



Syllabus Description

For
Computer Engineering Department
College of Engineering,
University of Basrah,
Basrah, Iraq



1. Introduction

1.1 Overview of Department of Computer Engineering

The computer engineering department was established in 1997-1998 to meet the emerging need for skilled computer engineers and to keep abreast of the scientific and technical progress in the world.

Since its inauguration, CoE department adopted a well academic program equal to the computer engineering departments worldwide by focusing on both theoretical and practical integrated aspects of the computer engineering field of study. The practical side of the program equals one third the total teaching process and the curriculums are kept updated.

The undergraduate study at the department is four years in length; from the moment of receiving the freshman year students whose average grades qualify them to join it up till to the graduation of the senior year students where they get their Bachelor of Science degree in computer engineering.

1.2 Program Educational Objective

The curriculum requirements specify subject areas appropriate to Computer Engineering (CoE). The professional component must include:

1. A combination of mathematics and basic sciences general education component (some with experimental experience) appropriate to the discipline.
2. Computer Engineering topics, consisting of Computer Engineering sciences and engineering design appropriate to the computer utilization study.
3. A general education component that complements the technical content of the curriculum and is consistent with the program and institution objectives.
4. These **requirements** are reporting in "The Curriculum Guidelines for Undergraduate Degree Programs in Computer Engineering. A report of Computing Curricula IEEE Computer Society CE-2004 and its updates (2010, 2012, 2014)". The Computer Engineering Task Force has sought to assemble a modern curriculum by first defining the primary disciplines that make up the body of knowledge for computer engineering. Some of these discipline areas contain material that should be part of all computer engineering curricula. These are the 18 knowledge areas, including two covering related mathematics topics, listed in Table 1.1



Table 1.1 The Computer Engineering Body of Knowledge

Computer Engineering Knowledge Areas and Units	
CE-ALG Algorithms [30 core hours] CE-ALG0 History and overview [1] *CE-ALG1 Basic algorithmic analysis [4] *CE-ALG2 Algorithmic strategies [8] *CE-ALG3 Computing algorithms [12] *CE-ALG4 Distributed algorithms [3] *CE-ALG5 Algorithmic complexity [2] *CE-ALG6 Basic computability theory	CE-CAO Computer Architecture and Organization [63 core hours] CE-CAO0 History and overview [1] CE-CAO1 Fundamentals of computer architecture [10] CE-CAO2 Computer arithmetic [3] CE-CAO3 Memory system organization and architecture [8] CE-CAO4 Interfacing and communication [10] CE-CAO5 Device subsystems [5] CE-CAO6 Processor systems design [10] CE-CAO7 Organization of the CPU [10] CE-CAO8 Performance [3] CE-CAO9 Distributed system models [3] CE-CAO10 Performance enhancements
CE-CSE Computer Systems Engineering [18 core hours] CE-CSE0 History and overview [1] CE-CSE1 Life cycle [2] CE-CSE2 Requirements analysis and elicitation [2] CE-CSE3 Specification [2] CE-CSE4 Architectural design [3] CE-CSE5 Testing [2] CE-CSE6 Maintenance [2] CE-CSE7 Project management [2] CE-CSE8 Concurrent (hardware/software) design [2] CE-CSE9 Implementation CE-CSE10 Specialized systems CE-CSE11 Reliability and fault tolerance	CE-CSG Circuits and Signals [43 core hours] CE-CSG0 History and overview [1] CE-CSG1 Electrical Quantities [3] CE-CSG2 Resistive Circuits and Networks [9] CE-CSG3 Reactive Circuits and Networks [12] CE-CSG4 Frequency Response [9] CE-CSG5 Sinusoidal Analysis [6] CE-CSG6 Convolution [3] CE-CSG7 Fourier Analysis CE-CSG8 Filters CE-CSG9 Laplace Transforms
CE-DBS Database Systems [5 core hours] CE-DBS0 History and overview [1] *CE-DBS1 Database systems [2] *CE-DBS2 Data modeling [2] *CE-DBS3 Relational databases *CE-DBS4 Database query languages *CE-DBS5 Relational database design *CE-DBS6 Transaction processing *CE-DBS7 Distributed databases *CE-DBS8 Physical database design	CE-DIG Digital Logic [57 core hours] CE-DIG0 History and overview [1] CE-DIG1 Switching theory [6] CE-DIG2 Combinational logic circuits [4] CE-DIG3 Modular design of combinational circuits [6] CE-DIG4 Memory elements [3] CE-DIG5 Sequential logic circuits [10] CE-DIG6 Digital systems design [12] CE-DIG7 Modeling and simulation [5] CE-DIG8 Formal verification [5] CE-DIG9 Fault models and testing [5] CE-DIG10 Design for testability
CE-DSP Digital Signal Processing [17 core hours] CE-DSP0 History and overview [1] CE-DSP1 Theories and concepts [3] CE-DSP2 Digital spectra analysis [1] CE-DSP3 Discrete Fourier transform [7] CE-DSP4 Sampling [2] CE-DSP5 Transforms [2] CE-DSP6 Digital filters [1] CE-DSP7 Discrete time signals CE-DSP8 Window functions CE-DSP9 Convolution CE-DSP10 Audio processing CE-DSP11 Image processing	CE-ELE Electronics [40 core hours] CE-ELE0 History and overview [1] CE-ELE1 Electronic properties of materials [3] CE-ELE2 Diodes and diode circuits [5] CE-ELE3 MOS transistors and biasing [3] CE-ELE4 MOS logic families [7] CE-ELE5 Bipolar transistors and logic families [4] CE-ELE6 Design parameters and issues [4] CE-ELE7 Storage elements [3] CE-ELE8 Interfacing logic families and standard buses [3] CE-ELE9 Operational amplifiers [4] CE-ELE10 Circuit modeling and simulation [3] CE-ELE11 Data conversion circuits CE-ELE12 Electronic voltage and current sources CE-ELE13 Amplifier design CE-ELE14 Integrated circuit building blocks



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<p>CE-ESY Embedded Systems [20 core hours]</p> <p>CE-ESY0 History and overview [1]</p> <p>CE-ESY1 Embedded microcontrollers [6]</p> <p>CE-ESY2 Embedded programs [3]</p> <p>CE-ESY3 Real-time operating systems [3]</p> <p>CE-ESY4 Low-power computing [2]</p> <p>CE-ESY5 Reliable system design [2]</p> <p>CE-ESY6 Design methodologies [3]</p> <p>CE-ESY7 Tool support</p> <p>CE-ESY8 Embedded multiprocessors</p> <p>CE-ESY9 Networked embedded systems</p> <p>CE-ESY10 Interfacing and mixed-signal systems</p>	<p>CE-HCI Human-Computer Interaction [8 core hours]</p> <p>CE-HCI0 History and overview [1]</p> <p>*CE-HCI1 Foundations of human-computer interaction [2]</p> <p>*CE-HCI2 Graphical user interface [2]</p> <p>*CE-HCI3 I/O technologies [1]</p> <p>*CE-HCI4 Intelligent systems [2]</p> <p>*CE-HCI5 Human-centered software evaluation</p> <p>*CE-HCI6 Human-centered software development</p> <p>*CE-HCI7 Interactive graphical user-interface design</p> <p>*CE-HCI8 Graphical user-interface programming</p> <p>*CE-HCI9 Graphics and visualization</p> <p>*CE-HCI10 Multimedia systems</p>
<p>CE-NWK Computer Networks [21 core hours]</p> <p>CE-NWK0 History and overview [1]</p> <p>CE-NWK1 Communications network architecture [3]</p> <p>CE-NWK2 Communications network protocols [4]</p> <p>CE-NWK3 Local and wide area networks [4]</p> <p>CE-NWK4 Client-server computing [3]</p> <p>CE-NWK5 Data security and integrity [4]</p> <p>CE-NWK6 Wireless and mobile computing [2]</p> <p>CE-NWK7 Performance evaluation</p> <p>CE-NWK8 Data communications</p> <p>CE-NWK9 Network management</p> <p>CE-NWK10 Compression and decompression</p>	<p>CE-OPS Operating Systems [20 core hours]</p> <p>CE-OPS0 History and overview [1]</p> <p>*CE-OPS1 Design principles [5]</p> <p>*CE-OPS2 Concurrency [6]</p> <p>*CE-OPS3 Scheduling and dispatch [3]</p> <p>*CE-OPS4 Memory management [5]</p> <p>*CE-OPS5 Device management</p> <p>*CE-OPS6 Security and protection</p> <p>*CE-OPS7 File systems</p> <p>*CE-OPS8 System performance evaluation</p>
<p>CE-PRF Programming Fundamentals [39 core hours]</p> <p>CE-PRF0 History and overview [1]</p> <p>*CE-PRF1 Programming Paradigms [5]</p> <p>*CE-PRF2 Programming constructs [7]</p> <p>*CE-PRF3 Algorithms and problem-solving [8]</p> <p>*CE-PRF4 Data structures [13]</p> <p>*CE-PRF5 Recursion [5]</p> <p>*CE-PRF6 Object-oriented programming</p> <p>*CE-PRF7 Event-driven and concurrent programming</p> <p>*CE-PRF8 Using APIs</p>	<p>CE-SPR Social and Professional Issues [16 core hours]</p> <p>CE-SPR0 History and overview [1]</p> <p>*CE-SPR1 Public policy [2]</p> <p>*CE-SPR2 Methods and tools of analysis [2]</p> <p>*CE-SPR3 Professional and ethical responsibilities [2]</p> <p>*CE-SPR4 Risks and liabilities [2]</p> <p>*CE-SPR5 Intellectual property [2]</p> <p>*CE-SPR6 Privacy and civil liberties [2]</p> <p>*CE-SPR7 Computer crime [1]</p> <p>*CE-SPR8 Economic issues in computing [2]</p> <p>*CE-SPR9 Philosophical frameworks</p>
<p>CE-SWE Software Engineering [13 core hours]</p> <p>CE-SWE0 History and overview [1]</p> <p>*CE-SWE1 Software processes [2]</p> <p>*CE-SWE2 Software requirements and specifications [2]</p> <p>*CE-SWE3 Software design [2]</p> <p>*CE-SWE4 Software testing and validation [2]</p> <p>*CE-SWE5 Software evolution [2]</p> <p>*CE-SWE6 Software tools and environments [2]</p> <p>*CE-SWE7 Language translation</p> <p>*CE-SWE8 Software project management</p> <p>*CE-SWE9 Software fault tolerance</p>	<p>CE-VLS VLSI Design and Fabrication [10 core hours]</p> <p>CE-VLS0 History and overview [1]</p> <p>CE-VLS1 Electronic properties of materials [2]</p> <p>CE-VLS2 Function of the basic inverter structure [3]</p> <p>CE-VLS3 Combinational logic structures [1]</p> <p>CE-VLS4 Sequential logic structures [1]</p> <p>CE-VLS5 Semiconductor memories and array structures [2]</p> <p>CE-VLS6 Chip input/output circuits</p> <p>CE-VLS7 Processing and layout</p> <p>CE-VLS8 Circuit characterization and performance</p> <p>CE-VLS9 Alternative circuit structures/low power design</p> <p>CE-VLS10 Semi-custom design technologies</p> <p>CE-VLS11 ASIC design methodology</p>
Mathematics Knowledge Areas and Units	
<p>CE-DSC Discrete Structures [33 core hours]</p> <p>CE-DSC0 History and overview [1]</p> <p>*CE-DSC1 Functions, relations, and sets [6]</p> <p>*CE-DSC2 Basic logic [10]</p> <p>*CE-DSC3 Proof techniques [6]</p> <p>*CE-DSC4 Basics of counting [4]</p> <p>*CE-DSC5 Graphs and trees [4]</p> <p>*CE-DSC6 Recursion [2]</p>	<p>CE-PRS Probability and Statistics [33 core hours]</p> <p>CE-PRS0 History and overview [1]</p> <p>CE-PRS1 Discrete probability [6]</p> <p>CE-PRS2 Continuous probability [6]</p> <p>CE-PRS3 Expectation [4]</p> <p>CE-PRS4 Stochastic Processes [6]</p> <p>CE-PRS5 Sampling distributions [4]</p> <p>CE-PRS6 Estimation [4]</p> <p>CE-PRS7 Hypothesis tests [2]</p> <p>CE-PRS8 Correlation and regression</p>

