counting Techniques 7.2. Probability 7.3. Mathematical Expectations 7.4. Normal Distributions 8. Inferential Statistics 8.1. Test of Hypothesis 8.2. Test Concerning Means, Variation, and Proportion 8.3. Contingency Tables 8.4. Test of Independence 8.5. Goodness-of-Fit Test 9. Analysis of Variance 10. Regression and Correlation
Laboratory Equipment	None

B. NATURAL/PHYSICAL SCIENCES

Course Name	**GENERAL CHEMISTRY**
Course Description	Basic concepts of matter and its classification; mass relationships in chemical reactions; properties of gases, liquids, and solids; concepts of thermochemistry; quantum theory and electronic behavior; periodic relationship of elements in the periodic table; intramolecular forces; and solutions.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Apply significant figures and appropriate units in all measurements and calculations; 2. Classify matter; distinguish between physical and chemical properties/changes; 3. Define and explain the concepts of atomic mass, average atomic mass, mole, molar mass and perform calculations involving these; 4. Balance and interpret chemical equations and perform stoichiometric calculations; 5. Write, explain and apply the gas laws; 6. Discuss the kinetic molecular theory (KMT) of gases and use the KMT to qualitatively explain the gas laws; argue the differences between ideal and non-ideal gas behavior;

	7. Define enthalpy; classify common processes as exothermic or endothermic and know the sign conventions; 8. Trace the various atomic theories; discuss the Bohr model; and explain the line spectra of hydrogen; Discuss the concept of electron density; contrast the Bohr's orbits with orbitals in the quantum theory; 9. Write electron configurations and orbital diagrams for multi electron atoms; 10. Use the periodic table to classify elements and predict trends in properties; 11. Write Lewis dot symbols and Lewis structure; 12. Explain valence bond theory, hybrid orbitals, and hybridization in common compounds 13. Distinguish between inter- and intramolecular forces; give examples of intramolecular forces and how they relate to physical properties; 14. Distinguish between crystalline and amorphous solids 15. Discuss various physical changes and interpret phase diagrams; 16. Distinguish different types of solutions; work with different concentration units; Understand the effect of temperature and pressure on solubility; and 17. Explain and apply colligative properties to determine molar mass.
Course Outline	1. The Study of Change 1.1. Introduction to Chemistry 1.2. Matter: Classification, States, Physical, and Chemical Properties 1.3. Measurement and Handling of Numbers 2. Atoms, Molecules, and Ions 2.1. The Atomic Theory 2.2. The Structure of the Atom 2.3. Atomic Number, Mass Number, Isotopes 2.4. The Periodic Table 2.5. Molecules and Ions 2.6. Chemical Formulas 2.7. Naming Compounds 3. Mass Relationships in Chemical Reaction 3.1. Atomic Mass 3.2. Molar Mass of an Element and Avogadro's Number 3.3. Molecular Mass 3.4. Percent Composition of Compounds 3.5. Chemical Reactions and Chemical Equations 3.6. Amounts of Reactants and Products 3.7. Limiting Reagents 3.8. Reaction Yield 4. Gases 4.1. Substances That Exist as Gases 4.2. Pressure of a Gas 4.3. The Gas Laws 4.4. The Ideal Gas Equation 4.5. Gas Stoichiometry 4.6. Dalton's Law of Partial Pressure 4.7. The Kinetic Molecular Theory of Gases 4.8. Deviation from Ideal Behavior

	5. Thermochemistry 5.1. Energy Changes in Chemical Reactions 5.2. Introduction to Thermodynamics 5.3. Enthalpy 6. Quantum Theory and the Electronic Structure of Atoms 6.1. From Classical Physics to Quantum Theory 6.2. Bohr's Theory of the Hydrogen Atom 6.3. The Dual Nature of the Electron 6.4. Quantum Mechanics 6.5. Quantum Numbers 6.6. Atomic Orbitals 6.7. Electron Configuration 6.8. The Building-Up Principle 7. Periodic Relationships Among the Elements 7.1. Periodic Classification of the Elements 7.2. Periodic Variation in Physical Properties 7.3. Ionization Energy 7.4. Electron Affinity 8. Chemical Bonding: Basic Concepts 8.1. Lewis Dot Structure 8.2. The Ionic Bond 8.3. The Covalent Bond 8.4. Electronegativity 8.5. Writing Lewis Structure 8.6. The Concept of Resonance 8.7. Bond Energy 9. Chemical Bonding: Molecular Geometry and Hybridization 9.1. Molecular Geometry 9.2. Dipole Moments 9.3. The Valence Bond Theory 9.4. Hybridization of Atomic Orbitals 9.5. Hybridization in Molecules Containing Double and Triple Bonds 10. Intermolecular Forces in Liquids and Solids 10.1. The KMT of Liquids and Solids 10.2. Intermolecular Forces 10.3. Properties of Liquids 10.4. Crystalline vs. Amorphous Solids 10.5. Phase Changes 10.6. Phase Diagrams 11. Physical Properties of Solutions 11.1. Types of Solutions 11.2. A Molecular View of the Solution Process 11.3. Concentration Units 11.4. Effect of Temperature and Pressure on Solubility 11.5. Colligative Properties
Laboratory Equipment	Chemistry Laboratory(see attached)

Course Name	**PHYSICS 1**
Course Description	Vectors; kinematics; dynamics; work, energy, and power; impulse and momentum; rotation; dynamics of rotation; elasticity; and oscillation.

Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	College Algebra Plane and Spherical Trigonometry
Course Objectives	After completing this course, the student must be able to: 1. Differentiate a vector from a scalar; 2. Determine the resultant of concurrent vectors; 3. Solve problems in kinematics; 4. Apply Newton's Laws of Motion; 5. Determine the gravitational force between different masses; 6. Solve problems involving centripetal force for horizontal and vertical curves; 7. Compute the work done on a given body; 8. Relate work and energy; 9. Solve problems by applying the law of conservation of energy; 10. Solve problems in impulse and momentum and collisions; 11. Determine the stress and strain on a body; and 12. Determine the period of a body in simple harmonic motion.
Course Outline	1. Work, Energy and Power 1.1. Definition of Work, Energy and Power 1.2. Conservation of Energy 2. Impulse and Momentum 2.1. Definition of Impulse and Momentum 2.2. Conservation of Momentum 3. Vector 3.1. Vectors and Scalars 3.2. Graphical Method 3.3. Analytical Method 4. Vector Subtraction 5. Kinematics 5.1. Equations of Kinematics 5.2. Freely Falling Bodies 5.3. Projectile Motion 6. Dynamics 6.1. Newton's Laws of Motion 6.2. Friction 6.3. First Condition of Equilibrium 7. Work, Energy and Power 7.1. Definition of Work, Energy and Power 7.2. Conservation of Energy 8. Impulse and Momentum 8.1. Definition of Impulse and Momentum 8.2. Conservation of Momentum 8.3. Collisions, Coefficient of Restitution 9. Rotation 9.1. Definition of torque 9.2. Second Condition of Equilibrium 9.3. Center of Gravity 10. Dynamics of Rotation

	10.1. Kinematics of Rotation 10.2. Dynamics of Rotation 10.3. Center of Gravity 11. Elasticity 11.1. Hooke's Law 11.2. Stress and Strain 11.3. Modulus of Elasticity 12. Oscillations 12.1. Definition of Vibration Motion and Simple Harmonic Motion 12.2. Kinematics of Simple Harmonic Motion 12.3. Simple Pendulum
Laboratory Equipment	Physics Laboratory (see attached)

Course Name	**PHYSICS 2**
Course Description	Fluids; thermal expansion, thermal stress; heat transfer; calorimetry; waves; electrostatics; electricity; magnetism; optics; image formation by plane and curved mirrors; and image formation by thin lenses.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Physics 1
Course Objectives	After completing this course, the student must be able to: 1. Describe the characteristics of fluids at rest and in motion; 2. Compute the buoyant force on an object immersed in a fluid; 3. Compute the pressure and flow speed of a fluid at any point in a flow tube; 4. Determine the amount of expansion of a given material in relation to temperature change; 5. Determine the change in temperature of a given amount of material that loses or gains; 6. Solve problems about the law of heat transfer; 7. Describe the three methods of heat transfer; 8. Discuss the properties of waves; 9. Describe the modes of vibration of strings and air columns; 10. Solve problems on Doppler Effect; 11. Compute the electric force between electric charges; 12. Compute the electric field due to electric charges; 13. Compute the electric potential due to a charge and electric potential energy of charges; 14. Define electric current, electric resistance and voltage; 15. Solve problems on resistance and cells in series and parallel; 16. State Kirchhoff's rules and apply them in a given circuit; 17. Compute the magnetic field of a given current-carrying conductors;

	18. Compute the magnetic torque on a current conductor in a magnetic field; and 19. Describe image formation by mirrors and lenses.
Course Outline	1. Fluids 1.1. Pressure, Specific Gravity, Density 1.2. Archimedes' Principle 1.3. Rate of Flow and Continuity Principle 1.4. Bernoulli's Principle 1.5. Torricelli's Theorem 2. Thermal Expansion, Thermal Stress 3. Heat Transfer 4. Calorimetry 4.1. Specific Heat 4.2. Law of Heat Exchange 4.3. Change of Phase 5. Waves 5.1. Types of Waves and Their Properties 5.2. Sounds 6. Electrostatics 6.1. Charge 6.2. Coulomb's Law 6.3. Superposition Principle 6.4. Electric Field Intensity 6.5. Work and Potential 6.6. Capacitors, Dielectrics 7. Electricity 7.1. Current 7.2. Resistance 7.3. EMF 7.4. Ohm's Law 7.5. Energy and Power in Circuits 7.6. Series and Parallel Connections 7.7. Kirchhoff's Rules 8. Magnetism 8.1. Magnetic Field of Moving Changes 8.2. Magnetic Filed of Current Element 8.3. Motion of a Charge in a Magnetic Field 8.4. Biot-Savart Law 8.5. Force on a Moving Charge in a Magnetic Field 8.6. Torque on a Current-Carrying Loop 9. Optics 9.1. Light as Electromagnetic Waves 9.2. Properties of Reflection and Refraction 10. Image Formation by Plane and Curved Mirrors 10.1. Graphical Methods 10.2. Mirror Equation 11. Image Formation by Thin Lenses 11.1. Graphical Methods 11.2. Lens Equation
Laboratory Equipment	Physics Laboratory (see attached)

C. BASIC ENGINEERING SCIENCES

Course Name	ENGINEERING DRAWING
Course Description	Practices and techniques of graphical communication; application of drafting instruments, lettering scale, and units of measure; descriptive geometry; orthographic projections; auxiliary views; dimensioning; sectional views; pictorial drawings; requirements of engineering working drawings; and assembly and exploded detailed drawings.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance of technical drawing knowledge and skills as applied to the various areas of engineering; 2. Apply the basic concepts of technical drawing and sketching; and 3. Prepare technical drawings.
Course Outline	1. Engineering Lettering 2. Instrumental Figures 3. Geometric Construction 4. Orthographic Projection 5. Dimensioning 6. Orthographic Views with Dimensions and Section View 7. Sectional View 8. Pictorial Drawing 9. Engineering Working Drawings 10. Assembly and Exploded Detailed Drawings
Laboratory Equipment	1. Drafting table 2. Drawing instruments 2.1. One 30-60 degree triangle 2.2. One 45 degree triangle 2.3. One technical compass 2.4. One protractor

Course Name	COMPUTER FUNDAMENTALS AND PROGRAMMING
Course Description	Basic information technology concepts; fundamentals of algorithm development; high-level language and programming applications; computer solutions of engineering problems.
Number of Units for Lecture and Laboratory	2 units laboratory

Number of Contact Hours per Week	6 hours laboratory
Prerequisite	Second Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand basic information technology concepts; 2. Use application software and the Internet properly; 3. Acquire proficiency in algorithm development using a high-level programming language; 4. Use the computer as a tool in engineering practice.
Course Outline	1. Introduction to Computers 1.1. Computer Organization 1.2. Number Systems and Data Representation 1.3. Application Software: Word Processing and Spreadsheet 1.4. The Internet 2. Programming 2.1. Algorithm Development 2.2. Programming Fundamentals
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. Word processing software 1.3. Spreadsheet software 1.4. High-level programming language 1.5. Internet browser and Internet connection

Course Name	**COMPUTER AIDED DRAFTING**
Course Description	Concepts of computer-aided drafting (CAD); introduction to the CAD environment; terminologies; and the general operating procedures and techniques in entering and executing basic CAD commands.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	Second Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Define the terms related to computer-aided drafting systems; 2. Identify the important tools used to create technical drawings in CAD; 3. Create electronic drawings (e-drawing) using CAD; and 4. Appreciate the usefulness of the knowledge and skills in computer aided drafting as applied in his/her professional development.
Course Outline	1. Introduction to CAD Software 2. CAD Drawing 3. Snapping, Construction Elements 4. Dimensioning

	5. Plotting, Inputting Images 6. 3D and Navigating in 3D 7. Rendering
Laboratory Equipment	1. Personal computer with: 1.1. Operating system 1.2. CAD software 2. Printer or plotter

Course Name	**STATICS OF RIGID BODIES**
Course Description	Force systems; structure analyses; friction; centroids and centers of gravity; and moments of inertia.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Physics 1 Integral Calculus
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles of equilibrium of particles; 2. Undertake vector operations such as vector cross and dot product; 3. Determine forces of 2D and 3D structures; 4. Understand the principles of static, wedge and belt friction; 5. Determine centroids, center of mass and center of gravity of objects; 6. Determine moment of inertia, mass moment of inertia; and 7. Analyze the stresses of trusses, beams and frames.
Course Outline	1. Introduction to Mechanics; Vector Operations 2. Force Vectors and Equilibrium of Particles 3. Vector Cross and Dot Product 4. Moment of a Force 5. Couples; Moment of a Couple 6. Equivalent Force Systems in 2D and 3D 7. Dry Static Friction, Wedge and Belt Friction 8. Centroid; Center of Mass; and Center of Gravity 9. Distributed Loads and Hydrostatic Forces; Cables 10. Moment of Inertia; Mass Moment of Inertia 11. Trusses; Frames and Machines; Internal Forces 12. Beams; Shear and Bending Moment Diagrams
Laboratory Equipment	None

Course Name	DYNAMICS OF RIGID BODIES
Course Description	Kinetics and kinematics of a particle; kinetics and kinematics of rigid bodies; work energy method; and impulse and momentum.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the principles governing the motion of particles, velocity and acceleration; 2. Understand the principles of Newton's Second Law and its applications; 3. Understand kinetics of particles in particular energy and momentum methods; and 4. Understand kinematics of rigid bodies, its energy and momentum.
Course Outline	1. Introduction to Dynamics 2. Position, Velocity, and Acceleration 3. Determination of the Motion of the Particles 4. Uniform Rectilinear Motion 5. Uniformly Accelerated Rectilinear Motion 6. Position Vector, Velocity, and Acceleration 7. Derivatives of Vector Functions 8. Rectangular Components of Velocity and Acceleration 9. Motion Relative to a Frame in Translation 10. Tangential and Normal Components 11. Radial and Transverse Components 12. Motion of Several Particles (Dependent Motion) 13. Kinetics of Particles: Newton's Second Law 13.1. Newton's Second Law of Motion 13.2. Linear Momentum of the Particle, Rate of Change of Linear Momentum 13.3. System of Units 13.4. Equation of Motion 13.5. Dynamic Equilibrium 13.6. Angular Momentum of Particle, Rate of Change of Angular Momentum 13.7. Equations in Terms of Radial and Transverse Components 13.8. Motion Under a Central Force 14. Kinetics of Particles: Energy and Momentum Methods 14.1. Work of Force 14.2. Kinetic Energy of a Particle, Principle of Work and Energy 14.3. Applications of the Principle of Work and Energy 14.4. Potential Energy 14.5. Conservative Forces 14.6. Conservation of Energy

	14.7. Principle of Impulse and Momentum 14.8. Impulsive Motion 14.9. Impact 14.10. Direct Central Impact 14.11. Oblique Central Impact 14.12. Problems Involving Energy and Momentum 15. Systems of Particles 15.1. Application of Newton's Second Laws to Motion of a System of Particles 15.2. Linear and Angular Momentum of a System of Particles 15.3. Motion of Mass Center of a System of Particles 15.4. Angular Momentum of a System of Particles About Its Mass Center 15.5. Conservation of Momentum for a System of Particles 15.6. Kinetic Energy of a System of Particles 15.7. Work-Energy Principle. Conservation of Energy for a System of Particles 15.8. Principle of Impulse and Momentum for a System of Particles 16. Kinematics of Rigid Bodies 16.1. Translation 16.2. Rotation About a Fixed Axis 16.3. Equations Defining the Rotation of a Rigid Body About a Fixed Axis 16.4. General Plane Motion 16.5. Absolute and Relative Velocity in Plane Motion 16.6. Instantaneous Center of Rotation in Plane Motion 16.7. Absolute and Relative Acceleration 16.8. Rate of Change of a Vector with Respect to a Rotating Frame 16.9. Plane Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.10. Motion About a Fixed Point 16.11. General Motion 16.12. Three-Dimensional Motion of a Particle Relative to a Rotating Frame; Coriolis Acceleration 16.13. Frame of Reference in General Motion 17. Plane Motion of Rigid Bodies: Forces and Accelerations 17.1. Equation of Motions 17.2. Angular Momentum of a Rigid Body in Plane Motion 17.3. Plane Motion of a Rigid Body. D' Alembert's Principle 17.4. Solution of Problems involving the Motion of a Rigid Bodies 17.5. Systems of Rigid Bodies 17.6. Constrained Plane Motion 18. Plane Motion of Rigid Bodies: Energy and Momentum Methods 18.1. Principle of Work and Energy for a Rigid Body 18.2. Work of Forces Acting on a Rigid Body 18.3. Kinetic Energy of a Rigid Body in Plane Motion 18.4 Systems of Rigid Bodies 18.5 Conservation of Energy 18.6 Principle of Impulse and Momentum 18.7 Conservation of Angular Momentum 18.8 Impulsive Motion

	18.9 Eccentric Impact
Laboratory Equipment	None

Course Name	**MECHANICS OF DEFORMABLE BODIES**
Course Description	Axial stress and strain; stresses for torsion and bending; combined stresses; beam deflections; indeterminate beams; and elastic instability.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Statics of Rigid Bodies
Course Objectives	After completing this course, the student must be able to: 1. Understand the concepts of stress and strain; 2. Calculate stresses due to bending, shears, and torsion under plain and combined loading; 3. Analyze statically determinate and indeterminate structures; and 4. Determine the elastic stability of columns.
Course Outline	1. Load Classification 2. Concept of Stress, Normal and Shear Stress 3. Stresses under Centric Loading 4. Stress Concentration 5. Plane Stress 6. Principal Stresses for Plane Stress 7. Mohr's Circle for Plane Stress 8. Deformations, Normal and Shear Strains 9. Material Properties 10. Working Stresses 11. Deformation in a System of Axially Loaded Members 12. Temperature Effects on Axially Loaded Members 13. Statically Indeterminate Members 14. Thin-Walled Pressure Vessel 15. Torsional Stresses; Elastic Torsion Formula 16. Torsional Deformation; Power Transmission 17. Flexural Stresses by the Elastic Curve 18. Moment Equation Using Singularity Function 19. Beam Deflection by the Double Integration Method 20. Area Moment Theorems 21. Moment Diagram by Parts 22. Beam Deflection by Area Moment Method 23. Statically Indeterminate Beams 24. Buckling of Long Straight Columns 25. Combined Loadings 26. Analysis of Riveted Connections by the Uniform Shear Method 27. Welded Connections
Laboratory Equipment	None

Laboratory Equipment	None

Course Name	**ENGINEERING MANAGEMENT**
Course Description	Decision-making; the functions of management; managing production and service operations; managing the marketing function; and managing the finance function.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the field of engineering management; 2. Know and apply the different functions of management.
Course Outline	1. Introduction to Engineering Management 2. Decision Making 3. Functions of Management 3.1. Planning / Coordinating 3.2. Organizing 3.3. Staffing 3.4. Communicating 3.5. Motivating 3.6. Leading 3.7. Controlling 4. Managing Product and Service Operations 5. Managing the Marketing Function 6. Managing the Finance Function
Laboratory Equipment	None

Course Name	**ENVIRONMENTAL ENGINEERING**
Course Description	Ecological framework of sustainable development; pollution environments: water, air, and solid; waste treatment processes, disposal, and management; government legislation, rules, and regulation related to the environment and waste management; and environmental management system.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	General Chemistry

Course Objectives	After completing this course, the student must be able to: 1. Understand the various effects of environmental pollution; 2. Know the existing laws, rules, and regulations of the government on environmental issues; 3. Identify, plan, and select appropriate design treatment schemes for waste disposal; and 4. Understand the importance of waste management and its relevance to the engineering profession.
Course Outline	1. Ecological Concepts 1.1. Introduction to Environmental Engineering 1.2. Ecology of Life 1.3. Biogeochemical Cycles 1.4. Ecosystems 2. Pollution Environments 2.1. Water Environment 2.2. Air Environment 2.3. Solid Environmental 2.4. Toxic and Hazardous Waste Treatment 3. Environmental Management System 3.1. Environmental Impact Assessment 3.2. Environmental Clearance Certificate
Laboratory Equipment	None

Course Name	**SAFETY MANAGEMENT**
Course Description	Evolution of safety management; safety terminology; safety programs adopted by high risk industries; hazards in the construction, manufacturing, gas and power plants, and other engineering industries and how to prevent or mitigate them; techniques in hazard identification and analysis in workplaces; off-the-job safety; disaster prevention and mitigation; and incident investigation.
Number of Units for Lecture and Laboratory	1 unit lecture
Number of Contact Hours per Week	1 hour lecture
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the importance and the value of safety; 2. Know the health hazards and their prevention; 3. Identify and mitigate or prevent hazards; and 4. Apply the concepts and principles of safety in engineering practice.
Course Outline	1. Overview of Safety 2. Basic Safety Procedures in High Risk Activities and Industries 2.1. Procedure in Hazards Analysis in the Workplace 2.2. Control of Hazardous Energies 2.3. Confined Space Entry

	2.4. Basic Electrical Safety 2.5. Fall Protection 2.6. Barricades and Scaffolds 2.7. Fire Safety and the Fire Code 2.8. Industrial Hygiene 2.9. Hazard Communication and Chemical Safety 3. Value Based Safety and Off-the-Job Safety 3.1. Safety as a Value; Choice vs. Compliance 3.2. Off-the-Job Safety (Residences and Public Places) 3.3. Safety as Related to Health Practices 4. Disaster Prevention and Mitigation 4.1. Rationale for Disaster Prevention and Loss Control 4.2. Planning for Emergencies 4.3. Emergency Response Procedures 5. Incident Investigation and Reporting 5.1. Accident Escalation, Incident Investigation and Reporting 5.2. Causal Analysis; Recognition of Root Cause 5.3. Identification of Corrective or Preventive Actions
Laboratory Equipment	None

D. ALLIED COURSES

Course Name	**ELECTRICAL CIRCUITS 1**
Course Description	Fundamental relationships in circuit theory, mesh and node equations; resistive networks, network theorems; solutions of network problems using Laplace transform; transient analysis; methods of circuit analysis.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Physics 2, Integral Calculus
Course Objectives	Differential Equations
Course Outline	Upon completion of the course, the student must be able to: 1. Know the different dc circuit parameters and components 2. Solve problems in application of the different principles, theorems and laws in dc circuits. 3. Help the students better understanding the basic principles correctly and confidently 4. Develop analytical skills in electric circuit analysis.
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	ELECTRICAL CIRCUITS 2
Course Description	Complex algebra and phasors; simple AC circuits, impedance and admittance; mesh and node analysis for AC circuits; AC network theorems; power in AC circuits; resonance; three-phase circuits; transformers; two-port network parameters and transfer function.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Electrical Circuits 1
Course Objectives	Upon completion of the course, the student must be able to: 1. Know the different ac circuit parameters and components 2. Solve problems involving single phase and three- phase system 3. Develop analytical skills in ac electric circuit analysis
Course Outline	1. Complex Algebra and Phasors 2. Impedance and Admittance 4. Simple AC Circuits 5. Transformers 6. Resonance 7. Mesh and Node Analysis for AC Circuits 8. AC Network Theorems 9. Power in AC Circuits 10. Three-Phase Circuits 11. Two-Port Network Parameters and Transfer Function
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	ELECTRONICS 1 (ELECTRONICS DEVICES AND CIRCUITS)
Course Description	Introduction to quantum mechanics of solid state electronics; diode and transistor characteristics and models (BJT and FET); diode circuit analysis and applications; transistor biasing; small signal analysis; large signal analysis; transistor amplifiers; Boolean logic; transistor switch.
Number of Units for Lecture and Laboratory	3 unit lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Physics 2, Integral Calculus
Course Objectives	Upon completion of the course, the student must be able to acquire a strong foundation on semiconductor physics; diode and diode circuit analysis; MOS and BJT (small and large signal) circuit analysis.