* Consult the CC2001 Report [ACM/IEEECS, 2001] for more detail on these knowledge



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1.3 ABET Program Outcomes

Program outcomes are defined by ABET as:

"Narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the skills, knowledge, and behaviors that students acquire in their matriculation through the program."

The Computer Engineering department has developed eleven Program Outcomes (POs). These outcomes are, in effect, what the students expected to know and achieve post-graduation.

Table 1.2 shows these program outcomes.

Table 1.2: Computer Engineering Program Outcomes

<u>Symbol</u>	<u>Description</u>
<u>a</u>	PO1: ability to apply knowledge of mathematics, science, and engineering fundamentals.
<u>b</u>	PO2: ability to outline and conduct experiments as well as analyze and interpret data.
<u>c</u>	PO3: ability to design an integrated system and its various components and processes, within realistic economic, environment, social, political, ethical, health and safety, manufacturability, and sustainability constraints.
<u>d</u>	PO4: ability to function on multi-disciplinary teams to analyze and solve problems.
<u>e</u>	PO5: ability to identify, evaluate and solve engineering problems.
<u>f</u>	PO6: understanding of the responsibility of engineers to practice in a professional and ethical manner at all times.
<u>g</u>	PO7: ability to communicate effectively using oral, written, and graphic forms.
<u>h</u>	PO8: the broad education necessary to understand the potential impact of engineering solutions on society and the environment.
<u>i</u>	PO9: understanding of the need for up-to-date engineering tools and other knowledge acquired through life-long learning.
<u>j</u>	PO10: knowledge of contemporary issues related to engineering.
<u>k</u>	PO11: ability to use modern engineering tools, skills and design techniques necessary for the practice of engineering.

1.4 University Linkage Program “Oklahoma State University”

The Computer Engineering Department had linkage program with Oklahoma State University OSU 2010-2013. The proposed curriculum have some disappointed :-

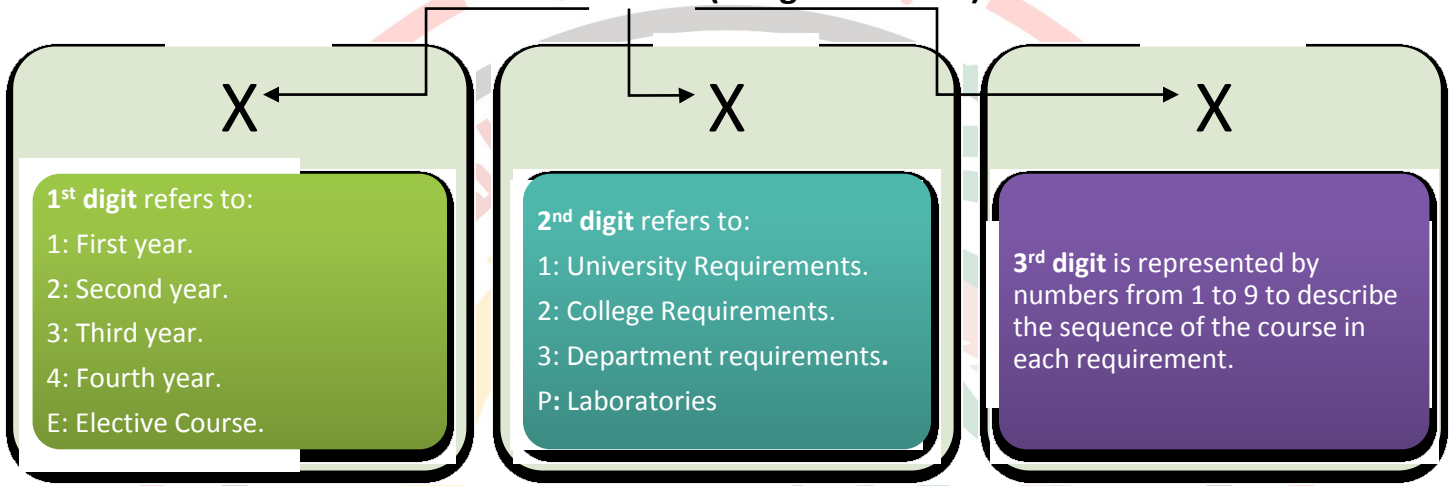
1. Redundancy in some curriculum titles.
2. The lack of an accurate description of some of the vocabulary curriculum.
3. OSU suggested curriculum do not cover the requirements for granting a Iraqi B.Sc. degree; like number of courses per semester, number of units and hours per week, and the ratio of practical hours to theoretical hours.

2. The Proposed Curricular/Course Description

In computer engineering department, each curricular is described by:

1. Curricular/Course Number and Title: each course is coded as:

Course Number = CoE + X X X (3 Digits Number)



For example: **CoE432 Computer Network** means that this is a computer engineering department course that is given to the **fourth year**; it is the **second course** within the **department requirement** courses.

2. Required or elective: whether it is required course for the program or an elective one.
3. Course description: defines what the course is designed for and why it is given to the students.
4. Prerequisites (if any): these have been established to assure an adequate and uniform background for students in advanced classes.
5. Course Topics: detailed syllabi of the course.



3. Graduation Requirements

To graduate, students have to complete 160 credit hours during her/his four years study

Table 3.1: Summary of Requirements “Iraqi description”

<i>Total CoE Requirements: 157 credit hours / 56 courses</i>		
Requirements	Credit-hours “Units”	Total hours
University Requirements	15	225
College Requirements	29	555
Department Requirements	113	2340
Total	157	3120

Table 3.2: Summary of Requirements “Iraqi description as sciences”

<i>Total CoE Requirements: 157credit hours / 56 courses</i>	
Requirements	Credit-hours “Units”
Humanities and Social Sciences CoE 112, CoE 114, CoE 212, CoE 422	8
Mathematics and Basic Sciences CoE 121, CoE 122, CoE 221, CoE 222, CoE 223, CoE 231, CoE 321, CoE 111, CoE 113, CoE 211	28
Computer Engineering Other courses	121
Total	157



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Table 3.3: Summary of Requirements “IEEE CE2004 description”

Total CoE Requirements: 157credit hours / 56 courses	
Topics	Credit-hours
Mathematics	19
Basic Science (Physics, Chemistry)	9
English, humanities and social sciences	8
Required computer science	9
Required computer engineering	94
Elective computer engineering	9
Other engineering courses	9
Total	157
Credit Hours for Computer Engineering Program	

3.1 University Requirements: _

Subject Code	Subject	Units Credit-hours	Weekly hours		
			Th.	Prac.	Tut.
CoE 111	General Chemistry	3	3		
CoE 112	English Language I	2	2		
CoE 113	English Language II/ Technical Writing	2	2		
CoE 114	Basic Physics	3	3		
CoE 211	Device Physics	3	3		
CoE 212	Human Rights, Democracy & Freedom	2	2		
Total		15	15	0	0
			15		

3.2 College Requirements:

Subject Code	Subject	Units	Weekly hours		
			Th.	Prac.	Tut.
CoE 121	Calculus I	3	3		1
CoE 122	Calculus II	3	3		1
CoE 123	Engineering Design / Auto CAD	3	2	2	
CoE 221	Calculus III	3	3		1
CoE 222	Differential Equations	3	3		1
CoE 223	Probability and Statistics	2	2		1
CoE 321	Linear Algebra	3	3		
CoE 322	Engineering Economics	2	2		
CoE 323	Random Signals & Systems	3	3		1
CoE 421	Ethics, Society, Profession	2	2		
CoE 422	Project management	2	2		1
Total		29	28	2	7
			37		



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3.3 Department Requirements:

Subject Code	Subject Title	Units	Weekly hours		
			Th.	Prac.	Tut.
CoE 131	Electric Circuits	3	3		1
CoE 132	Programming & Prob. Solving	3	3		1
CoE 133	Fundamentals of Logic systems	2	2		1
CoE 1P1	Lab1(Programming+ Electrical Circuits)	3		6	
CoE 134	Digital Logic Circuits	2	2		1
CoE 135	Object Oriented Programming and Data Structure	3	3		1
CoE 1P2	Lab2(OOP + Digital Logic)	3		6	
CoE 231	Discrete Structures	2	2		1
CoE 232	Signals & Systems	3	3		1
CoE 233	Digital System Design	3	3		1
CoE 2P1	Lab3(Digital System Design+ Device Physics)	3		6	
CoE 234	Computer Organization	3	3		
CoE 235	Algorithms	3	3		
CoE 236	Digital Electronics	3	3		1
CoE 237	Instrumentation	3	3		
CoE 2P2	Lab4(Computer Organization+ Algorithms)	3		6	
CoE 331	Computer Architecture	3	3		
CoE 332	Operating Systems	3	3		
CoE 333	Digital Signal Processing	3	3		1
CoE 334	Analog Electronics	3	3		
CoE 3P1	Lab5(OS + DSP + Electronics)	4		8	
CoE 335	Microprocessor Systems	3	3		
CoE 336	Operating system Programming	2	2		
CoE 337	Digital Communication	2	2		1
CoE 338	Computer Maintenance	2	1	2	
CoE E3x	CoE Elective I (x= 1,2,3,9)	3	3		
CoE 3P2	Lab6(Microprocessor+ OSP + Matlab)	4		8	
CoE 431	Software Design	3	3		
CoE 432	Computer Network	3	3		
CoE 433	Control System	3	3		1
CoE 434	Engineering Project (Two semesters)	6	1*2	4*2	
CoE E3x	CoE Elective II (x= 1,2,3,9)	3	3		
CoE 4P1	Lab7(Software Design+ Control system)	3		6	
CoE 435	Embedded Computing Systems	3	3		
CoE 436	Network Technology	3	3		
CoE 437	Parallel Processing Architecture	3	3		
CoE E3x	CoE Elective III (x= 1,2,3,9)	3	3		
CoE 4P2	Lab8(Embedded Computing+ Networks)	3		6	
TOTAL		113	82	62	12
			156		