Course Outline	1. Orientation: Review of Course 2. Assessment of the Different Types of Learners 3. Fundamentals of tubes and other devices 4. Introduction of Semiconductors 5. Diode Equivalent Circuits 6. Wave Shaping Circuits 7. Special Diode Application 8. Power Supply And Voltage Regulation 9. Bipolar Junction Transistor 10. Small- Signal Analysis (BJT) 11. Field Effect Transistor 12. Small-Signal Analysis (FET) 13. Large-Signal Analysis
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**ELECTRONICS 2** **(ELECTRONIC CIRCUITS ANALYSIS AND DESIGN)**
Course Description	High frequency transistor models; analysis of transistor circuits; multi-stage amplifier, feedback, differential amplifiers and operational amplifiers; integrated circuit families (RTL, DTL, TTL, ECL, MOS)
Number of Units for Lecture and Laboratory	3 unit lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Electronics 1 (Electronics Devices and Circuits)
Course Objectives	Upon completion of the course, the student must be able to: 1. Review the basic electronics learned in Electronics 1. 2. Analyze different circuits and models at high frequency. 3. Analyze and solve problems with regards to transistor circuits. 4. Define an operational amplifier. 5. Analyze combinational and sequential devices for logic circuits. 6. Familiarize with the integrated circuit families.
Course Outline	1. Introduction and Review of Logarithms and Decibels 2. BJT Lower Critical Frequency Response 3. JFET Lower Critical Frequency Response 4. BJT Higher Critical Frequency Response 5. JFET Higher Critical Frequency Response 6. Cascade and Cascode Connection 7. CMOS Circuit, Darlington and Feedback Pair Connection 8. Current Mirrors and Current Source 9. Differentials Amplifier 10. Introduction to Operational Amplifier 11. Practical Operational Amplifier 12. Operational Amplifier Specification 13. Introduction to Feedback System

	14. Feedback Connections and Practical Feedback Circuits 15. Negative Feedback System 16. Positive Feedback 17. Introduction to Oscillator 18. RC Feedback Oscillator Circuits 19. LC Feedback Oscillator Circuits 20. Other Types of Oscillator 21. Introduction to Filters 22. Designing Filters 23. Types of Filters 24. Transistor Fabrication 25. Designing Integrated Circuit Families
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**ENTREPRENEURSHIP**
Course Description	The course includes the journey into the world of entrepreneurship with introspection of a business idea into a viable venture. The focus is on unleashing the entrepreneurial spirit in each individual.
Number of Units for Lecture and Laboratory	3 Units Lecture
Number of Contact Hours per Week	3 Hours Lecture
Prerequisite	Fifth Year Standing
Course Objectives	At the end of the course the students should be able to: 1. Explain the concept of entrepreneurship and its associated tools & processes. 2. Present a business plan and defend. 3. Relate the significance of entrepreneurship in the socio-economic development of the country.
Course Outline	Part I. Concepts. The Nature of Small Business and Entrepreneurship: Learning to become an Entrepreneur 1. Entrepreneurship 2. Entrepreneurial profile & competencies 3. Creativity and Innovation 4. Business Idea/ Legal Issues 5. Market Study 6. Product Concept 7. Business Model & Organization 8. Startup Venture Part II. Practice. Getting into Business: Making the Final Year Project (Thesis) as a Business Start up 1. Options for going into Business 2. Researching and Analyzing Business Opportunities

	3. Preparing the Business Plan 4. Legal Issues 5. Financing New and Growing Business Ventures 1. Accessing Business Advice and Assistance Part III. Getting into the Real World: Joining in the PESO CHALLENGE.
Laboratory Equipment	None

E. PROFESSIONAL COURSES

Course Name	**ADVANCED ENGINEERING MATHEMATICS FOR CpE**
Course Description	A study of selected topics in mathematics and their applications in advanced courses in engineering and other allied sciences. It covers the study of Complex numbers and complex variables, Laplace and Inverse Laplace Transforms, Power series, Fourier series, Fourier Transforms, z-transforms, power series solution of ordinary differential equations, and partial differential equations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Differential Equations
Course Objectives	After completing this course, the student must be able to: 1. To familiarize the different parameters, laws, theorems and the different methods of solutions in advance mathematics. 2. To develop their abilities on how to apply the different laws, methods and theorems particularly in complex problems.
Course Outline	1. Complex numbers and complex variables 2. Laplace and Inverse Laplace Transforms 3. Power Series 4. Fourier Series 5. Fourier Transforms 6. Power Series solution of differential equations 6.1. Legendre Equation 6.2. Bessel Equations 7. Partial Differential Equations
Laboratory Equipment	None

Course Name	DISCRETE MATH
Course Description	This course deals with logic, sets, proofs, growth of functions, theory of numbers, counting techniques, trees and graph theory.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	College Algebra
Course Objectives	After completing this course, the student must be able to: 1. Prove theorems and using logic 2. Demonstrate knowledge of the basic concepts of discrete mathematics. 3. Apply counting techniques in calculation of discrete probabilities. 4. Use trees and graph theory in dealing with discrete mathematics problems. 5. Exhibit awareness of issues related to the computer engineering applications of discrete mathematics.
Course Outline	1. Logic, Sets, Proofs, and Functions 2. Algorithms, Integers and Matrices 2.1 Growth of Functions 2.2 Complexity of Algorithms 2.3 Number Theory 2.4 Matrices 3. Counting Techniques 4. Relations 5. Graph Theory 6. Trees 7. Introduction to Modeling Computation
Laboratory Equipment	None

Course Name	COMPUTER ENGINEERING DRAFTING AND DESIGN
Course Description	A study of the principles of layout of electrical and electronic drawings, stressing modern representation used for block diagrams, wiring/assembly drawings and printed circuit board layouts.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	Third Year Standing
Course Objectives	After completing this course, the student must be able to:

	1. Understand the Electronic symbols, components; Electronic diagrams, flowcharts, system structures; Electro-mechanical packaging; and Printed circuit board (PCB) layouts. Be able to identify electronic symbols and components; 3. Be able to create detailed drawings of electronic circuits; and 4. Be able to layout and design artwork for PCB.
Course Outline	1. Block Diagrams and Flowcharts 2. Introduction to Electronics 2.1 Concepts in Electronics 2.2 Electrical, Electronic and Logic Components 2.3 Designation, Standards and Abbreviations 3. Schematic Diagram 4. Hand-sketched Schematic Diagrams 5. Introduction to Circuit Layout Software Tool 6. Schematic Capture 7. Wiring and Cabling Diagrams 8. Electronic Packaging
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**CONTROL SYSTEMS**
Course Description	The course includes the control devices, equations of a systems and block diagram of systems.
Number of Units for Lecture and Laboratory	3 units lecture, 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Electronics 2, Electrical Circuits 2
Course Objectives	After completing this course, the student must be able to design the different control systems relevant to daily lives and to the industry.
Course Outline	1. Introduction to Control System 2. Block diagram of Control Systems 3. Block Diagram Algebra and Transfer Function 4. Transfer Function 4.1 As applied to circuit 4.2 As applied to block diagram 4.3 As applied to differential equation 4.4 As applied to Laplace transform 5. Partial Fraction Expansion
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**COMPUTER SYSTEM ARCHITECTURE**
Course Description	The course includes the theory and principles of computer design.

	The focus is on the understanding of the design issues specifically the instruction set architecture and hardware architecture. The students are encourage to have a case study on the existing architectural computer designs in order to fully understand its principles.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Computer System Organization with Assembly Language, Advanced Logic Circuit
Course Objectives	After completing this course, the student must be able to: 1. Describe how computer technology has evolved and how this rapid evolution has influenced computer architecture. 2. Explain how computer design affects the system performance and cost of a computer. 3. Identify the issues in instruction set design and memory design.
Course Outline	1. Computer Architecture 1.1 Introduction-Compute Organization vs Computer Architecture 1.2 CISC/RISC Architecture, etc. 1.3 Classification of Computer Architecture 1.4 Measuring and Reporting Performance 1.5 Factors Influencing the Success of a Computer Architecture 2. Central Processing Unit 3. Data Path Design 4. Control Unit Design
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**COMPUTER SYSTEM ORGANIZATION WITH ASSEMBLY LANGUAGE**
Course Description	The course includes the internal number representation and arithmetic; computer structure and machine language; assembly language concept and assembly language instructions
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Data Structures and Algorithm Analysis
Co requisite	Computer Systems with Assembly Language Laboratory
Course Objectives	After completing this course, the student must be able to: 1. Recall, recognize data, concepts and generalization related to

	machine language and assembly language. 2. Discuss computer structure and programs related to assembly language. 3. Express ideas effectively in relation with computer structure and assembly language program. 4. Utilize debug/ assembler and linker in making assembly language program. 5. Generate program assembly language.
Course Outline	1. Computer Systems 1.1. Evolution of Microcomputers 1.2. Von Neumann Architecture 1.3. Computer Systems Components 2. Assembly Language Concepts 2.1. Instruction and Machine formats 2.2. Addressing modes 2.3. Types of operands and operations 3. Assembly Language Programming 4. Memory System 5. I/O System
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**PRINCIPLES OF COMMUNICATION**
Course Description	The course includes communication systems; transmission media; spectral analysis of signals; noise and distortion; methods of analog and digital modulation; multiplexing systems; telephony; introduction of information theory
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Electronics 2, Electrical Circuits 2
Course Objectives	After completing this course, the student must be able to: 1. Define the different components of an electronic communications system and know the different issues affecting it. 2. Understand the different methods of analog and digital modulation and demodulation. 3. Discuss the theories involved in multiplexing. 4. Appreciate the basics of information theory.
Course Outline	1. Introduction to Electronic Communications Systems 2. Spectral Analysis of Signals (Fourier Analysis, Bandwidth, Filters) 3. Amplitude Modulation 4. Angle Modulation (FM and PM) 5. Noise Calculations 6. Pulse Modulation and Multiplex Systems 7. Coding Scheme 8. Digital Modulation (PCM)

	9. Error Detection and Correction
Laboratory Equipment	None

Course Name	**DATA COMMUNICATIONS**
Course Description	The course includes theory and components of data communication systems; data transmission techniques; communication error detection and correction; computer communication interfaces and adapters; telephone system interfaces
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Principles of Communication
Course Objectives	After completing this course, the student must be able to: 1. Identify the fundamental concepts relating to general data communications and computer networks. 2. Understand the different error-handling techniques. 3. Know the different communication interfaces of a personal computer. 4. Discuss how the telephone system is used in the transmission and reception of data.
Course Outline	1. Introduction to Data Communications Systems 2. Data Transmission Techniques 2.1 Serial 2.2 Parallel 2.3 Synchronous 2.4 Asynchronous 3. Error Handling 4. Computer Communications Interfaces and Adapters (RS-232, USB, Firewire, Lan Modem etc.) 5. Telephone System 5.1 Telephone System Interfaces (File Transfer Protocols)
Laboratory Equipment	None

Course Name	**COMPUTER NETWORKS**
Course Description	The course includes Computer networks and open system standards; transmission media and methods; LAN and WAN technologies; packet forwarding; host-to-host communications; network services; wireless networks; computer network design; network administration, management and security.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory

Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Data Communications
Course Objectives	After completing this course, the student must be able to: 1. Identify and appreciate the different applications and types of computer communication networks. 2. Understand and describe the concept and functionality of each layer in the ISO reference model for open systems interconnection. 3. Describe the different topologies, transmission media, and access control methods commonly used in wired local area networks. 4. Discuss the common network services used. 5. Understand the technological issues and operational characteristics associated with wireless LANs. 6. Know the different aspects of network administration, management and security.
Course Outline	1. Introduction to Computer Networks 2. ISO/OSI Reference Model 3. TCP/IP 4. Local Area Networks (Transmission Media, LAN Standards and Protocols, Network Hardware and Software) 5. Wide Area Networks (Host-to-host communication, packet forwarding) 6. Computer Network Design 7. Network Administration and Management 8. Security
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**DATA STRUCTURES AND ALGORITHMS ANALYSIS**
Course Description	The course includes linear data structures such as arrays, stacks, queues, linked-lists; nonlinear data structures such as generalized lists, trees, and graphs; operations on these using algorithms such as insertions, deletions, and traversals
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Computer Fundamentals and Programming
Course Objectives	After completing this course, the student must be able to: 1. Recognize the different linear and nonlinear data structures 2. Graphically represent any data structure 3. Have a clear understanding of the algorithms for creating, accessing, and destroying structural information 4. Determine the complexity of common algorithms

	5. Apply programming techniques like searching and sorting in solving problems
Course Outline	1. Introduction/Design Principles 2. Analysis of Algorithms 3. Stacks, Queues and Link List 4. Sequences 5. Trees 6. Simple Sorting Method 7. Searching Algorithm 8. Advance Sorting Method 9. Graphs 10. Weighted Graphs
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**OPERATING SYSTEMS**
Course Description	The course includes different policies and strategies used by an operating system. Topics include operating systems structures, process management, storage management, file systems and distributed systems.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Computer System Organization with Assembly Language
Course Objectives	After completing this course, the student must be able to: 1. Understand the goals of an operating system 2. Discuss the different algorithms used for CPU scheduling 3. Describe the different memory management techniques 4. Understand different file system implementation 5. Discuss deadlock avoidance and resolution. 6. Know the basic concepts of distributed operating system
Course Outline	1. Introduction 1.1 Computer hardware structures 1.2 Operating systems concepts 2. Operating Systems Services 2.1 Process management 2.1.1 Process model and control 2.1.2 Threads 2.1.3 Concurrency 2.1.4 Deadlocks 2.2 Memory Management 2.2.1 Stores and store management 2.2.2 Paging and virtual memory 2.3 Scheduling

	2.4 I/O management 2.5 File management 2.6 Command interpreter 3. Distributed Systems 3.1 Basic concepts 3.2 Distributed processing 3.3 Distributed process management
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**SYSTEM ANALYSIS AND DESIGN**
Course Description	This course covers the different phases of systems development and engineering with focus on analysis and design. It covers how to handle requirements, architectural design, integration and verification and shall be facilitated thru project-team design approach in accordance with recognized standards. The students will also be introduced to recent work on the complexity of real world systems, with issues such as multi-level systems, and iterative development.
Number of Units for Lecture and Laboratory	2 units lecture 1 unit laboratory
Number of Contact Hours per Week	2 hours lecture 3 hours laboratory
Prerequisite	Data Structures and Algorithms Analysis, Object-Oriented Programming
Course Objectives	After completing this course, the student must be able to: 1. Perform needs analysis. 2. Translate requirements into systems models. 3. Design solutions for system requirements. 4. Apply interviewing and data gathering techniques and best practices. 5. Present the result of systems analysis and be able to learn how to compare the existing system to the proposed system. 6. Design a proposed system and present its feasibility. 7. Develop a functional understanding of rapid prototyping and other rapid development of systems 8. Demonstrate the team and interpersonal skills
Course Outline	1. Introduction 1.1 The Nature of System 1.1.1 System Definition 1.1.2 Classification of System 1.1.3 General System Principle 1.1.4 Players in the System Game 1.1.5 Embedded Systems 2 Business Processes 3 System Analysis 3.1 Overview of Analysis

	3.1.1 Analysis Definition 3.1.2 Characteristics of Analysis 3.2 Problems of Analysis 3.3 Systems Analysis Definition 3.4 Advantages and Limitation 3.5 Responsibilities of a System Analyst 4 Tools of the System Analyst 4.1 System Development Life Cycle (Structured and Object-Oriented) 4.2 System Model 4.3 Tools of Structure Analysis 4.3.1 Modeling System Functions 4.3.2 Modeling Stored Data 4.3.3 Modeling Program Structures 4.3.4 Other Modeling Tools 5 Feasibility Study 5.1 Technical Feasibility 5.2 Operational Feasibility 5.3 Economic Feasibility 5.3.1 Cost Benefit Analysis 6. Systems Analysis Design Approaches 6.1 Project Fundamentals 6.1.1 Project Scheduling Tools 6.1.2 Managing Analysis and Design Activities 6.1.3 Fact Gathering Techniques 6.2 The Analysis Process 6.2.1 Using Diagrams 6.2.2 Using Data Dictionaries 6.2.3 Process Specifications 6.3 The Essentials of Design 6.3.1 Output Design 6.3.2 Input Design 6.3.3 Databases 6.3.4 User Interfaces 6.3.5 Data-Entry Procedures
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**ENGINEERING ETHICS & COMPUTER LAWS**
Course Description	The course includes moral issues and decisions confronting individuals and organizations involved in engineering. This subject will focus on the study the code of ethics, conflict of interest, safety and risk tradeoffs in design, confidentiality, behavior in the work place, intellectual property, patents, trade secrets and contemporary issues in engineering.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Fifth Year Standing

Course Objectives	After completing this course, the student must be able to: 1. Understand the fundamentals of professionalism and ethics with the focus on the fields of engineering. 2. Study the codes of ethics, conflict of interest, safety and risk tradeoffs in design, confidentiality, behavior in the work place, intellectual property, patents, trade secrets and contemporary issues in engineering.
Course Outline	1. Principles of Ethics 2. Professional Ethics, Codes of Conduct, and Moral Responsibility 3. Ethical Issues 3.1. Professional Responsibility 3.2. Health and Safety 3.3. Privacy 3.4. Security 4. Philippine IT and related Laws 4.1. Electronic Commerce Act 4.2. Access Device Regulations Act 4.3. Intellectual Property Code 5. Transnational Issues 5.1. Cybercrimes 5.2. Electronic Commerce 5.3. International Agreements 6. Social Issues 6.1. Digital Divide, Equity and Access 6.2. Online Communities and Social Networking 6.3. Nanoethics and Other Emerging Issues
Laboratory Equipment	None

Course Name	**COMPUTER HARDWARE FUNDAMENTALS**
Course Description	This course provides an introduction to microcomputer systems hardware, operating system and application software. Installation of basic Local Area Network is also included. It covers topics on microcomputer installation, servicing and troubleshooting techniques, LAN setup and configuration. Concepts are learned through extensive hands-on activities. The proper use and care of tools and equipment are emphasized in the course.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	None
Course Objectives	After completing this course, the student must be able to: 1. Configure Hardware and Software components 2. Perform PC troubleshooting and preventive maintenance 3. Set up and configure a network

Course Outline	1. Fundamental Components of Computer System 1.1 Hardware 1.2 Software (OS, Utility and Application Software) 1.3 Peopleware 1.4 Dataware 1.5 Firmware 1.6 Netware 2. Basic PC troubleshooting and preventive maintenance 2.1 Rules in troubleshooting business 3. System Administration
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**ADVANCED LOGIC CIRCUIT**
Course Description	This course on digital design focuses on different methodologies and styles in hardware modeling with emphasis on the use of hardware description languages (HDLs). It covers very high speed integrated circuit hardware description language (VHDL) fundamental language concepts and elements and the different levels of descriptions such as behavioral and structural.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Logic Circuits Switching Theory
Co-requisite	Advanced Logic Circuit Lab
Course Objectives	After completing this course, the student must be able to: 1. Differentiate technologies related to HDLs such as programmable logic devices, FPGAs and ASICs and advantages and disadvantages of each related field. 2. Construct, compile and execute VHDL programs using provided software tools. 3. Differentiate and implement levels of hardware modeling abstraction using VHDL 4. Design digital components and circuits that are testable, reusable and synthesizable 5. Simulate, analyze and test digital designs using provided software tools 6. Build interests in digital design and related fields.
Course Outline	1. Introduction 2. Algorithm State Machines 2.1 ASM Chart 2.2 Control implementation 2.3 Design with Multiplexes 3. Overview of Digital Systems

	3.1 Evolution of Digital System Design Methodology 3.2 Different Hardware Description Languages (HDLs) 3.3 History of VHDL 3.4 Advantages and Disadvantages of VHDL 4. VHDL-Related Technologies and Fields 4.1 PLDs 5. Hardware Modeling using VHDL 5.1 Levels of Modeling or Abstraction 5.2 VHDL Model Components or Structural Elements 6. VHDL Language 6.1 Lexical Elements 6.2 Scalar Data Types 6.3 Expressions and Operators 6.4 Control Structures 7. VHDL Language 7.1 Composite Data Types 7.2 Access Types 7.3 File Types 8. Basic Modeling Concepts 9. Subprogram and Packages 10. Algorithmic State Machines 10.1 ASM Charts 10.2 Control Implementation 10.3 Design with Multiplexers
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**LOGIC CIRCUITS SWITCHING THEORY**
Course Description	The course includes design and analysis or digital circuits. This course covers both combinational (synchronous and asynchronous) logic circuits with emphasis on solving digital problems using hardwired structures of the complexity of medium and large-scale integration.
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Electronics 1
Co-requisite	Logic Circuits Laboratory
Course Objectives	After completing this course, the student must be able to: 1. Define the operation of the basic combinational circuits including decoders, encoders, multiplexers, demultiplexers, ALUs, and memory circuits. 2. Define the operation of basic sequential circuits including flip-flops, counters, and registers and 3. Analyze and design synchronous and asynchronous sequential circuits.