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4. The Proposed Computer Engineering CoE Program: Curriculum

Typical degree program is shown in the following Tables for Computer Engineering, where recommended CoE course plan by semester is presented

First year

Semester 1

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 121	Calculus I	3		1	3
CoE 131	Electric Circuits	3		1	3
CoE 132	Programming & Prob. Solving	3		1	3
CoE 133	Fundamentals of Logic systems	2		1	2
CoE 111	General Chemistry	3			3
CoE 112	English Language I	2			2
CoE 1P1	Lab1(Programming+ Electrical Circuits)		6		3
Total		16	6	4	19
		26			

Semester 2

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 122	Calculus II	3		1	3
CoE 134	Digital Logic Circuits	2		1	2
CoE 135	Object Oriented Programming and Data Structure	3		1	3
CoE 123	Engineering Design / Auto CAD	2	2		3
CoE 113	Basic Physics	3			3
CoE 114	English language II/ Technical Writing	2			2
CoE 1P2	Lab2(OOP + Digital Logic)		6		3
Total		15	8	3	19
		26			



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Second year

Semester 3

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 221	Calculus III	3		1	3
CoE 231	Discrete Structures	2		1	2
CoE 232	Signals & Systems	3		1	3
CoE 233	Digital System Design	3		1	3
CoE 211	Device Physics	3			3
CoE 212	Human Rights, Democracy & Freedom	2			2
CoE 2P1	Lab3(Digital Design + Device Physics)		6		3
Total		16	6	4	19
		26			

Semester 4

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 222	Differential Equations	3		1	3
CoE 223	Probability and Statistics	2		1	2
CoE 234	Computer Organization	3			3
CoE 235	Algorithms	3			3
CoE 236	Digital Electronics	3		1	3
CoE 237	Instrumentation	3			3
CoE 2P2	Lab4(Computer Organization+ Algorithms)		6		3
Total		17	6	3	20
		26			



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Third year

Semester 5

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 321	Linear Algebra	3			3
CoE 331	Computer Architecture	3			3
CoE 332	Operating Systems	3			3
CoE 333	Digital Signal Processing	3		1	3
CoE 334	Analog Electronics	3			3
CoE 322	Engineering Economics	2			2
CoE 3P1	Lab5(OS + DSP + Electronics)		8		4
Total		17	8	1	21
		26			

Semester 6

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 323	Random Signals & Systems	3		1	3
CoE 335	Microprocessor Systems	3			3
CoE 336	Operating system Programming	2			2
CoE 337	Digital Communication	2		1	2
CoE 338	Computer Maintenance	1	2		2
CoE E3x	CoE Elective I (x= 1,2,3,,9)	3			3
CoE 3P2	Lab6(Microprocessor+ OSP + Matlab)		8		4
Total		14	10	2	19
		26			



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Fourth year

Semester 7

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 431	Software Design	3			3
CoE 432	Computer Network	3			3
CoE 433	Control System	3		1	3
CoE 434	Engineering Project (continued)	1	4		continued
CoE 421	Ethics, Society, Profession	2			2
CoE E3x	CoE Elective II (x= 1,2,3,,9)	3			3
CoE 4P1	Lab7(Software Design+ Control system)		6		3
Total		15	10	1	17
		26			

Semester 8

Code	Subject	Number of Hours Per Week			Credit Units
		Theoretical	Practical	Tutorial	
CoE 422	Project management	2		1	2
CoE 435	Embedded Computing Systems	3			3
CoE 436	Network Technology	3			3
CoE 437	Parallel Processing Architecture	3			3
CoE 434	Engineering Project	1	4		6
CoE E3x	CoE Elective III (x= 1,2,3,,9)	3			3
CoE 4P2	Lab8(Embedded Computing+ Networks)		6		3
Total		15	10	1	23
		26			

Summer Training

The **Computer Engineering (CoE)** curriculum requires students to complete one month of summer training at private industries or governmental firms. This training is a compulsory component of graduation requirements. It is supervised by the Summer Training Committee of the department.



5. Courses Syllabi

Subject : CoE 121 Calculus I

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: None

Practical :

Tutorial : 1 Hr/wk

Course Description:

This course reviews the basic ideas you need to start calculus for computer science and engineering, also for students intending to continue to more advanced courses in calculus and mathematics in general. Topics include a brief review of functions, followed by discussion of limits, derivatives, and applications of differential calculus to real-world problem areas. An introduction to integration concludes the course, with a brief description of vectors and complex geometry.

Course Topics:

1- Preliminaries:

Real numbers and the real line, lines, circles, and parabolas, functions and their graphs, Absolute value function, greatest integer function, signum function, domain and range algebraic functions, combining functions, shifting and scaling function graphs, even and odd functions, trigonometric functions

2- Differentiation:

Limits, continuity and differentiability. Rules of Differentiation, chain rule, implicit differentiation, higher order differentiation, application, time rate, maxima and minima, concave, curve plotting, inverse functions, the limit $\sin x/x$, trigonometric functions and their inverse.

3- Integration:

Finite integration, rules of integration, applications, area, volume, arc-length, integration methods, special integrals, rotating and shifting of axes, conical sections.

4- Vectors:

Vectors in the plane, in the space, scalar and vector products, triple products. Equations of lines and planes in the space.

5- Complex Geometry:

Complex numbers: $z = x + jy$ as an affix on the real point (x, y) , modulus, argument, conjugate, addition, subtraction, products of such numbers, (Cartesian, trigonometric, polar and exponential) forms, transformations: translation, rotation by an angle.



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Subject : CoE 131 Electrical Circuits

Units “Credit Hours”: 3

Pre-requisite: None

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial : 1 Hr/wk

Course Description:

This course is designed to give the students an introduction to electrical currents, voltages, and the different elements of AC and DC circuits. Also, it teaches them how to analyze DC and AC circuits in steady and transient states.

Course Topics:

1. **Introduction:** Units, atomic structure, conductor, semiconductor and isolator. Electrical current, potential and potential difference. Electromotive force (EMF). Resistance and conductance, temperature effect, resistor types, color code resistance, ohm's law, linear and nonlinear resistance, electrical energy and power, efficiency.
2. **DC Circuit analysis:** Serial and parallel circuits, Kirchhoff's law, internal resistance of source, dependent sources, source transformation. Methods of analysis, Branch current, Mesh analysis, node analysis, examples, delta/ star transformation.
3. **Network Theory:** Superposition, Thevenin, Norton, reciprocity theorem, maximum power transfer.
4. **DC Transient:** The capacitor, capacitor current and voltage, the inductor, inductor current and voltage, exponential response, source free RC and RL circuit, unit step input, steady state and transient terms in RC and RL circuit.
5. **AC Circuit:** AC quantities (resistance, reactance, and impedance, conductance, susceptance, and admittance, peak values, maximum, average, and r.m.s values, phasor quantities). AC circuit analysis (equivalent impedance, power in AC circuit, power factor, power factor correction, AC circuit's analysis with network theorem). Single phase, and three phase circuits, star/delta transformation.
6. **Resonance:** Series resonance, parallel resonance, quality factor, selectivity, half power frequencies and bandwidth. Serial- parallel resonance circuit, locus diagram.



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Subject : CoE 132 Programming and Problem Solving

Pre-requisite: None

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial : 1 Hr/wk

Course Description:

The course Indicate some reasons for studying programming fundamentals, covers the basics of programming and the “C++” programming language, including syntax, fundamental data structures, algorithms and basic problem-solving, control structures, string manipulation and list processing, concepts of executive programs.

Course Topics:

1. **An introduction to programming fundamentals:** topics, variables, data types, and operations. Programming paradigms (Functional, Procedural, Object-oriented, and Event-Driven).
2. **Problem-solving Algorithms:** Problem-solving strategies and process, Implementation strategies for algorithms, Debugging strategies, the concept and properties of algorithms, structured decomposition
3. **Programming in C++:** Basic syntax and semantics, Variables, types, expressions, assignment, Mathematical functions, logical and bitwise and arithmetic operations, Simple I/O, Functions and parameter passing, procedural programming, Encapsulation and information-hiding Separation of behavior and implementation.
4. **Control structures:** Conditional and iterative control structures, loops, sequencing, selection, and iteration functions.
5. **Basic Data Structures:** Primitive types, Arrays, Strings and string processing, Records, stack, and heap allocation.
6. **Structure programming:** static and dynamic structure programming.
7. **Recursion:** Recursive mathematical functions, Divide-and-conquer strategies, Recursive backtracking, Implementation of recursion in C++.



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Subject : **CoE 133 Fundamental of Logic Systems**

Units “Credit Hours”: **2**

Pre-requisite: None

Theoretical : **2 Hr/wk**

Practical :

Tutorial : **1 Hr/wk**

Course Description:

This course gives overview of digital systems and their applications. Understand how signed numbers, unsigned numbers, and alphanumeric characters are represented in binary different numbering systems. Highlight the importance of Boolean logic to the knowledge area. Contrast the meanings of gates, circuits, combinational circuits, and modules. Be able to manipulate and simplify Boolean algebraic expressions and functions of different forms. The basic logic operations and gates.

Course Topics:

1. **Introduction and overview:** introduction of logic systems, variables, and relations.
2. **Number systems:** binary systems, base conversion, representation of numbers and characters using binary codes, octal number system, Decimal number System, Hexadecimal number system, number system conversion, and other Radix (r) system to Decimal conversion.
3. **Arithmetic Operations:** Binary arithmetic (addition, subtraction, multiplication, division). Octal and Hexadecimal arithmetic (addition, subtraction, multiplication, division).
4. **Boolean algebra:** Boolean algebra symbols, axioms, switching algebra and functions, theorems (Generalized De Morgan, Shannon, expansion theory), and operations.
5. **Manipulation and simplification:** Boolean algebraic expressions and functions are simplified using Boolean theorems and K-map(plotting, cell grouping,)
6. **Analysis and design of combinational circuits:** Logic operators, Analysis using basic gates and/or combinational devices.



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Subject : CoE 122 Calculus II

Units “Credit Hours”: 3

Pre-requisite: CoE 121

Theoretical : 3 Hr/wk

Practical :

Tutorial : 1 Hr/wk

Course Description:

This is the second course in calculus, intended for students who have already completed a Calculus I course in limits, differential and integral calculus, and need to extend their skills in this subject.

Course Topics:

1- Coordinates:

Polar coordinates: areas and lengths in polar coordinates equivalent points and equivalent equations, the relation between the Cartesian and the polar systems, areas, other applications. Three dimensional coordinates: Cartesian, cylindrical, and spherical.