Course Outline	1. Review of Number Systems 2. Review of Boolean Algebra and Digital Logic 2.1 Basic Definitions of Different Logic Gates 2.1.1 Gates Diagram 2.1.2 Truth Table 2.2 Basic Theorems and Properties of Bolean Algebra 2.3 Bolean Functions 2.3.1 Canonical and Standard Forms 2.3.2 Representation of Bolean Functions using Logic Circuits 2.4 The Map Method 2.5 NAND and NOR Implementation 3. Combinational Logic 3.1 Design Procedure 3.2 Adders and Subtractors 3.3 Code Conversion 3.4 Decoders and Multiplexers 3.5 Read-Only Memory (ROM) and Programmable Logic Array (PLA) 4. Synchronous Sequential Logic 3.1 Representation of Flip-Flops 3.2 Flip-Flop Characteristic Table 3.3 Flip-Flop Excitation Tables 3.4 Design Procedure 3.5 Design using State Equations 3.6 Design of Counters with Logic Diagrams 3.7 State Reduction and Assignment 3.8 Analysis of Sequential Circuits
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**DIGITAL SIGNAL PROCESSING**
Course Description	The course includes the fundamental concepts and practical application of Digital Signal Processing
Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Advanced Engineering Mathematics for CpE
Course Objectives	After completing this course, the student must be able to: 1. Understand the fundamental concepts of Digital Signal Processing 2. Learn the practical application of DSP systems 3. Have a broad foundation on basic DSP theory to prepare the students in their specialization studies
Course Outline	

	2. Theory of Discrete – time Signals and Systems 2.1 Discrete-Time Signals 2.2 Discrete-Time System 3. Introduction to Discrete Transforms 3.1 Frequency Domain of Signals 3.2 Fourier Series 3.3 Discrete Fourier Transform 3.4 Fast Fourier Transform 3.5 Other Discrete Transforms 4. The Z-Transform 4.1 Z- and Inverse Z- Transforms 4.2 Properties of the Z-Transforms 4.3 Applications of Z-Transforms 5. Convolution and Correlation 5.1 Fundamental Concept on Convolution of Signals 5.2 Fundamental Concepts on Cross Correlation 5.3 Fundamental Concepts on Auto-Correlation 6. Digital Filters 6.1 Review on the concepts of filters 6.2 Design of FIR Filters 6.3 Design of IIR Filters 7. Multirate Digital Signal Processing 7.1 Concepts of Multirate Signal Processing 7.2 Software implementation of Sampling Rate Converters 7.3 Application examples 8. Spectrum Estimation and Analysis 8.1 Spectral Analysis 8.2 Practical Application 9. Real-Time DSP
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**OBJECT ORIENTED PROGRAMMING**
Course Description	The course introduces object-oriented programming concepts and techniques using an object-oriented programming language (e.g. C++, Java, Python, etc.) It covers the imperative language features of the language in comparison with C and involves the students in graphical user interface development. The course also involves the students in hands-on work using various software tools based upon the latest Software Development Kit (SDK) of the programming language used.
Number of Units for Lecture and Laboratory	2 units lecture 1 unit laboratory
Number of Contact Hours per Week	2 hours lecture 3 hours laboratory
Prerequisite	Data Structures and Algorithms Analysis
Course Objectives	At the end of the course, the students must be able to:

	1. develop software using the object-oriented paradigm 2. apply object-oriented analysis and design to solve engineering problems 3. develop graphical user interfaces 4. apply best practices in coding software
Course Outline	1. Introduction to Object Oriented Programming and UML 1.1. Fundamental Concepts 1.1.1. Classes, Objects, and Methods 1.1.2. Inheritance 1.1.3. Encapsulation and Abstraction 1.1.4. Polymorphism 1.2. Unified Modeling Language (UML) 1.2.1. Basic Concepts 1.2.2. Association, Aggregation, Composition, and Multiplicity 1.2.3. UML Diagrams 2. Object Oriented Analysis and Design 2.1. Cohesion and Coupling Concepts 2.2. Data-Driven Design 2.3. Responsibility-Driven Design 2.4. Object-Oriented Design using UML 3. Programming Language Fundamentals 3.1. Coding Conventions 3.2. Data Types 3.3. Constants and Variables 3.4. Attributes, Methods, and Constructors 3.5. Control and Iterative Statements 3.6. Characters and Strings 3.7. Arrays 4. Advanced Programming Language Fundamentals 4.1. Inheritance 4.2. Abstract Classes 5. Exception Handling 5.1.1. Understanding Errors and Exceptions 5.1.2. Try, Catch, and Finally 6. Graphical User Interface Programming 6.1. Forms and Widgets 6.2. Graphics, Images, and Sound 6.3. Layout Managers 6.4. Event Handling
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	**MICROPROCESSOR SYSTEM**
Course Description	The course is the study of the design, and applications of microprocessor systems based on stated requirements. The focus is on the basic understanding of its structure and function in order to appreciate the architectural design of microprocessor. The students are encouraged to study various types of microprocessors in order to acquire a better understanding of microprocessor.

Number of Units for Lecture and Laboratory	3 units lecture 1 unit laboratory
Number of Contact Hours per Week	3 hours lecture 3 hours laboratory
Prerequisite	Logic Circuits Switching Theory, Computer System Organization with Assembly Language
Course Objectives	After completing this course, the student must be able to: 1. Design microcomputer systems using a microprocessor or a micro controller. 2. Implement microprocessor based system using different levels of implementation. 3. Develop the control software for the given system implementation
Course Outline	Part 1. Microprocessor Systems Design 1. Review of Microprocessor Architecture and Computer Organization 2. Processor System Level of Implementation 3. Hardware Design and Software Design 3.1 Memory Interfacing 3.2 CPU support devices programming 3.2.1 GPIO 3.2.2 Timer 3.2.3 Interrupts 3.2.4 DMA 3.2.5 Communication Devices 4. Development Platform 5. System Software Design and Programming Part II. Micro controller 6. Microcontroller Hardware Features 7. Microcontroller Instruction Set 8. Development Platform Part III. Interfacing 9. Interfacing Digital IO 10. Analog IO 11. Interfacing Communication Devices Part IV. Systems Design and Development 12. System Development Life Cycle 13. Design for Testability 14. Design Tradeoffs 15. Estimating Project Cost 16. Estimating unit cost
Laboratory Equipment	Please refer to Annex IV – Laboratory Requirements

Course Name	DESIGN PROJECT 1 (METHODS OF RESEARCH)
Course Description	This course provides essential ideas, concepts and principles in methods of research, as well as the important skills needed by the researcher in the various techniques and procedures in the correct preparation and presentation of research report. Required output is a project proposal.
Number of Units for Lecture and Laboratory	2 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Microprocessor System
Course Objectives	After completing this course, the student must be able to: 1. Gain better knowledge, greater understanding, and deep appreciation of the nature, purposes, and significance of research in dealing with various problems that are related to Computer Engineering. 2. Acquire greater knowledge and understanding of various research techniques. 3. Focus on decision making on the feasibility of a chosen project proposal based on defined criteria and considerations. 4. Become more research-oriented in their professional work.
Course Outline	1. Introduction 2. Fundamentals of Research 3. Documentation 1.1 The Problem & Its Background 1.2 Review of Related Literature 1.3 Design Methodology 4. Preparation of Proposal 5. Submission & Defense
Laboratory Equipment	None

Course Name	DESIGN PROJECT 2 (PROJECT IMPLEMENTATION)
Course Description	A course in which individuals or small teams use the principle of computer engineering in the design, building and testing of special circuits or simple systems. The objectives should be the scope of the project proposal in the design project 1 (Methods of Research).

Number of Units for Lecture and Laboratory	2 unit laboratory
Number of Contact Hours per Week	6 hours laboratory
Prerequisite	Design Project 1(Methods of Research)
Course Objectives	After completing this course, the student must be able to: 1. Enhance the capabilities in terms of analysis and design 2. Enable the use of skills for practical application 3. Develop the student's personality vis a vis technical ability
Course Outline	1. Orientation and Briefing 2. Lecture on Documentation 2.1 Data Analysis and Interpretation 2.2 Summary, Conclusion, and Recommendation 3. Preparation and Submission of Proposal 4. Oral Presentation of Approved Proposal 5. Approved Design Project Implementation 5.1 Submission and Presentation of Progress Reports 6. Initial Presentation (Pre-Defense) 7. Final Presentation (Final Defense)
Laboratory Equipment	None

Course Name	**SOFTWARE ENGINEERING**
Course Description	The course includes lifecycle models for software development; software requirements specification; structured analysis and design; software metrics and planning; software testing; reusable software management issues.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Data Structures and Algorithms Analysis
Course Objectives	After completing this course, the student must be able to: 1. Describe the process models of software life cycle 2. Gather requirements for a realistic software system 3. Design software systems at the architectural level, and at lower levels, using techniques such as object-oriented design or structured design 4. Validate requirements and designs and adjust the specification or design as necessary

	5. Describe several methods of estimating the cost and developing a schedule for a programming project 6. Prepare effective, professional software-related documents
Course Outline	1. Introduction to Software Engineering 2. Software Engineering Paradigms 2.1 Software Development Life Cycle 2.2 Prototyping 2.3 RAD 3. Project Planning 4. System Software Requirements 5. Structured Analysis and Extensions 6. Software Design and Implementation 7. Software Integrity
Laboratory Equipment	None

Course Name	**SEMINARS AND FIELD TRIPS**
Course Description	The course includes seminars and lecturers on current trends and issues on Computer Engineering developments. Include field trips to different companies and plants dealing with computer system facilities.
Number of Units for Lecture and Laboratory	1 unit laboratory
Number of Contact Hours per Week	3 hours laboratory
Prerequisite	5th Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Understand the major areas of computer engineering through various seminars conducted by resource persons 2. Expose in the actual industry environment
Course Outline	1. Seminars 1.1 Software and Application Development 1.2 Hardware 1.3 Computer Networks 1.4 Microelectronics 1.5 Career Development 2. Field Trips 2.1 Minor Company/Industry Trips 2.2 Major Company/Industry Trips

Course Name	**ON-THE-JOB TRAINING**
Course Description	A course that enable the students to relate their acquired competencies to the realities and problems of industries. This may

	include involvement in the industry's manpower requirements, development and research concerns, trainings, applications of principles, environmental concerns, ethical and behavioral concerns, decision making, and equipment and materials concerns.
Number of Contact Hours per Week	240 Hours
Prerequisite	Completed 75% of the total required units of the program, 5th Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Involve and participate in a real organization. 2. Complete 240 hours in a company or organization where skills in planning, team management, communications, and technical skills, are applied.
Course Outline	1. Orientation and Presentation of Policies and Guidelines 2. Assertion of Student's OJT on the company 3. Completion of 240 hours 3.1 Submission of Progress Reports 4. Final Report Presentation

F. Technical Elective Courses

Course Name	**ON-LINE TECHNOLOGY**
Course Description	The course includes building and management of a data warehouse application in an online environment, with emphasis on data accessibility using different computing devices, from the desktop to mobile.
Number of Units for Lecture and Laboratory	2 units lecture 1 unit laboratory
Number of Contact Hours per Week	2 hours lecture 3 hours laboratory
Prerequisite	Computer Networks
Course Objectives	After completing this course, the student must be able to: 1. Possess a solid grasp of the different technologies on device connectivity; and 2. Develop an online database application accessible through the various access devices.
Course Outline	1. Introduction to Markup Languages 1.1 HTML 1.2 WML 1.3 XML 2. XML Programming

	manufacturing. 5. Explain how planar process is done on microchip fabrication from crystal growth to wafer test and evaluation. 6. Identify the latest technologies involved in IC fabrication for different IC packages.
Course Outline	1. Principles of Semiconductor 1.1 Atomic Structure 1.2 Semiconductor, Conductor, Insulator 1.3 Energy Level / Quantum Numbers 1.4 Extrinsic and Intrinsic Semiconductor 1.5 Structure of Crystal 1.6 Crystal Defects 1.7 Miller Indices 2. Intro to IC Manufacturing 2.1 Evolution of Semiconductor Manufacturing 2.2 Moore's Law 2.3 Issues on Power Consumption 2.4 IC Cost 3. Microchip Fabrication Process: Planar Process 3.1 Crystal Growth and Wafer Preparation 3.2 Oxidation: Grove & Deals Model for Oxidation 3.3 Photolithography/Photomasking 3.4 Doping: Diffusion and Ion Implantation 3.5 Chemical Vapor Deposition 3.6 Physical Vapor Depostion: Evaporation and Sputtering 3.7 Metallization 3.8 Wafer Test and Evaluation / Contamination Control 4. IC Packaging a. IC Packages b. Digital Logic Families c. NMOS and PMOS Technologies d. Analog MOS Devices e. Memories
Laboratory Equipment	None

Course Name	**MICROELECTRONICS**
Course Description	This course is an introduction to digital IC design. It covers topics on the electronic properties of materials, the process of fabrication of Digital IC, and the basic concepts in designing digital gates using CMOS design flow process, and the integration of these basic cell structures into fundamental system building blocks.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Advanced Logic Circuit, Electronics 2

	manufacturing. 5. Explain how planar process is done on microchip fabrication from crystal growth to wafer test and evaluation. 6. Identify the latest technologies involved in IC fabrication for different IC packages.
Course Outline	1. Principles of Semiconductor 1.1 Atomic Structure 1.2 Semiconductor, Conductor, Insulator 1.3 Energy Level / Quantum Numbers 1.4 Extrinsic and Intrinsic Semiconductor 1.5 Structure of Crystal 1.6 Crystal Defects 1.7 Miller Indices 2. Intro to IC Manufacturing 2.1 Evolution of Semiconductor Manufacturing 2.2 Moore's Law 2.3 Issues on Power Consumption 2.4 IC Cost 3. Microchip Fabrication Process: Planar Process 3.1 Crystal Growth and Wafer Preparation 3.2 Oxidation: Grove & Deals Model for Oxidation 3.3 Photolithography/Photomasking 3.4 Doping: Diffusion and Ion Implantation 3.5 Chemical Vapor Deposition 3.6 Physical Vapor Depostion: Evaporation and Sputtering 3.7 Metallization 3.8 Wafer Test and Evaluation / Contamination Control 4. IC Packaging a. IC Packages b. Digital Logic Families c. NMOS and PMOS Technologies d. Analog MOS Devices e. Memories
Laboratory Equipment	None

Course Name	**MICROELECTRONICS**
Course Description	This course is an introduction to digital IC design. It covers topics on the electronic properties of materials, the process of fabrication of Digital IC, and the basic concepts in designing digital gates using CMOS design flow process, and the integration of these basic cell structures into fundamental system building blocks.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Advanced Logic Circuit, Electronics 2

Course Objectives	After completing this course, the student must be able to: 1. Explain the process flow in CMOS IC fabrication and manufacturing. 2. Contrast the different process flow in digital IC design. 3. Specify gate specifications based on given performance requirements. 4. Design digital systems using CMOS digital IC process flow.
Course Outline	1. Fundamental Concepts 2. CMOS IC Processing Design and Layout 3. Integrated Circuit Devices and Modeling 4. MOS Design 5. CMOS Design Styles 6. CMOS Timing and IO Considerations 7. Synchronous IC Design Considerations 8. Advanced CMOS Logic Design 9. Digital IC System Building Blocks 10. Integrated Memories
Laboratory Equipment	None

Course Name	**EMBEDDED SYSTEM**
Course Description	This course provides an introduction to embedded systems design. It presents the two aspects of embedded systems as both hardware and software in a unified view. The first part is an overview to embedded systems, design challenges, technologies and development and implementation tools. The second part explores the various hardware implementation technologies; custom single-processor, general-purpose processor and memory and peripheral devices interfacing. Finally, the third part covers IC and Design Technology.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	2 hours lecture
Prerequisite	Computer System Organization with Assembly Language
Course Objectives	After completing this course, the student must be able to: 1. Design embedded systems using different design methodologies and technologies. 2. Use development tools such as hardware system compilers and embedded system software development tools. 3. Apply design tradeoffs in developing embedded solutions to a given problem or situation.

Course Outline	1. Embedded System Overview 1.1 Overview 1.2 Design challenge 1.3 Processor Technology 1.4 IC Technology 1.5 Design Technology 1.6 Tradeoffs 2. Processor Hardware 2.1 Custom single processor 2.2 General purpose processor 3. Development Environment 3.1 Design flow 3.2 Design tools 4. System Memory and Peripheral Interfacing 4.1 Communication Basics 4.2 Wired and wireless Protocol concepts 5. Digital IC Technologies 5.1 Full custom (VLSI) IC technology (Semi-custom (ASIC) 6. Design Technology 6.1 EDA tools 7. PID Control Basics 8. Typical controller features, options, and capabilities 9. A/D and D/A Conversion
Laboratory Equipment	None

Course Name	**MANAGEMENT INFORMATION SYSTEM**
Course Description	This course provides an integrative study of what constitutes management information, goals of management, and measures of information value in support of those goals and usual sources of information. The course reviews how management utilizes the vast amounts of computer-generated data, through class discussion and analysis.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Course Objectives	In this course, students will gain a practical know how of how information technologies are being applied to business information for the individual, the group and the organization. This course is designed to help students gain a working knowledge of common computer and information system concepts, demonstrate the application of information system knowledge in existing organization, become aware of ethical considerations in information management, gain and exposure to the potential Business uses and misuses of the Information Technology.

Course Outline	1. The information system Revolution: Transforming Business and Management 2. Principles of Technology Management 3. IT Acquisitions Management 4. Redesigning the Organization with information Systems 5. System Success and Failure: Implementation 6. Managing Data Resources 7. Managing People in Technology Based Organizations Issues 8. Information Systems Security and Control 9. Information Risk Assessment and Security Management 10. Financial Management for Technology Managers
Laboratory Equipment	None

Course Name	**EMERGING TECHNOLOGY**
Course Description	This course focuses on the management and use of emerging technologies (past, present and future), more specifically on the effective integration of information technologies (e.g., programming languages, software packages, operating systems, security issues and hardware infrastructure) within organizations. During the course each student will develop a broad understanding of emerging technologies in general, while developing their knowledge/skill in the use of one particular technology. Learning will be accomplished through assigned reading, class discussion, and hands-on use of state-of-the-art technology. Each student in the course will research and report on one or more of the emerging technologies selected for the course; each report will be in both written and presentation form. Each student in the course will be responsible for demonstrating understanding of each technology covered in the course at the depth of the course report on the technology. By participating in a self-administered learning process (consisting of mentorship, goal setting, and outcome measurement), students will experience a method for learning about emerging technologies, which they can use throughout their careers.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	Fifth Year Standing

Number of Units for Lecture and Laboratory	2 Units Lecture
Number of Contact Hours per Week	2 Hours Lecture
Prerequisite	5th Year Standing
Course Objectives	After completing this course, the student must be able to: 1. Describe the general concepts about quality 2. Apply functional, structural, and statistical testing 3. Use alternatives to testing such as inspection, formal verification, and fault tolerance 4. Understand concepts in quality analysis, including quality models and measurements, defect analysis, and software reliability engineering
Course Outline	1. Introduction to Quality Concepts 1.1 Quality Assurance & Control 1.2 Quality Management Gurus 2. ISO and CMMI 3. QA Processes, Tools, and Metrics 4. The QA Function 5. Infrastructure and Support Activities 6. Digital IC Test Systems 7. Bare Board Test, Bare Board Testers 8. Boundary Scan
Laboratory Equipment	None

Course Name	**DATABASE MANAGEMENT SYSTEM**
Course Description	This course covers the concepts and definitions of databases, the database environment, database design, development, database security and implementation as well as data warehouses. Students will have practical and hands-on experience in SQL (structured-query-language), which is generally used in the development of database applications as well as management of databases.
Number of Units for Lecture and Laboratory	2 units lecture 3 1 unit laboratory
Number of Contact Hours per Week	2 hours lecture 3 1 hours laboratory
Prerequisite	None
Course Objectives	At the end of the course, the student is expected to have learned the important concepts of the DBMS as well as earned some practical hands-on experience with database management systems through the use of SQL.

Course Outline	1. Overview of Database Systems 2. Introduction to Database Design 3. The Relational Model 4. SQL: Queries, Constraints, Triggers 5. Overview of Storage and Indexing 6. Storing Data: Disks and Files 7. Tree-Structured Indexing 8. Hash-Based Indexing 9. Overview of Query Evaluation 10. External Sorting 11. Evaluating Relational Operators 12. A Typical Relational Query Optimizer 13. Overview of Transaction Management 14. Concurrency Control 15. Crash Recovery 16. Schema Refinement and Normal Forms 17. Physical Database Design and Tuning 18. Security and Authorization 19. Parallel and Distributed Databases 20. Object-Database Systems 21. Data Warehousing and Decision Support 22. Data Mining 23. Project Work – Create a small database using SQL.
Laboratory Equipment	PC, free Database software such as MySQL.

Course Name	**PROJECT MANAGEMENT**
Course Description	The course includes the fundamentals of Project Management; Project Management Process, Project Management Initiation; Project Planning and Quality; Time & Resonance Management; Risk; Health and Safety; Project Cost & Budget; The Project Team; Contracts; Procurement & Closure failure Mit9igation
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Course Objectives	After completing this course, the student must be able to create a project plan given a case scenario.
Course Outline	1. Fundamentals of Project Management 2. Project Management Process 3. Project Management Initiation 4. Project Planning and Quality 5. Time & Resource Management 6. Risk, Health & Safety 11. Project Management Teams 12. Contracts, Procurement & Closure 13. Project Management Process, Monitoring, Evaluation
Laboratory Equipment	None

II. NON-TECHNICAL COURSES

C. LANGUAGES

Course Name	**ENGLISH 3 (TECHNICAL COMMUNICATION)**
Course Description	The nature of technical communication; skills and strategies for reading and writing literature reviews, journal articles, and technical reports; making oral presentations.
Number of Units for Lecture and Laboratory	3 units lecture
Number of Contact Hours per Week	3 hours lecture
Prerequisite	English 2
Course Objectives	After completing this course, the student must be able to: 1. Differentiate technical writing from other types of writing; 2. Engage him/herself critically in the reading of a specialized text; 3. Write a summary and review of a journal article; 4. Write a research paper on a technical topic; and 5. Properly acknowledge sources by using a prescribed citation format; 6. Prepare an oral presentation on a technical topic; and 7. Deliver properly an oral technical presentation.
Course Outline	1. The Nature of Technical Communication 2. Technical Writing 2.1. Introduction to Technical Writing 2.2. Library Orientation 2.3. Technical Writing: Formal Schema/Style; Word Choice 2.4. Types of Text Structure in Technical Writing 2.5. Introduction to Research: Choosing a Topic, Outlining 2.6. Skills and Strategies for Reading and Writing Journal Articles, Literature Reviews, and Technical Reports 2.7. Evaluating Sources and Preparing a Preliminary Bibliography 2.8. Preparing and Interpreting Non-Prose Forms 2.9. Summarizing and Analyzing a Journal Article 2.10. Preparing the Different Parts of the Research Paper or Technical Report 2.11. Writing Bibliographies Using a Prescribed Format 2.12. Independent Study 3. Oral Technical Presentations 3.1. Preparing the Presentation Materials 3.2. Delivering the Technical Presentation
Laboratory Equipment	None

LABORATORY REQUIREMENTS
Bachelor of Science in Computer Engineering (BSCpE)

A. ALLIED COURSES

ELECTRICAL CIRCUITS I

Exercises	Required Equipment	Required Quantity per group	Minimum Required quantity
1. Familiarization with Electrical Measuring Instruments a. Determine the characteristics of an analog ammeter b. Determine the characteristics of an analog voltmeter c. Measurement of current and voltage using analog ammeter and voltmeter	Circuits Trainer with power supply Analog DC Ammeter (100 mA dc) Analog DC Voltmeter (20V dc) Multimeter Watt meter	1 set 1 pc 1 pc. 1 pc. 1 pc.	5 sets 5 pcs 5 pcs 5 pcs 5 pcs
2. Analysis of resistive networks a. Demonstration on the characteristics of series-parallel circuits b. Demonstration on the characteristics and principle of basic electric circuit laws c. Demonstration on the use of basic principles involved in series, parallel, and series-parallel circuits.	Circuits Trainer with power supply Analog DC Ammeter (100 mA dc) Analog DC Voltmeter (20V dc) Multimeter	1 set 1 pc. 1 pc. 1 pc.	5 sets 5 pcs 5 pcs 5 pcs
3. Resistance Bridge Circuit a. Operating principles of wheatstone bridge circuits b. Resistance bridge circuits under balanced condition with and without strain. c. Resistance bridge circuits under unbalanced condition with strain.	Circuits Trainer with power supply Analog DC Ammeter (zero centered) Analog DC Voltmeter (zero centered) Multimeter Potentiometer Strain Transducer	1 set 1 pc 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 sets 5 pcs 5 pcs 5 pcs 5 pcs 5 pcs 5 pcs 5 pcs