2- Determinants and Matrices:

Matrix basics, add and subtract matrices, multiply a matrix by a scalar, multiply matrices, take the transpose of a matrix, special types of matrices, matrix properties, some properties of determinants, system of linear equations, Gramer's rule ,matrices, some and product of matrices, the inverse of matrix, solution of linear equations by matrices.

3- Functions of two or more variables:

Partial differentiation, total differential, multiple integrals.

4- Multiple Integrals:

Double integrals over rectangles, double integrals over general regions, double integrals in polar coordinates, applications of double integrals, triple integrals, triple integrals in cylindrical coordinates, triple integrals in spherical coordinate's, change of variables in multiple integrals.



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Subject : CoE 134 Digital Logic

Units “Credit Hours”: 2

Pre-requisite: CoE 133

Theoretical : 2 Hr/wk

Practical : - Hr/wk

Tutorial : 1 Hr/wk

Course Description:

Identify some contributors to digital logic and relate their achievements to the knowledge area. Explain why Boolean logic is important to this subject. Articulate why gates are the fundamental elements of a digital system. Work with binary number systems and arithmetic. Derive and manipulate switching functions that form the basis of digital circuits. Reduce switching functions to simplify circuits used to realize them. Analyze and explain uses of small- and medium-scale logic functions as building blocks. Design and describe the operation of basic memory elements. Analyze circuits containing basic memory elements. Apply the concepts of basic timing issues, including clocking, timing constraints.

Course Topics:

- 1. Introduction and overview:** Indicate some reasons for studying digital logic. Highlight some people that influenced or contributed to the area of digital logic. Indicate some important topic areas such as logic circuits, switching, memory, registers, and digital systems. Mention how systems result from modules and circuits. Explore some additional resources associated with digital logic. Explain the purpose and role of digital logic in computer engineering.
- 2. Combinational Logic:** Code conversions (BCD, Gray, excess-3, and weighted codes). MSI circuits: Adders/ Subtractors (Half and Full adders, Half and Full subtractor). Comparators, Multiplexers, Demultiplexers, Decoders, and Encoders.
- 3. Sequential Logic:** Flip- Flops (S-R, J-K, D, T), master/slave FF, Timing diagrams of clocked FF.
- 4. Analysis and design of synchronous sequential logic circuits:** Latches and flip-flops (SR, JK, D, and T).
- 5. Registers and Counters:** Registers (SISO, SIPO, PISO, PIPO) , timing sequence of registers. Synchronous versus asynchronous counters.



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Subject :	CoE 135 Object Oriented Programming and Data Structure	Units “Credit Hours”:	3
Pre-requisite:	CoE 132	Theoretical :	3 Hr/wk
		Practical :	- Hr/wk
		Tutorial :	1 Hr/wk

Course Description:

The course gives the fundamentals of object-oriented programming, Identify data structures useful to represent specific types of information, and also gives an introduction to database systems and data modeling, architectures, and Fundamental concepts of structured query language.

Course Topics:

1. **Object-oriented programming in C++:** Class hierarchies, object, Encapsulation, Abstraction, Polymorphism, Dynamic binding, Message passing, Messages Association, Interfaces, inheritance, and Operator overloading.
2. **Data Structures:** Pointers and references, Linked structures, Implementation strategies for stacks, queues, and hash tables, Implementation strategies for graphs and trees, Strategies for choosing the right data structure.
3. **Database systems:** definition and role in computer engineering, Components, Database management system (DBMS), Database architectures (possibilities, concept, data independence), and query.
4. **Data modeling:** Concepts (key, foreign key, record, relation), Conceptual models (possibilities, entity-relationship model and UML; strengths and weaknesses), and object oriented models.
5. **Structured query language (SQL):** Fundamental concepts including data definition, query formulation, update sub-language, constraints, and integrity.



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Subject : CoE 123 Engineering Design/
Auto CAD

Pre-requisite: None

Units “Credit Hours”: 3

Theoretical : 2 Hr/wk

Practical : 2 Hr/wk

Tutorial :

Course Description:

This course is designed to give the students an introduction to the engineering drawing and its tools. It also gives them a course in AutoCad 2000 software.

Course Topics:

1. ACAD: hardware requirements, running AutoCAD.
2. Types of Coordinates: description of drawing areas, limits, grid, snap.
3. Drawing commands: line, arc, and circles.
4. Display Commands: zoom, region.
5. Editing Commands: erase, move, copy, break, trim, rotate, scale, fillet, mirror, scale.
6. Selection Objects: object- snap. Array, text, dimensions.
7. Orthogonal Projection, Viewing and Dimensions, ISO drawing.



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Subject : CoE 221 Calculus III

Units “Credit Hours”: 3

Pre-requisite: CoE 121, CoE 122

Theoretical : 3 Hr/wk

Practical :

Tutorial : 1 Hr/wk

Course Description:

This mathematics course covers and vector calculus, sequences and series, Laplace transform and partial differentiation it depends on the main topics of Calculus I and Calculus II courses. And can be as an introduction to study the topics of engineering analysis.

Course Topics:

1- Vector Analysis: Scalars and vectors, components of a vector, addition of vectors, multiplication by scalars, vector in space, dot product, cross product, forms of equation of a curve in space, parametric representation, tangential and normal vectors, curvature, radius of curvature, forms of equation of a surface in space, gradient and normal vectors, vector function in Cartesian cylindrical and spherical coordinates, speed, and acceleration, line, surface, and volume integrals Green's theorem, Stock's theorem, and Divergence theorem.

2- Sequences and series: Sequences and subsequences, limits, uniqueness of limits, series convergence and divergence, comparison test, comparison of ratios, integral test, test of alternating series, absolute and conditional convergence, Infinite series test for convergence, power series for functions, Taylor 's theorem, Mclaurian series, and convergence of power series, differentiation and integration, solution of differential equations by series, Legender and Bessel equations.

3- Laplace Transform: Definition of the Laplace transform, transforms and properties, inverse transform, partial fraction, application, D.E. solutions using Laplace transform, convolution theorem.

4- Partial Differentiation: Functions of two or more variables, tangent plane and normal line, the directional derivative, the gradient, the chain rule for partial derivatives, the total differential, maximum and minimum of two independent variables.



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Subject : CoE 231 Discrete Structures

Units “Credit Hours”: 2

Pre-requisite: Pre-calculus or equivalent

Theoretical : 2 Hr/wk

Practical :

Tutorial : 1 Hr/wk

Course Description:

The purpose of this course is to understand and use discrete structures that are backbones of computer science. In particular, this class is meant to introduce logic, proofs, sets, relations, functions, with an emphasis on applications in computer science.

Course Topics:

- 1-Logic:** propositional logic, logical equivalence, predicates & quantifiers, and logical reasoning.
- 2- Sets:** basics, set operations
- 3- Functions:** one-to-one, onto, inverse, composition, graphs
- 4- Integers:** greatest common divisor, Euclidean algorithm.
- 5- Sequences and Summations**
- 6- Mathematical reasoning:** Proof strategies, Mathematical Induction, Recursive definitions, Structural Induction
- 7- Counting:** basic rules, Pigeon hall principle, Permutations and combinations, Binomial coefficients and Pascal triangle.
- 8- Relations:** properties, Combining relations, Closures, Equivalence, partial ordering
- 9- Graphs ,** directed, undirected graphs.



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Subject : CoE 232 Signals & Systems

Units “Credit Hours”: 3

Pre-requisite: CoE 131

Theoretical : 3 Hr/wk

Practical :

Tutorial : 1 Hr/wk

Course Description:

This course introduces the necessary tools for continuous-time signal analysis and linear time-invariant (LTI) systems analysis to the student. It also covers the essential concepts of time and frequency domain representation of a signal, as well as, the time and frequency response of an LTI system.

Course Topics:

1. **Signals and Spectra:** Phasors and Line Spectra, one-sided and two-sided spectra, Classification of Signals, Signal Energy and Signal Power.
2. **Fourier Series and Transform:** Fourier Series; Trigonometric, and Exponential, Parseval's Theorem, Fourier Transform, Fourier Transform properties.
3. **Convolution:** Convolution Integral, Convolution Relationships, Convolution with Unit Impulse Function, Graphical Representation of Convolution.
4. **LTI Systems:** LTI Systems; Basics and Concepts, LTI System Response, Time Response, Frequency Response, Block Diagram Analysis of Systems, Energy and Power Spectral Densities, Correlation Functions, Signal Distortion and Distortionless Transmission.
5. **Applications of Systems:** Amplitude Modulation (AM), Types, Generation and Detection, Angle Modulation, Types, Generation, and Detection.



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Subject : CoE 233 Digital System Design

Units “Credit Hours”: 3

Pre-requisite: CoE 133, CoE 134

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial : 1 Hr/wk

Course Description:

Introduction to logic circuits design, sequential circuits, and shift registers design. Analysis and design of synchronous and asynchronous networks using FSM charts. Minimization of hazards and glitches. Hierarchical, modular design of digital systems, Synthesis of digital circuits from HDL models, RTL, modeling and simulation using VHDL and FPGA.

Course Topics:

1. **Introduction and Overview:** combinational versus sequential circuits, Hierarchical design of combinational circuits using logic modules, PLA, Random-access memory (RAM), realization of logic functions using PLA and/ or RAM.
2. **Analysis of Sequential logic circuits:** Finite state machines (FSMs), clocked and unclocked, Mealy vs. Moore models of FSMs, Modeling FSM behavior: State diagrams and state tables, timing diagrams, algorithmic state machine charts, Analysis of synchronous and asynchronous circuits.
3. **Design of Sequential logic circuits** Design of synchronous sequential circuits: State minimization, state assignment, next state and output equation realization. Sequential functional units: Data registers, shift registers, counters, sequence detectors, synchronizers, controllers.
4. **Digital systems design:** Hierarchical, modular design of digital systems. Synthesis of digital circuits from HDL models. Design principles and techniques: Bridging conceptual levels – top down/bottom up, iteration, satisfying a behavior with a digital structure. Functional units, building blocks and LSI components: Adder, shifter, register, and control circuits, tri-state devices and buses.
5. **Realization using field-programmable gate arrays (FPGAs):** Control concepts: Register transfer notation, major control state, sequences of micro-operations, conditional execution of micro-operations. Timing concepts: System timing dependencies, sequencing, clock generation, distribution, and skew. Programmable logic devices (PLDs) and field-programmable gate arrays (FPGAs), PLAs, ROMs, PALs, complex PLDs.
6. **System Modeling:** Schematic capture. Hierarchical schematic modeling for complex systems. Digital system modeling with hardware description languages VHDL. Other modeling techniques (timing diagrams, register transfer languages, state diagrams, algorithmic state machines).
7. **System Simulation:** Functional simulation of combinational and sequential circuits. Timing models of digital circuit elements: Propagation delay, rise/fall time, setup and hold times, pulse widths. Timing simulation to measure delays and study signals subject to timing constraints.
8. **Formal verification:** Relationship of good design practice to formal verification. Comparison and contrast of formal verification, validation, testing. Verification by model checking. Verification by proofs. Verification by equivalence checking. Verification by assertions and verification languages. Verification by testing.