4. Mesh Analysis and Nodal Analysis a. Investigation of the effects of mesh analysis on multiple active linear sources in a network b. Verification of the linear response at any point in a mesh circuit c. Investigation on the effects of nodal analysis on multiple active linear source in a network d. Verification of the linear response at any point in a nodal circuit	Computer Unit Circuit simulation software	1 set 1 pc	5 sets 5 pcs
5. The Superposition Theorem and Linearity a. Determine the effects of multiple active linear sources in a network b. Verification of linear response at any point in a linear circuit having several independent linear sources c. Illustrations on the principle of linearity	Circuits Trainer with power supply Analog DC Ammeter (100 mA dc) Multimeter	1 set 1 pc. 1 pc.	5 sets 5 pcs 5 pcs
6. Thevenin's and Norton's Theorems a. Demonstration on the principles of Thevenin's Theorem b. Demonstration on the principles of Norton's Theorem c. Relationship between Thevenin's and Norton's Theorems	Circuits Trainer with power supply Ammeter (100 mA dc) Multimeter	1 set 1 pc. 1 pc.	5 sets 5 pcs 5 pcs
7. Feedback and Natural Responses of RC Circuits with DC Excitation a. Analysis of the effect of energy- storing devices (like capacitors) in DC circuits. b. Demonstration on the	Circuits Trainer with power supply Function Generator Oscilloscope Multimeter	1 set 1 unit 1 unit 1 pc.	5sets 5 units 5 units 5 pcs.

charging and discharging response of a capacitor with DC excitation. c. Verification of the natural and forced responses of a DC-excited RC circuit. d. Distinguish between natural, forced, and complete responses of a dynamic RC circuit.			
8. Forced and Natural Responses of RL Circuits with DC Excitation a. Analysis on the effect of energy-storing devices (like Inductors) in DC circuits. b. Demonstration on the charging and discharging responses of an inductor with DC excitation c. Verification on the natural and forced responses of a DC-excited RL circuit. d. Distinguish between natural, forced, and complete responses of a dynamic RL circuit.	Circuits Trainer with power supply Ammeter (100 mA dc) Multimeter	1 set 1 pc. 1 pc.	5 sets 5 pcs. 5 pcs.
9. Forced and Natural Responses of RLC Circuits with DC Excitation a. Demonstration on the charging and discharging responses of an inductor with a capacitor on DC excitation. b. Verification on the natural and forced responses of a DC-excited RL circuit. c. Distinguish between natural, forced, and complete responses	PC Circuit simulator	1 unit 1 unit	5 units 5 units

of a dynamic RC circuit.			
The remaining meetings should be reserved for the presentation of project and completion of other course requirements such as practical, oral, or written examinations, where applicable.			

** maximum of 5 students per group.*

ELECTRICAL CIRCUITS II

Exercises	Required Equipment	Required Quantity per group	Minimum Required quantity
1. RMS Value of an A.C. Sinusoidal Waveform a. Investigation on the RMS value of an AC Sinusoidal Waveform and the associated power	Variable Regulated Power Supply Unit (0 – 20V DC and 0 – 5V AC) Multimeter (V.O.M.) DC Ammeter (0 – 100 mA) AC Ammeter ((0 – 100 mA) 2-Channel Oscilloscope)	1 unit 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs.
2. Resistive, Inductive, and Capacitive Circuits with a Sinusoidal Excitation a. Investigation on the characteristics of a resistive circuit with a sinusoidal excitation b. Investigation on the characteristics of an inductive circuit with a sinusoidal excitation c. Investigation on the characteristics of a capacitive circuit with a sinusoidal excitation	Function Generator Multimeter (V.O.M.) AC Ammeter (0 – 100 mA) 2-Channel Oscilloscope Resistive Load (100 ohms) Resistive Load (470 ohms) Capacitive Load (2.2 microFarad) Inductive Load (100 milliHenry)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
3. Impedance of a Series RLC Circuit a. Investigation on the impedance of a series RLC circuit and compare it with the	Function Generator Multimeter AC Ammeter (0 – 100 mA) Resistive Load (100 ohms)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.

impedance of its constituent components	Capacitive Load (2.2 microFarad) Inductive Load (100 milliHenry) Practical Inductor ((100 – 200 mH)	1 pc.	5 pcs.
4. Impedance and Admittance of a Parallel RLC Circuit a. Investigation on the impedance and admittance of parallel-connected components when driven by a sinusoidal alternating current.	Function Generator Multimeter AC Ammeter (0 – 100 mA) Resistive Load (100 ohms) Capacitive Load (2.2 microFarad) Inductive Load (100 milliHenry)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
5. Computer-Aided Software AC Circuit Analysis Simulation for Network Theorems a. Verification of Superposition Theorem using computer-aided software AC circuit analysis simulation b. Verification of Thevenin's and Norton's Theorems using computer-aided software AC circuit analysis simulation	PC with Computer-Aided Software AC Circuit Analysis Function Generator Multimeter AC Ammeter (0 – 100 mA) Resistive Load (1000 ohms) Capacitive Load (2.2 microFarad) Inductive Load (100 milliHenry) Inductive Load (150 milliHenry)	1 unit 1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs
6. Power in AC Circuits. Investigation on the power dissipated by the resistive components and the power associated with reactive components as well as power associated with the equivalent impedance of an AC circuits	Function Generator Multimeter AC Ammeter (0 – 100 mA) Wattmeter Resistive Load (100 ohms) Capacitive Load (100 nanoFarad) Inductive Load (100 milliHenry)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
7. Balanced Thee-phase Systems a. Verification on the voltage and current relations in a balanced wye 3-phase system b. Verification on the voltage and current relations in a balanced	Test Bed Purely Resistive Impedance (3,000 ohms) Multimeter AC Ammeter (0 – 3 A) Wattmeter Balanced 3-Phase Source (220 V$_{rms}$ at 60	1 set 3 pcs. 1 pc. 1 pc. 1 pc.	5 sets 3 pcs. 5 pcs. 5 pcs. 5 pcs.

delta 3-phase system c. Measurement of 3-phase power using the two-wattmeter method.	Hz)		
8. Series Resonance a. Further investigation on series RLC circuits, especially around the point of minimum impedance.	Function Generator Multimeter AC Ammeter (0 – 100 mA) Resistive Load (1000 ohms) Capacitive Load (2.2 microFarad) Inductive Load (100 milliHenry)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
9. Parallel Resonance a. Further investigation on parallel RLC circuits, especially around the point of maximum impedance.	Function Generator Multimeter AC Ammeter (0 – 100 mA) Resistive Load (1000 ohms) Resistive Load (100 ohms) Capacitive Load (2.2 microFarad) Inductive Load (100 milliHenry)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
10. Two-Port Network Parameters a. Investigation on the different parameters of a two-port network.	Variable Regulated Power Supply Unit (0 – 20V DC and 0 – 5V AC) Multimeter (V.O.M.) AC Ammeter (0 – 100 mA) Resistor (1000 ohms) Resistor (470 ohms) Resistor (680 ohms) Resistor (2,000 ohms)	1 unit 1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 units 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs. 5 pcs.
The remaining meetings should be reserved for the presentation of project and completion of other course requirements such as practical, oral, or written examinations, where applicable.			

- maximum of 5 students per group

ELECTRONICS 1
(ELECTRONICS DEVICE AND CIRCUITS)

Exercises	Required Equipment	Required Quantity per group	Minimum Required quantity
1. Component and Equipment Familiarization	Function Generator Digital Multimeter (DMM) Component board with Power Supply Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs
2. Diode Characteristics	DC Power Supply Analog Multimeter Digital Multimeter (DMM) Breadboard Oscilloscope Desktop Computer	1 pc. 1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
3. The Diode Limiter	Function Generator Semiconductor Devices Circuit Board with Power Supply Oscilloscope Digital Multimeter (DMM) Desktop Computer	1 pc. 1 pc 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
4. The Diode Clamper	Function Generator Semiconductor Devices Circuit Board with Power Supply Oscilloscope Digital Multimeter (DMM) Desktop Computer	1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs. 5 pcs 5 pcs 5 pcs 5 pcs
5. Rectifiers and Filters	Digital Multimeter (DMM) Function Generator Oscilloscope Semiconductor Devices Circuit Board with Power	1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs

	Supply Desktop Computer		
6. The Voltage Doubler	Digital Multimeter Semiconductor Devices circuit Board with Power Supply Function Generator Digital Oscilloscope Desktop Computer	1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
7. Zener Diode and Voltage Regulation	Digital Multimeter (DMM) Breadboard Semiconductor Devices Circuit board with Power Supply DC Supply Desktop computer	1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
8. Bipolar Junction Transistor	Digital Multimeter (DMM) F.A.C.E.T. base unit Semiconductor Devices Ckt. board Desktop computer	1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs
9. Transistor Biasing	Digital Multimeter (DMM) Semiconductor Devices Circuit board with power supply Desktop computer	1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs
The remaining meetings should be allotted for the presentation of a project related to Electronics, and completion of other course requirements such as practical, oral, or written examinations, where applicable			

** maximum of 5 students per group*

ELECTRONICS 2
(ELECTRONICS CIRCUIT ANALYSIS AND DESIGN)

Exercise	Required Equipment	Required Quantity per group	Minimum Required quantity
1. Small-signal Amplifier a. Common-Base b. Common-Emitter c. Common-Collector	Digital Multimeter (DMM) Transistor Amplifier Circuit board with Power Supply Function Generator Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc	5 pcs. 5 pcs. 5 pcs. 5 pcs
2. Cascaded Amplifier a. Direct Coupled b. RC Coupled c. Transformer Coupled	Digital Multimeter (DMM) Transistor Amplifier Circuit board Function Generator Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc	5 pcs 5 pcs 5 pcs 5 pcs
3. Power Amplifier a. Single-ended b. Push-pull	Digital Multimeter (DMM) Transistor Power Amplifier Circuits Ckt. board Function Generator Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc 1 pc	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
4. JFET Fundamentals	Digital Multimeter (DMM) FET Fundamentals Circuit board with Power Supply Function Generator Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc 1 pc	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
5. JFET Amplifier	Digital Multimeter (DMM) FET Fundamentals Circuit board with Power Supply Function Generator Oscilloscope	1 pc. 1 pc. 1 pc 1 pc	5 pcs 5 pcs 5 pcs 5 pcs
6. Amplifier Frequency Response	Digital Multimeter (DMM) Transistor Power Amplifiers Ckt. board Function Generator Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc 1 pc	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs
7. Feedback Amplifier	Digital Multimeter (DMM) Transistor Feedback Circuits Ckt. board Function Generator Oscilloscope	1 pc. 1 pc. 1 pc. 1 pc. 1 pc.	5 pcs 5 pcs 5 pcs 5 pcs 5 pcs

- maximum of 5 students per group

B. PROFESSIONAL COURSES

COMPUTER ENGINEERING DRAFTING AND DESIGN

Exercise	Required Equipment	Required Quantity*
1. Block Diagrams and Flowcharts Drafting Rules	PC & any appropriate software	Depending on the class size (1:1 ratio)
2. Electronics Symbols standards	PC & any circuit layout software tool	Depending on the class size (1:1 ratio)
3. Schematic layout using drafting software tool	PC & any circuit layout software tool	Depending on the class size (1:1 ratio)
4. PCB layout using drafting software tool	PC & any pcb layout software tools	Depending on the class size (1:1 ratio)
5. Schematic to PCB layout using drafting software tool	PC & any circuit layout software tools	Depending on the class size (1:1 ratio)
6. Wiring and Cabling diagram using drafting software tool	PC & any wiring and cabling layout software tools	Depending on the class size (1:1 ratio)

CONTROL SYSTEMS

Exercise	Required Equipment	Required Quantity*
1. Transfer Function	PC and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
2. Block Diagram Reduction	PC and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
3. Root-Locus Plots	PC and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
4. Analysis of Controlled System	PC and Control System Module or engineering and scientific calculations software	Depending on the class size (1:1 ratio)
5. Controlled System with Compensation	PC and Control System Module or engineering and scientific calculations	Depending on the class size

	software	(1:1 ratio)
6. Time Delay Element	PC and Control System Module or engineering and scientific calculations software	Depending on the class size (1:1 ratio)
7. Control System without Compensation	PC and Control System Module or engineering and scientific calculations software	Depending on the class size (1:1 ratio)
8. Controller Types	PC and Control System Module or engineering and scientific calculations software	Depending on the class size (1:1 ratio)
9. PI, PD, and PID Controller	PC and Control System Module or engineering and scientific calculations software	Depending on the class size (1:1 ratio)
10. Automatic Digital Control	PC and Control System Module or engineering and scientific calculations software	Depending on the class size (1:1 ratio)

*For Control System module, maximum of five students for every module

COMPUTER SYSTEM ARCHITECTURE

Exercise	Required Equipment	Required Quantity*
1. Review of the Development Platform	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
2. Datapath: Register Set Implementation	1. Computers (Suitable to run the software required) 2. Software: Electronic Design Automation tool	1 set for a group of 5
3. Datapath: Arithmetic Logic Unit Implementation	1. Computers (Suitable to run the software required) 2. Software: Electronic Design Automation tool	1 set for a group of 5
4. Datapath: Routing Ciruit Implementation	1. Computers (Suitable to run the software required) 2. Software: Electronic Design Automation tool	1 set for a group of 5
5. Control Unit: Hardwired Control Implementation	1. Computers (Suitable to run the software required) 2. Software: Electronic Design Automation tool	1 set for a group of 5
6. Control Unit: Microprogrammed Control Implementation	1. Computers (Suitable to run the software required)	1 set for a group of 5

	2. Software: Electronic Design Automation tool	
7. Integration: Integrating the Datapath and Control Unit	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tools for VHDL or Verilog 4. Oscilloscope (preferably, digital storage oscilloscope).	1 set for a group of 5

COMPUTER SYSTEM ORGANIZATION WITH ASSEMBLY LANGUAGE

Exercise	Required Equipment	Required Quantity*
1. Introduction to Assembly Language tools	Computer & Assembly Language software tools	Depending on the class size (1:1 ratio)
2. Translation of C program statements to assembly	Computer & Assembly Language software tools	Depending on the class size (1:1 ratio)
3. Data Transfer & String Instructions	Computer & Assembly Language software tools	Depending on the class size (1:1 ratio)
4. Arithmetic Instructions	Computer & Assembly Language software tools	Depending on the class size (1:1 ratio)
5. Bit Manipulation Instructions	Computer & Assembly Language software tools	Depending on the class size (1:1 ratio)
6. Program Control Instructions	Computer & Assembly Language software tools	Depending on the class size (1:1 ratio)
7. I/O Port Interfacing	Computer Assembly Language software tools, I/O devices	Depending on the number of groups(1:5 ratio)
8. Memory Interfacing	Computer, Assembly Language software tools, Memory devices	Depending on the number of groups(1:5 ratio)

COMPUTER NETWORKS

Exercise	Required Equipment	Required Quantity*
1. Structured Cabling Preparation	Wire cutter and stripper	Depending on class size (1:1)

	RJ-45 Crimp Tool 3-4 feet of Category 5/5e or Category 6 cable RJ-45 connectors Patch cable checker (optional)	class size (1:1)
2. Network Hardware Familiarization and Network Operating System Installation	Network Ready Computer • Network Interface Card • (NICs with different bus types: • PCI, PCI-X, PC Card/PCMCIA, USB, FireWire • Wireless NICs) Network Operating System	Depending on class size (1:1)
3. Network connectivity configuration	Network Ready Computer Network Operating System Computer *Switch / Hub	Depending on class size (1:1)
4.Checking Network Connection	Network Ready Computer Network Operating System Computer *Switch / Hub	Depending on class size (1:1)
5.Subnetting	Network Ready Computer Network Operating System Computer *Switch / Hub	Depending on class size (1:1)
6.File and Printer Sharing Across LAN with security and accounting	Network Ready Computer Network Operating System Computer *Switch / Hub	Depending on class size (1:1)
7. DHCP and DNS Configuration	Network Ready Computer Network Operating System Computer *Switch / Hub	Depending on class size (1:1)
8. Routing and Remote Access Service (RRAS) Configuration	Network Ready Computer Network Operating System Computer *Switch / Hub	Depending on class size (1:1)

* Number of Switch / Hub will depend on the number of ports

DATA STRUCTURES AND ALGORITHMS ANALYSIS

Exercise	Required Equipment	Required Quantity*
1. List Operations	Computer & C programming language software tool	Depending on the class size (1:1 ratio)
2. Stack operations & applications	Computer & C programming language software tool	Depending on the class size

		(1:1 ratio)
3. Linear and Circular Queue operations	Computer & C programming language software tool	Depending on the class size (1:1 ratio)
4. Singly and Doubly Linked List	Computer & C programming language software tool	Depending on the class size (1:1 ratio)
5. Binary Trees operations	Computer & C programming language software tool	Depending on the class size (1:1 ratio)
6. Sorting Algorithms	Computer & C programming language software tool	Depending on the class size (1:1 ratio)
7. Searching Algorithms	Computer & C programming language software tool	Depending on the class size (1:1 ratio)
8. Graph Traversals	Computer & C programming language software tool	Depending on the class size (1:1 ratio)

OPERATING SYSTEMS

Exercise	Required Equipment	Required Quantity*
1. UNIX and C Programming	Computer, UNIX and C Programming language software tool	Depending on the class size (1:1 ratio)
2. UNIX Commands	Computer, UNIX	Depending on the class size (1:1 ratio)
3. UNIX Shell Programming	Computer, UNIX	Depending on the class size (1:1 ratio)
4. System Calls	Computer, UNIX and C Programming language software tool	Depending on the class size (1:1 ratio)
5. Observing OS Behavior	Computer, UNIX	Depending on the class size (1:1 ratio)
6. Processes Creation and Execution	Computer, UNIX	Depending on the class size (1:1 ratio)
7. Threads Creation and Execution	Computer, UNIX and C Programming language software tool	Depending on the class size (1:1 ratio)

8. Process/Threads Synchronization	Computer, UNIX and C Programming language software tool	Depending on the class size (1:1 ratio)
9. Inter-Process Communication	Computer, UNIX and C Programming language software tool	Depending on the class size (1:1 ratio)
10. Memory Management	Computer, UNIX and C Programming language software tool	Depending on the class size (1:1 ratio)

SYSTEMS ANALYSIS AND DESIGN

Exercise	Required Equipment	Required Quantity*
Modeling the System	PC & any modeling software or diagramming tool	Depending on the class size (1:1 ratio)

COMPUTER HARDWARE FUNDAMENTALS

Exercise	Required Equipment	Required Quantity*
1. Actual familiarization with different types of processors for desktop, mobile and server computers	Different types of processors for desktop, mobile and server computers. (Oldest – most recent)	1 set for a group of 4
2. Familiarization with different form factors	Different system unit or chassis for desktop, mobile and server computers	1 set for a group of 4
3. Familiarization with I/O components/ devices	Different types of I/O Components/devices	1 set for a group of 4
4. Familiarization with Typical System Board Layout	Different system boards/motherboards	1 set for a group of 4
5. Primary and Secondary Storage	Different types of memory modules (primary) and secondary storage	1 set for a group of 4
6. Computer Assembly and disassembly	Computer and its peripherals	1 set for a group of 4
7. Software Installation	Different System and Application Software	1 set for a group of 4
8. Network Cables, Cabling and Tools	Different types of network cables, cabling and tools	1 set for a group of 4
9. Basic PC Troubleshooting	PC and troubleshooting tools	1 set for a group of 4

ADVANCED LOGIC CIRCUIT

Exercise	Required Equipment	Required Quantity*
1. Review of Development Platform	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
2. Mealy Machine	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
3. Moore Machine	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
4. Sequence Detector	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
5. Project: Basic Digital System Design		Individual

LOGIC CIRCUITS SWITCHING THEORY

Exercise	Required Equipment	Required Quantity*
1. Digital Logic Gate Familiarization	Logic Gates, Breadboard, Power Supply, Logic Probe, LEDs	Depending on the class size (1:1 ratio)
2. Review of Development Platform	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
3. Combinational Network	multiplexers, decoders, code converter, encoder, Breadboard, Power Supply, Logic Probe, LEDs	1 set for a group of 5

4. Combinational Network Subsystem: multiplexers, decoders, code converter	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
5. Arithmetic Circuit: Adders, Subtractors	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool	1 set for a group of 5
6. Arithmetic Circuit: multipliers/dividers	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool 4. Digital Storage Oscilloscope	1 set for a group of 5
7. Sequential Circuit: Counters	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool 4. Digital Storage Oscilloscope	1 set for a group of 5
8. Sequential Circuit: Registers	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool 4. Digital Storage Oscilloscope	1 set for a group of 5
9. Sequential Circuit: ROM/RAM	1. Programmable Logic Development Board 2. Computers (Suitable to run the software required) 3. Software: Electronic Design Automation tool 4. Digital Storage Oscilloscope	1 set for a group of 5

DIGITAL SIGNAL PROCESSING

Exercise	Required Equipment	Required Quantity*
1. Discrete Fourier Transform Properties	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)

2. Fast Convolution	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
3. Discrete-Time Fourier Transform Properties	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
4. Sampling Analog Signals	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
5. Interpolation	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
6. Sampling Digital Signals	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
7. IIR Filters : Examples	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
8. IIR Design for Given Magnitude	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
9. Stationary Random Sequences	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)
10. Digital Images	Computer and engineering and scientific calculations software	Depending on the class size (1:1 ratio)

OBJECT ORIENTED PROGRAMMING

Exercise	Required Equipment	Required Quantity*
1. Object-Oriented Program Design	Computer, Design Software	Depending on class size (1:1 ratio)
2. Introduction to Object-Oriented Programming Language	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
3. Control and Iterative Statements	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
4. Characters and Strings	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
5. Object Arrays	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)

6. Inheritance, Interfaces, and Templates (Session 1 of 2)	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
7. Inheritance, Interfaces, and Templates (Session 2 of 2)	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
8. Graphical User Interface Programming (Session 1 of 2)	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
9.Graphical User Interface Programming (Session 2 of 2)	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)
10. Event Handling	Computer, Integrated Development Environment (IDE) for Object-Oriented Programming Language	Depending on class size (1:1 ratio)

MICROPROCESSOR SYSTEM

Exercise	Required Equipment	Required Quantity*
1. Review of Development Platform	1. Programmable Logic Development Board 2. Computers, Pentium class or equivalent 3. Software: Electronic Design Automation tools for VHDL or Verilog 4. Microprocessor Development System: Emulator, C Compiler, Assembler, Debuggers 5. Microcomputer Development System 6. Microcontroller Development System 7. Oscilloscope (preferably, digital storage oscilloscope). 8. Logic Analyzers (32 channels). Mixed signal capability preferred 9. Universal Prototyping System: Breadboard, protoboard	
2. Microprocessor System: Digital IO Interfacing: Keypad/LCD	1. Computers, Pentium class or equivalent 2. Microprocessor Development System: Emulator, C Compiler, Assembler, Debuggers 3. Prototyping Board 4. Keypad Module 5. LCD Module	
3. Microprocessor System: Analog IO	1. Computers, Pentium class or equivalent 2. Microprocessor Development	

	System: Emulator, C Compiler, Assembler, Debuggers 3. Prototyping Board 4. ADC Module 5. DAC Module	
4. Microcontroller System: Digital IO Interfacing: Keypad/LCD	1. Computers, Pentium class or equivalent 2. Microprocessor Development System: Emulator, C Compiler, Assembler, Debuggers 3. Prototyping Board 4. Keypad Module 5. LCD Module	
5. Microcontroller System: Analog IO	1. Computers, Pentium class or equivalent 2. Microprocessor Development System: Emulator, C Compiler, Assembler, Debuggers 3. Prototyping Board 4. ADC Module 5. DAC Module	
6. Process Control	1. Computers, Pentium class or equivalent 2. Microprocessor Development System: Emulator, C Compiler, Assembler, Debuggers 3. Prototyping Board 4. DC Motor Module 5. Stepper Motor Module	
7. Communication: Interfacing a microcontroller system previously developed to the PC through the RS232C interface.	1. Programmable Logic Development Board 2. Computers, Pentium class or equivalent 3. Software: Electronic Design Automation tools for VHDL or Verilog 4. Microprocessor Development System: Emulator, C Compiler, Assembler, Debuggers 5. Microcomputer Development System 6. Microcontroller Development System 7. Oscilloscope (preferably, digital storage oscilloscope). 8. Logic Analyzers (32 channels). Mixed signal capability preferred 9. Universal Prototyping System: Breadboard, protoboard	