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Subject : CoE 211 Device Physics

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: CoE 113, CoE 131

Practical : - Hr/wk

Tutorial :

Course Description: This course is an introduction to the crystal structure of solids, the physics of semiconductors, and the pn junction, with an emphasis on types and applications to semiconductor devices. Three terminal devices such as BJT, JFET, and MOSFET are studied carefully with their biasing circuits and configurations of small signal amplifiers.

Course Topics:

1. **Properties of materials:** Solid-state materials, electrons and holes, Doping, acceptors and donors, P-and-N-type material, Conductivity and resistivity, Drift and diffusion currents, mobility and diffusivity.
2. **Diodes circuits:** Diode operation and i-v characteristics, Regions of operation, models, and limitations, Tunnel, Zener, Varicap, LED, Photo, Laser, Microwave diodes, Single diode circuits, the load line, Multi-diode circuits, Rectifiers, dc-dc converters, Clipping and clamping, Electronic gates, Diode logic (AND and OR functions).
3. **Bipolar transistors and logic families:** npn and pnp transistor operation, i-v characteristics, Regions of operation, models, and limitation, Transfer characteristic of BJT with load resistor, Biasing for logic and amplifier applications, Logic level definitions, The differential pair as a current switch, Transistor-transistor logic – inverters, NAND, other functions, Emitter-coupled logic – OR/NOR gate, other functions, Low voltage bipolar logic families, DPAIR Transistors.
4. **MOS transistors and biasing:** Field-effect transistor operation, i-v characteristics NMOS, Regions of operation, models, and limitations, Enhancement and depletion-mode devices, PMOS devices, Transfer characteristic of FET with load resistor, Biasing for logic and amplifier applications. MOSFETS, MESFET, and BIMOS transistors.
5. **Amplifier design:** Characteristics and properties of a linear amplifier, voltage gain, current gain, power gain, dB scale, frequency domain characteristics, distortion, Definition of small-signal in diodes and transistors, Bias circuits for linear amplification, voltage, current, power gain, input/output resistances, Amplifier configurations: BJT common-emitter, common-base and common-collector, MOSFET common-source, common gate, Common drain, Low frequency response, high frequency device models, high frequency response, Short-circuit and open-circuit time constant techniques, Multistage transistor amplifiers, ac and dc coupled amplifiers; frequency response, Differential pairs such as MOSFET and BJT, Current sources and biasing, current mirrors, active loads, Classical op-amp input stages, Elementary two- and three-stage op-amp circuits.



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Subject :	CoE 212 Human Right, Democracy, and Freedom	Units “Credit Hours”:	2
		Theoretical :	2 Hr/wk
Pre-requisite:	None	Practical :	
		Tutorial :	

Course Description:

This course is designed to give the student the definition of human rights, the concepts of human rights, international human rights laws, human rights in Islam, and human rights in Iraq and their relationship to the Iraqi laws. This course is also designed to give the student the definition of freedom and democracy. It explains the history of democracy, democracy and freedom properties, and ancient democracy & its comparison to modern one.

Course Topics:

1. Human rights definition and history.
2. Human rights and Islam.
3. Iraq constitution and its role in human rights.
4. Child rights.
5. International human rights guarantee laws.
6. The concept of democracy.
7. The concept of freedom.
8. History of democracy and freedom.
9. The properties and principles of democracy and freedom.
10. The relationship between freedom and democracy.



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Subject :	CoE 222 Differential Equations	Units “Credit Hours”:	3
		Theoretical :	3 Hr/wk
Pre-requisite:	CoE 221	Practical :	
		Tutorial :	1 Hr/wk

Course Description:

The construction of mathematical models to address real-world problems has been one of the most important aspects of each of the branches of science. It is often the case that these mathematical models are formulated in terms of equations involving functions as well as their derivatives. Such equations are called differential equations. If only one independent variable is involved, often time, the equations are called ordinary differential equations. The course will demonstrate the usefulness of ordinary differential equations for modeling physical and other phenomena. Complementary mathematical approaches for their solution will be presented, including analytical methods, graphical analysis and numerical techniques.

Course Topics:

1- Introduction to Differential Equations: Definitions and terminology. Initial-value problems. Differential equations as mathematical models

2- First-Order Differential Equations: Solution curves without a solution; direction fields, autonomous first-order differential equations. Separation of variables . Linear equations . Exact equations . Solutions by substitutions.

3- Modeling with First-Order Differential Equations: Linear models; exponential growth and decay, Newton's law of cooling, mixture problems, series circuits Non-linear models; logistic growth, chemical reactions. Systems of differential equations; radioactive series, mixtures, predator-prey models, competition models, networks.

4- Higher-Order Differential Equations: Linear differential equations; initial-value and boundary-value problems, homogenous equations, non-homogeneous equations. Reduction of order. Homogenous linear equations with constant coefficients. Undetermined coefficients; superposition approach, annihilator approach.

5- Modeling with Higher-Order Differential Equations: Linear models with initial value problems; spring/mass systems with free undamped motion, free damped motion, and driven motion; series circuit analogue. Linear models with boundary value problems. Nonlinear models.



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Subject :	CoE 223 Probability and Statistics	Units “Credit Hours”:	2
		Theoretical :	2 Hr/wk
Pre-requisite:	Pre-calculus or equivalent	Practical :	
		Tutorial :	1 Hr/wk

Course Description:

Randomness, finite probability space, probability measure, events; conditional probability, independence, Bayes’ theorem; discrete random variables; binomial and Poisson distributions; concepts of mean and variance; continuous random variables; exponential and normal distribution, probability density functions, calculation of mean and variance; central limit theorem and the implications for the normal distribution.

Course Topics:

- 1- **Exploring Univariate Data:** Types of data. Mean and Median. Standard Deviation and Variance. Range, IQR and Finding Outliers. Graphs and Describing Distributions.
- 2- **Introduction to Probability:** Counting Techniques, Combinations and Permutations. Sets and Venn Diagrams. Basic Probability Models. General Probability Rules.
- 3- **Discrete and Continuous Distributions:** Random Variables. Binomial Distributions. Geometric Distributions. Density Curves. The Normal Distribution. Standard Normal Calculations.
- 4- **Samples and Experiments:** Sampling. Designing Experiments. Simulating Experiments.
- 5- **Estimation:** Margins of Error and Estimates. Confidence Interval for a Proportion. Confidence Interval for the Difference of Two Proportions. Confidence Interval for a Mean. Confidence Interval for the Difference of Two Means.



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Subject : CoE 234 Computer Organization

Units “Credit Hours”: 3

Pre-requisite: CoE 233

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial :

Course Description:

This course introduces the general microcomputer organization. The topics include the components of a computing system and interactions among them, overview of the memory and memory segmentation and the data exchange between CPU and memory unit. Also, the course includes the fetch and execute cycles, instruction decoding and execution, and addressing modes. The instruction set and assembly language are explained during this course. Memory fundamentals, basic element of the memory, memory interfacing, and address decoding are also studied in this course.

Course Topics:

- 1- Introduction to computer organization:** Indicate some important topic areas such as system organization and architecture, history of computer systems and its development, general model of computer organization (CPU, Memory, I/O).
- 2- The software Architecture of the microprocessor unit:** Bus interface unit BIU, execution units EU, instruction queue, pipelined and non-pipelined architecture, the software model of 8088/86286/386/Pentium microprocessors, instruction pointer, segment registers, general purpose registers, pointer and index registers, and status register. Memory address space, segmentation and data organization.
- 3- Data type:** Representation of integers and real numbers, signed and unsigned numbers, packed and unpacked BCD numbers, and ASCII codes.
- 4- Instruction set and assembly programming:** Introduce the instruction format, instruction fetching, decoding, and executing operations, addressing modes, instruction types (data movement, arithmetic, logic, strings, branching, subroutine call and return mechanisms, and interrupt instructions). The course introduces the programming in assembly language for Intel x86-based microcomputers.
- 5- Real Mode and Protected mode of x86 Microprocessors:** Explain the difference between real and protected modes of microcomputer system operations and their memory management and organization.
- 6- Memory Interface:** Clock system, bus cycle and time states, hardware organization of the memory address space, memory control signals, read and write bus cycles, buses buffering and demultiplexing, memory technologies such as SRAM, DRAM, ROM, PROM, EPROM, and FLASH, error detecting and error correcting system, design a complete memory subsystem and its interface. Example Intel processors memory interface.



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Subject : CoE 235 Algorithms

Units “Credit Hours”: 3

Pre-requisite: CoE 135, CoE 231

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial :

Course Description:

Studying the general topics of algorithms Design and the analysis techniques for solving domain specific problems, algorithm design strategies, distributed algorithms, sorting and searching algorithms, graph searching algorithms, algorithm evaluation and complexity, non-algorithmic solution, and incompatibility.

Course Topics:

1. **Introduction:** Basic algorithms, algorithm using, complexity, the purpose and role of algorithms in computer engineering.
2. **Algorithmic analysis:** behavior (best, average, and worst case), Big “O,” little “o,” omega, and theta notation, measurements, Time and space tradeoffs, recursive algorithms. Distributed algorithms Concurrency and Scheduling.
3. **Algorithmic strategies:** Brute-force/exhaustive algorithms, Greedy algorithms, Divide-and-conquer, Backtracking, and heuristics algorithms.
4. **Sorting and searching algorithms:** Sequential and binary search algorithms, Binary search trees, Hash tables , Topological sort, Depth- and breadth-first traversals, spanning tree, graphs adjacency matrix and Shortest-path algorithms (Dijkstra’s and Floyd’s algorithms), and Transitive closure (Floyd’s algorithm).
5. **Algorithmic complexity:** Tractable and intractable problem, P and NP problems, Standard NP-complete problems, halting problem, incomputable functions and its Implications.
6. **Basic computability theory:** Deterministic finite Automata (DFA), Non-deterministic finite Automata (NFA), Equivalence, Context-free grammars, and Pushdown automata (PDA).



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Subject : CoE 236 Digital Electronics

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: CoE 131, CoE 211

Practical :

Tutorial : 1 Hr/wk

Course Description:

This course covers the main aspects required in digital electronic circuits.

Course Topics:

1. **MOS logic families:** Logic level definitions, NMOS logic design: Inverter, NOR, NAND, SOP, POS, complex gates, PMOS logic, CMOS logic: Inverter, NOR, NAND, SOP, POS, complex gates, Dynamic logic, CVS logic, Cascade buffers, NMOS and CMOS power/delay scaling.
2. **Design parameters and issues:** Switching energy, power-delay product comparison, Propagation delay, rise time, fall time, Fan-in and fan-out, Power dissipation, noise margin, Power supply distribution, Sources of signal coupling and degradation, Transmission line effects; passive, active, dc and ac termination, Element tolerances, Worst-case analysis of circuits, Monte Carlo analysis, Monte Carlo analysis in SPICE, Six-sigma design.
3. **Storage elements:** Latches, Flip-flops, Static RAM cells, Dynamic RAM cells, Sense amplifiers.
4. **Interfacing logic families and standard buses:** Terminal characteristics of various logic families, Standard interface characteristics, Level translations: TTL/CMOS, TTL/ECL, CMOS/ECL, Single-ended to differential and differential to single-ended conversion, Transmission line characteristics, reflections, Bus termination: Passive, active, dc, ac, 4-20 mA current interfaces, RS-XXX buses, IEEE-XXXX buses, Low-level differential signaling, RAMBUS, DDR.
5. **Data conversion circuits:** D/A Converters: Definitions such as for codes, A/D Converters, Definitions such as for codes, Sample-and-hold circuits.
6. **Introduction to VLSI and ASIC design:** Explain the purpose and role of VLSI and ASIC design in computer engineering.
7. **Functions of basic inverter structure:** Connectivity, layout and basic functionality of a CMOS inverter.
8. **Combinational logic circuits:** Basic CMOS gate design, Layout techniques for combinational logic structures, Transistor sizing for complex CMOS logic devices, Transmission gates, Architectural building blocks (multiplexers, decoders, adders, counters, multipliers).
9. **Sequential logic structures:** Storage mechanisms in CMOS logic, Dynamic latch circuits, Static latch and flip-flop circuits, Sequential circuit design, Single and multiphase clocking, Clock distribution, clock skew.
10. **Chip input-output circuits:** General I/O pad issues, Bonding pads, ESD Protection circuits, Input, Output, Bidirectional, and analog pads, VDD and VSS pads.
11. **Processing and Layout:** Processing steps for patterning SiO₂ on a silicon wafer, CMOS processing technology steps and their results, Layout design rules and their objectives, Scalable (-based) design rules, Design-rule checking.



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Subject : CoE 237 Instrumentation

Units “Credit Hours”: 3

Pre-requisite: CoE 131, CoE 211

Theoretical : 3 Hr/wk

Practical :

Tutorial :

Course Description

Principle of measurement, measuring electrical quantities, analogue and digital transducers, measurement of level, pressure, flow, temperature and other industrial measurements.

Course Topics

1. **Introduction:** Instrumentation applications, SI Units, Fundamental and derived units , Elements of measuring instrument, Feedback system. Types of instruments , precision and accuracy. Primary measurement and secondary measurement.
2. **Electrical Measurements:** Galvanometer, Voltage measurement, Current measurement, Resistance measurements. Electronic measurement devices. D.C. and A.C. Bridges.
3. **Electrical Transducers:** Resistive, Inductive and Capacitive transducers, measurement of transducer output, modulation and demodulation in transducers.
4. **Industrial measurements:** Level measurement, Pressure measurement: Burden tube, Bellows, Diaphragms, Differential pressure measurement, Flow measurement, Temperature measurement, Force, Load cell.
5. **Digital Transducers:** Opt couplers and OID, optical detection, magnetic pickups, Speed measurement, Position measurement, principle of mouse. Other digital transducers.



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Subject : CoE 321 Linear Algebra

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: Pre-calculus or equivalent

Practical :

Tutorial :

Course Description:

At its root, linear algebra is the study of systems of linear equations. Systems of linear equations are ubiquitous in the natural and social sciences. One major contribution to the topic was made by Gauss (1777–1855), who was confronted with large systems of linear equations in his work on astronomy and developed the famous method of least squares to cope with measurement errors. Later in the nineteenth century Cauchy, Sylvester, Cayley and others developed the concept of a matrix, which provides the most convenient language for the theory and practice of linear equations. Matrices are intricate algebraic objects with many fascinating properties, but they also provide a bridge between linear equations and vectors, so infusing the subject of linear algebra with a strong geometric flavor. We will delve into all these topics, as well as the notions of determinant and eigenvalues, which are important numbers associated with any square matrix.

Course Topics:

1. **Linear Equations in Linear Algebra:** Systems of Linear Equations. Row Reduction and Echelon Forms. Vector Equations. The Matrix Equation $Ax = b$. Solution Sets of Linear Systems. Applications of Linear Systems. Linear Independence. Introduction to Linear Transformations. The Matrix of a Linear Transformation. Linear Models in Business, Science, and Engineering.
- 2-**Matrix Operations:** The Inverse of a Matrix. Characterizations of Invertible Matrices. Partitioned Matrices Matrix Factorizations. The Leontief Input-Output Model. Applications to Computer Graphics. Subspaces of R^n . Dimension and Rank. Introduction to Determinants. Properties of Determinant. Cramer’s Rule, Volume, and Linear Transformations.
- 3-**Vector Spaces:** Vector Spaces and Subspaces. Null Spaces, Column Spaces, and Linear Transformations. Linearly Independent Sets; Bases. Coordinate Systems. The Dimension of a Vector Space. Rank. Change of Basis . Applications to Difference Equations. Applications to Markov Chains.
- 4-**Eigenvalues and Eigenvectors:** Eigenvectors and Eigenvalues. The Characteristic Equation. Diagonalization. Eigenvectors and Linear Transformations. Complex Eigenvalues. Discrete Dynamical Systems. Applications to Differential Equations. Iterative Estimates for Eigenvalues.
- 5- **Orthogonality and Least Squares:** Inner Product, Length, and Orthogonality. Orthogonal Sets. Orthogonal Projections. The Gram-Schmidt Process. Least-Squares Problems. Applications to Linear Models.



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Subject : CoE 331 Computer Architecture

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: CoE 234

Practical : - Hr/wk

Tutorial :

Course Description:

Introduction to the design and performance analysis of Digital Arithmetics,, the trade-off analysis in designing various components of computer architecture, which includes , arithmetic (fixed and floating point) units design, ALU design, memory hierarchy, control unit design.

Course Topics:

1. **Introduction and Overview:** General definition, purpose of Digital Arithmetic and Introduction to computer architecture, CPU organization and its parts, sketch CPU organization, definition of the performance factors, reasons for binary arithmetic with computers. Review of basic fixed- point number representation systems (non-negative and signed integers), sign detection.
2. **Algorithms and design of the common Fixed- Point arithmetic operations:** design of two operand addition/ subtraction: (CRA, CLA), data compression, multi-operand addition (carry save adder CSA), sequential multiplier, recoding (coding), Booth recoding multiplier, division algorithms: (restoring and non-restoring) division.
3. **Design of High speed CPU components:** design of combinational shifters (barrel shifters), general- purpose registers (GPR), Timers, Tri- state buffers, arithmetic and logic unit (ALU).
4. **Real number representations:** IEEE754 FP representation and format (sign , exponent, and magnitude) of floating point numbers, exceptions, special values, single- precision and double- precision format, dynamic range, integer to real numbers conversion.
5. **Floating- point Algorithms and Implementation:** FP addition/ subtraction, multiplication, multiply- add fused (MAF) unit, division.
6. **Memory system hierarchy: role of memory system,** High-Speed Memories: locality of reference, Cache Memory: (Organization and Mapping Techniques, Replacement Algorithms, write policies) . Main memory systems: Types of main memories: (SRAM, DRAM), main memory characteristics and performance: (latency, cycle time, and bandwidth).
7. **Virtual Memory System:** (Paging, Segmentation, and hybrid), fault trap, Address Translation Virtual to physical, translation look-aside buffer TLB.
8. **Control Unit Design:** Single Bus Organization, Control Unit Operations: Instruction sequencing, Micro operations and Register Transfer. Hardwired Control: Design methods – State table and classical method, Design Examples - Multiplier CU. Micro-programmed Control: Basic concepts, Microinstructions and micro- program sequencing.
9. **Processor Design:** Datapath and control; single cycle design and implementation; simplifying control design; multicycle implementation of datapath and control.



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Subject : CoE 332 Operating Systems

Units “Credit Hours”: 3

Pre-requisite: CoE 135, CoE 234

Theoretical : 3 Hr/wk

Practical :

Tutorial :

Course Description:

Introduction to operating systems. Types of operating systems, Process management, Scheduling, memory management, File management, Protection and security.

Course Topics

- 1- **History and overview:** Introduction, Hardware: CPU, memories, Memory hierarchy, I/O devices, I/O interrupts, DMA, Firmware: BOIS, Software, Operating systems review and its roles, Types of operating systems, Time sharing, Concurrency, System programs, Operating system structures, Operating system components, Microkernel, System calls and APIs, Interrupts, General definitions: Buffering, resources, device management, device driver, caching, crash...etc.
- 2- **Process Management:** Processes, Process state diagram, Process control block (PCB), Context switch, Process scheduling, Queuing diagram, Schedulers, Types and operation of processes., Bounded-buffer problem.
- 3- **Threads:** Definition, Benefits, Types of threads, Multithreading models, Java threads, Java thread management, Java thread states, Producer-consumer problem.
- 4- **Scheduling and dispatch :** CPU-I/O burst cycle, Preemptive and non-preemptive scheduling, Dispatcher, Scheduling criteria, Multi-processor and multiple core scheduling.
- 5- **Process Synchronization:** Define the problem, Race condition, Critical section problem, Mutual exclusion, Semaphore, Starvation, Producer-consumer problem, Monitors.
- 6- **Deadlock:** Definition, Deadlock characterization, Necessary conditions, Resource allocation graph, Deadlock prevention, avoidance, and recovery. Process termination.
- 7- **Memory Management:** Address binding, Logical vs. physical address space, Static and dynamic loading and linking, Overlaying and swapping, paging, segmentation, fragmentation, Memory hierarchy.
- 8- **File systems:** Definition, attribute, types, access methods, Directory, Allocation methods, Consistency checking, Backup and restore, Disk management.
- 9- **Protection and Security:** Goals of protection, Domain of protection, Access matrix, Access control and rights, Cryptography, User authentication, Firewall.



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Subject :	CoE 333 Digital Signals Processing	Units “Credit Hours”:	3
Pre-requisite:	CoE 232	Theoretical :	3 Hr/wk
		Practical :	- Hr/wk
		Tutorial :	1 Hr/wk

Course Description:

Digital processing of signals, sampling, z-transforms, difference equations, discrete-time Fourier transforms, discrete and fast Fourier transforms, digital filter design.

Course Topics:

1. **Fundamentals of discrete time systems:** introduction, basic definitions, important Discrete Time (DT) signals, DT systems, and Fourier transform of sequences.
2. **The Z transform:** definition of Z-transform, inverse Z-transforms, relationships between system representations, computation of frequency response.
3. **Realizations of digital filters:** direct form realizations of IIR filters, cascade realizations of IIR filters, parallel realizations of IIR filters, and realizations of FIR filters.
4. **Sampling:** Sampling of continuous time signals, changing the sampling rate, multirate signal processing, interpolation, and decimation.
5. **Digital filter design:** design of IIR and FIR filters.
6. **Discrete Fourier transform:** properties, circular convolution, and Fast Fourier Transform “FFT”



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Subject : CoE 334 Analog Electronics

Units “Credit Hours”: 3

Pre-requisite: CoE 211

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial :

Course Description:

This course give a detail information on different types of amplifiers, multipliers, oscillators, voltage and current regulators, and filters.

Course Topics:

1. **Circuit modeling and simulation:** DC analysis, AC analysis, Transient analysis, Simulation control options, Built-in solid-state device models, Device parameter control, Libraries, Mixed-mode simulation.
2. **Feedback Amplifiers:** Voltage amplifiers, Current amplifiers, Trans impedance amplifiers, Trans conductance amplifiers.
3. **Voltage and current regulators:** Series voltage regulators, Current limiting regulators, Fold back limiting regulators, Shunt voltage regulators, Switching regulators, Current regulators with floating load, Current regulators with grounded load.
4. **Oscillators:** Barkhausen Criterion, Low frequency oscillators, RC-phase shift oscillators, Wien-bridge oscillators, High frequency oscillators, Hartley oscillators, Colpitts oscillators, Clapp and Meissner oscillators, Negative resistance oscillators, Crystal oscillators.
5. **Power amplifiers:** Class-A amplifier, Class-B amplifier, Class-AB amplifier, Class-C amplifier, Class-D amplifier, and Class-E amplifier.
6. **Operational amplifiers:** Ideal op-amps and circuit analysis, Ideal op-amp circuits: Inverting and non-inverting amplifiers, summing amplifier, difference amplifier, and integrator, low pass filter, Non-ideal op-amps: dc errors, CMRR, input and output resistances, frequency response, output voltage and current limitations, Circuits with non-ideal amplifiers, Multi-stage op-amp circuits, Non linear applications.
7. **Analog multipliers:** Techniques used in design of analog multipliers, Squaring, square root, and division circuits utilizing analog multipliers.
8. **Active filters:** Types of filters, direct simulation of active filters, Single loop and multiple loop filters, VCVS filters, MLFB filters.



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Subject : CoE 322 Engineering Economics

Units “Credit Hours”: 2

Theoretical : 2 Hr/wk

Pre-requisite: Junior Standing “3rd Year Standing”

Practical :

Tutorial :

Course Description:

Time value of money, economic analysis of engineering projects, planning and capital budgeting, rate-of-return analysis, depreciation, cash-flow analysis, organizational behavior, business organization forms, design of organizational structures, financial analysis and management. Prerequisite: Junior standing.

Course Topics:

1. Making Economic Decision
2. Engineering Cost and Cost Estimating
3. Engineering Economic Concepts
4. Time Value of Money & Cash Flow Diagrams
5. Simple and Compound Interest Calculations
6. Equivalence for Repeated Cash Flows
7. Present Worth Analysis
8. Annual Cash Flow Analysis
9. Rate of Return Analysis
10. Choosing the Best Alternative
11. Future Worth
12. Benefit-Cost Ratio, Payback Period
13. Sensitivity and Breakeven Analysis
14. Sustainability Issues
15. Renewable Energy Projects
16. Key Players, Project Delivery, Phases
17. Financial Sources, Instruments & Applications
18. Obtaining Financing and Approaches
19. Financing Risks & Requirements
20. Overcoming Key Barriers
21. Energy Efficiency Projects
22. Energy Programs



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Subject :	CoE 323 Random Signals & Systems	Units “Credit Hours”:	3
		Theoretical :	3 Hr/wk
Pre-requisite:	CoE 223, CoE 232	Practical :	
		Tutorial :	1 Hr/wk

Course Description:

Purpose and the nature of sampling; nature of estimates, point estimates, interval estimates; maximum likelihood principle approach, least squares approach; confidence intervals; estimates for one or two samples; development of models and associated hypotheses; nature of hypothesis formulation, null and alternate hypotheses, testing hypotheses; criteria for acceptance of hypothesis t-test, chi-squared test; correlation and regression; Markov processes, discrete time systems and continuous time systems; queuing theory including system simulation and modeling, queuing methods; use of appropriate statistical packages..

Course Topics:

- 1- **Introduction & Mathematical Review:** Sample Spaces and Events, Probability Laws. Conditioning on Events, The Total Probability Theorem, Bayes' Rule, Independence. The Counting Principle, Permutations, Combinations, Partitions, Combinatorial Examples
- 2- **Discrete Random Variables:** Probability Mass Functions, Important Discrete Random Variables, Functions of Random Variables
- 3- **Discrete Expectations and Discrete Random Vectors:** Expected Value, Functions and Expectations, Moments, Ordinary Generating Functions. Joint Probability Mass Functions, Functions and Expectations, Conditional Random Variables, Conditional Expectation, Independence, Multiple Random Variables
- 4- **Continuous Random Variables:** Cumulative Distribution Functions, Probability Density Functions, Important Distributions, Additional Distributions
- 5- **General Expectations, Bounds and Empirical Distributions:** Expectations, Moment Generating Functions, Inequalities. Convergence of Random Sequences, The Law of Large Numbers, The Central Limit Theorem



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Subject :	CoE 335 Microprocessor Systems	Units “Credit Hours”:	3
		Theoretical :	3 Hr/wk
Pre-requisite:	CoE 331	Practical :	
		Tutorial :	

Course Description:

This course introduces input/ output interface, memory mapped input/output, design of input/output ports with specific addresses, programmable input/output, programmable timers, interrupt address pointer, masking of interrupt, software interrupt, non-mask able interrupt, reset, programmable interrupt controller, and direct memory access DMA.

Course Topics:

1- I/O fundamentals: Handshaking, buffering, I/O read and write bus cycles.

2- Design of I/O ports: Design of isolated and memory-mapped I/O with a specific decoded port address.

3- Programmable I/O: Programmable peripheral interface (8255 PPI) internal architecture, port description, programming and modes of operation, interfacing with microprocessor. Programmable communication interface (8251 PCI) internal architecture, programming and modes of operation, interfacing with microprocessor. Keyboard and display controllers., and I/O Performance.

4- Programmable Timers: Programmable interval timer (8254 PIT) internal architecture, counters, programming and modes of operation, interfacing with microprocessor.

5- Interrupt structures: Vectored and prioritized interrupts, interrupt handling, interrupts service routines structure, software interrupt, BIOS and DOS interrupts, key board, display, mouse,...etc, internal interrupt, non-maskable interrupt, reset, external hardware interrupt. Programmable interrupt controller (8259 PIC) internal architecture and programming, multiple cascaded (master/slave) PICs configuration, and interfacing with microprocessor.

6- Direct memory access DMA: DMA operation in microcomputer system, programmable direct memory access controller (8237 DMA controller), programming and interfacing.

7- Buses: Bus protocols, local and global buses, bus arbitration.

8- Mass storage Devices: Floppy, Optical disk, Hard disk, RAID.



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Subject : CoE 336 Operating Systems
Programming

Pre-requisite: CoE 332

Units “Credit Hours”: 2
Theoretical : 2 Hr/wk
Practical : - Hr/wk
Tutorial :

Course Description

Execution of common UNIX user/administrator commands. Writing, compiling, and executing example Java programs which examine and display internal system data structures on a live UNIX system. The course is enhanced with a short introduction of some up-to-date computing techniques such as: Mobile computing, Cloud computing, android programming.

Course Topics

- 1- **UNIX System Overview:** Introduction, UNIX Architecture, Logging In, Files and Directories, Input and Output, Programs and Processes, UNIX Standardization, Feature Test Macros, Primitive System Data Types, Conflicts Between Standards.
- 2- **File and directories:** File Descriptors, function file functions, I/O functions , file traction, Link, Unlink, directory and its functions.
- 3- **Standard I/O Library:** Streams and FILE Objects, Standard Input, Standard Output, and Standard Error, Buffering, Opening , reading , writing a Stream, Formatted I/O stream, Temporary Files, Alternatives to Standard I/O.
- 4- **Process Control:** Process Identifiers, fork and vfork Functions, wait functions, Race Conditions, exec Functions, User ID and group ID functions, Interpreter and system functions, Process Accounting, User Identification, Process time.
- 5- **Threads:** Thread Concepts, Identification, Creation, Termination, Synchronization, Thread Limits, Attributes, Cancel Options. Threads and Signals, Threads and fork, Threads and I/O.
- 6- **Inter-process Communication:** Pipes, popen and pclose Functions, Coprocesses, FIFOs, XSI IPC, Message Queues, Semaphores, Shared Memory, Client–Server Properties.
- 7- **Network IPC: Sockets:** Socket Descriptors, Addressing, Connection Establishment, Data Transfer, Socket Options, Out-of-Band Data, Nonblocking and Asynchronous I/O, STREAMS-Based Pipes, UNIX Domain Sockets, Passing File Descriptors, An Open Server.
- 8- **Mobile computing:** Introduction, Types of wireless devices, Mobile objects , Moving object databases (MOD), Query language for MOD, Applications and challenges, future.
- 9- **Cloud Computing:** Introduction, architecture, characteristics, service models, SaaS maturity model, Layers, virtualization and virtual machines, sourcing,, taxonomy, storage, Modular datacenter, platforms.
- 10- **Android programming:** Introduction, Making and testing android projects, Basic program structure, Java-based layout, XML-based layout, Android studio, Eclipse ADT visual layout editor, Hybrid layout, Project structure, Accessing sensors on android devices, Database connections.



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Subject :	CoE 337 Digital Communication	Units “Credit Hours”:	2
		Theoretical :	2 Hr/wk
Pre-requisite:	CoE 232	Practical :	
		Tutorial :	1 Hr/wk

Course Description:

This course reviews the ideas of Digital communication systems including different types of encoding and multiplexing techniques. It also demonstrates the performance of digital systems and the guided and unguided transmission media. Cellular networks are also included.

Course Topics:

1. **Introduction to Digital Communication:** Communication model, OSI introduction, Sampling theory, channel capacity, Shannon theorem.
2. **Data Encoding, Transmission, and Multiplexing:** Pulse modulation (PWM, PAM, PPM, PCM, DPCM, delta modulation), line coding, FDM, TDM, ASK, FSK, BPSK, QPSK, and QAM,
3. **Performance of digital receiver:** transmission impairments: noise (Gaussian, impulsive and shot noise) and losses (optical, coaxial, radio), BER (Bit- error-ratio) and S/N ratio,.
4. **Transmission Media:** Guided transmission media (coaxial, optical fiber), wireless transmission, and wireless propagation.
5. **Spread spectrum:** Direct sequence, Frequency hopping and time hopping, CDMA.
6. **Cellular Wireless Networks:** Cellular network organization, operation, mobile radio propagation effect, and cellular network generations.
7. **Error control techniques:** checksum, summation code, Hamming code, CRC and Block codes.
8. **Switching techniques:** Store and forward packet and message switching, circuit switching, datagram and virtual circuit packet switching.



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Subject : CoE 431 Software Design

Units “Credit Hours”: 3

Pre-requisite: CoE 135, CoE 235, CoE 336

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial :

Course Description:

Foundations of software design, reasoning about software, software life cycle, requirements, project management and testing. Including the calculus of programs, quality and test measurement, survey of formal specification techniques and design languages, human-computer interaction, graphical user interfaces.

Course Topics:

1. **Software life cycle and process models:** life cycle, life cycle model, quality, phases, Process improvement, Process assessment models, metrics, standards and guidelines.
2. **Software requirements and specifications:** Requirements analysis modeling techniques, Prototyping, formal specification techniques, functional and non-functional requirements.
3. **Software design:** design concepts, architecture, structured design, Object-oriented analysis and design, Component-level design, Design for reuse, Quality in relation to specification (completeness, consistency, simplicity, verifiability).
4. **Software testing:** Testing fundamentals, tools, test plan creation, test case generation Validation planning, Black-box and white-box testing techniques, Unit integration, validation, system testing, Object-oriented testing, , Measures of Reliability and Availability, and inspections
5. **Software evolution:** Software maintenance, forms of maintenance, defect removal, upgrade, enhancement, Patterns of behavior, bottlenecks measurement, regression testing version control, Software re-use, and Reengineering.
6. **Project management:** Programming environments, Requirements analysis and design modeling tools, teams composition, project management difficulty, Resource allocation, Gantt charts, Project planning, costing, and timely compliance and delivery.
7. **Concurrent Design:** performance constraints, real-time features remands, Hardware and software co-design.
8. **Computer Interfaces:** define HCI, context, reasons, web interface, Human performance models, usability testing, graphical user interfaces GUI, web interfaces.



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Subject : CoE 432 Computer network

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: CoE 337

Practical :

Tutorial :

Course Description:

Introduction to the design and performance analysis of computer networks Architectures, protocols, standards and technologies of computer networks. Including different computer networks types, media, models, switching, retransmission, flow and error control.

Course Topics:

1. **Introduction and overview:** General definition, fundamental concepts of network, reasons for studying networks, type of nodes, types of computers (LANs, MANs, WANs), Network Criteria (performance, reliability, and security), hardware and software components of networks , network types (LAN, WAN, MAN, and wireless),and Network line configuration (point-to-point, multipoint).
2. **Network Topologies** (mesh, star, tree, bus, ring), LAN Network Models (client/server and peer to peer).
3. **Network architecture:** Protocol suits and layering concepts, OSI reference models, Connection-oriented and connectionless services.
4. **Flow and Error Control:** ARQ system utilization of networks: stop and wait protocol and Sliding Window, Go back N and selective repeat protocols. Error detection techniques.
5. **Media Access Control:** Random access, control access, CSMA, Reservation, Polling, token ring, Channelization.
6. **LAN and WAN technologies:** Ethernet, token Ring, Gigabit Ethernet, network evaluation, efficiency, capacity.
7. **Network and internetworking devices:** as repeaters, bridges, switches, routers, and gateways.
8. **Switching techniques and communication services:** Circuit and packet switching.
9. **Wireless network:** wireless standards, wireless LANs, ESS and BSS, Distribution.



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Subject : CoE 433 Control Systems

Units “Credit Hours”: 3

Pre-requisite: CoE 232, Pre-calculus

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial : 1 Hr/wk

Course Description:

This course is to explore the modeling of linear dynamic systems via differential equations and transfer functions utilizing state-space and input-output representations; analysis of control systems in the time and frequency domains and using transfer function and state-space methods; study of the classical stability tests, such as the Routh-Hurwitz and Nyquist criterions, and design methods using root-locus plots and Bode plots.

Course Topics:

1- Mathematical models of control systems, Transfer functions and block diagrams:

Mathematical models for electrical and mechanical systems. Simple spring- dash-pot system and DC servomotor, transfer function, block diagram representation, signal flow graph and Mason's formula,

2- Time-domain responses: Time response of first order system, time response of second order system, transient response and steady state error.

3- Stability Analysis: Stability analysis by Routh- Hurwitz criterion, root locus plot, frequency response method, Nyquist criterion a Bode plot techniques.

4-State space analysis: Standard form, state space model from differential equation, solution of state equation, state transition matrix, controllability test, observability test.

5- Digital Control Systems: Introduction to digital control systems, pulse transfer function.



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Subject :	CoE 434 Engineering Project	Units “Credit Hours”:	6 (3*2)
	Two semesters	Theoretical :	1 Hr/wk
Pre-requisite:	Senior Standing “4th Year Standing”	Practical :	4 Hr/wk
		Tutorial :	

Note:- The Course is covered by two semesters

This course covers the complete design cycle for several small design projects, each including establishing objectives, synthesis, analysis, construction, testing and evaluation. Use of modern lab equipment and fabrication techniques. Development of communication skills, and discusses student project teams design, build, test and present results for realistic projects from university and industrial sponsors. Formulation of specifications, consideration of alternative solutions, feasibility ---considerations, Detailed system descriptions, economic factors, safety, reliability, aesthetics, ethics and social impact.



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Subject :	CoE 422 Project Management	Units “Credit Hours”:	2
Pre-requisite:	Senior “4 th Year Standing”	Theoretical :	2 Hr/wk
		Practical :	
		Tutorial :	1 Hr/wk

Course Description:

This course is specifically designed to provide the knowledge and techniques required to properly manage projects of all types and sizes. Course material covers the approaches and practices in project management over the lifespan of the project cycle. This course is a highly interactive course with hands-on in-class practicing projects and analysis of real-world project examples. While providing the knowledge in project planning and control techniques, it focuses on the development of project leadership, teamwork, and problem solving skills.

Course Topics:

1. Project, Characteristic of Project, Project Management, Stakeholders.
2. Project Life Cycle, Characteristic of Project Life Cycle, Project Versus Operation.
3. Project Management Life Cycle, Process Group Life Cycle, Characteristic of Project Management Life Cycle, Project management Process, Project Management Knowledge Areas.
4. Form of Organization.
5. Network, Critical Path Method.
6. Pert Technique (Time and Cost).
7. Precedence Technique.
8. Applications of Microsoft Project.
9. Applications of Primavera.
10. The Resource Allocation Problems.
11. Linear Programming.
12. Profile Maximization problems.
13. Maintenance Concept and Policy.
14. Systems.



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Subject : CoE 435 Embedded Computing
Systems

Pre-requisite: CoE 237, CoE 335

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial :

Course description: Introducing microcontrollers for embedded system design. I/O interfacing analogue and digital signals, Real time OS, Multiprocessor systems, Networking for embedded systems, hardware and software design techniques.

Course Topics

- 1- Introduction to embedded systems:** Indicate some reasons for studying embedded systems, Product life cycle, Quality design, Debugging, Computers, processors, memory, and microcontrollers, Digital logic and open collector, Types of real-time systems.
- 2- Embedded ARM microcontrollers:** ARM processor architecture, Software model, Addressing modes, programming instructions, Fundamental concepts of assembly language and linking: labels, address management.
- 3- Microcontroller Hardware:** Microcontroller I/O pins, I/O programming and the direction register, Phased-lock loop, SysTick timer, Measurement of dynamic efficiency, Power management, Fault tolerant system.
- 4- Real-time operating systems:** Fundamentals, Foreground/Background, Delay tasks, Round Robin scheduler, Semaphores, Thread synchronization or rendezvous, Resource sharing, non-reentrant code or mutual exclusion, Thread communication using: mailbox and FIFO queue, Switch debouncing, Deadlocks, Monitors, Free RTOS.
- 5- Interfacing and Communication:** Introduction to interfacing, Synchronous serial interface SSI, LCD interface, Scanned keyboard, Actuators, Pulse width modulation, Motors drivers, I²C interface, USB interface, High speed interfacing: Hardware FIFO, Dual-port memory, DMA controllers sensors interface.
- 6- Interrupt programming and real-time systems:** I/O synchronization, Interrupt concepts, Polled I/O vs. interrupt-driven I/O, NVIC on ARM processor, SysTick periodic interrupts, Timer periodic interrupt, Ballast code timing, Multithreading.
- 7- Analog I/O Interfacing:** Analog to digital conversion, Real-time data acquisition, Digital to analog conversion, 4~20mA signal standards.
- 8- Software design:** Quality programming, Modular software design, and Threads, Call graph, Data-flow graph, Top-down vs. bottom-up design, Memory management and the Heap.
- 9- Networked embedded systems:** Networked embedded systems, Reentrant programming, Critical section, Network topologies: ring, bus, multi-hop., Producer- consumer using FIFO queue, Distributed systems, Wireless communication, Internet-enabled embedded systems.
- 10- High speed networks:** Fundamentals, CAN, Ethernet, Internet of Things.
- 11- Robotic systems:** Introduction to Digital Control, Closed-loop control, PID controllers, Fuzzy logic control.



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Subject : CoE 436 Network Technology

Units “Credit Hours”: 3

Pre-requisite: CoE 235, CoE 432

Theoretical : 3 Hr/wk

Practical : - Hr/wk

Tutorial :

Course Description:

The concepts of internetworking, internetwork architecture, protocols, network services and applications. Server based operation. Networking problem notification and control. Authentication and security issues.

Course Topics:

1. Internetworking Protocol suites (TCP/IP), protocols stack, functions and layers.
2. **Internet addressing:** Logical addressing, classful and classless addressing, subnetting, and address translation.
3. **Networking Protocol:** IPv4, IPv6, Packetizing, datagram and virtual circuit networks, network services, fragmentation.
4. **Network supporting protocols:** Address mapping ARP, RARP, BOOTP, DHCP, error reporting ICMP. Multicasting IGMP. Routing concepts.
5. **Process- to- Process delivery protocols:** Connectionless and Connection-Oriented Service, transport control protocol TCP, user datagram protocol UDP, stream transfer control protocol SCTP, Multi homing.
6. **Application Level Protocols:** Telnet, FTP, TFTP, NFS, SMTP, LPD, X Window, SNMP, DNS.
7. **Network Congestion:** packet switching network congestion, Open-loop congestion control, and Closed-loop congestion control.
8. **Client-server computing:** Web technologies: Server-side programs; common gateway interface (CGI), applet concept, HTTP, client-server relationship, Uniform Resource Locator, scripts.
9. **Network Security Concepts:** Authentication, Encryption and decryption, cryptography, Public key, private key, symmetric key, filtering.



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Subject : CoE 437 Parallel Processing
Architecture

Units “Credit Hours”: 3

Theoretical : 3 Hr/wk

Pre-requisite: CoE 234, CoE 331

Practical :

Tutorial :

Course Description: Instruction level pipelining and Superscalar Processors, Multiple Processor Organizations, Closely and loosely coupled multiprocessors systems, Symmetric Multiprocessors, Clusters, UMA NUMA, Vector Computations, RISC: Instruction execution characteristics, RISC architecture and pipelining. RISC vs CISC. Management methods for parallel computers.

Course Topics:

1. **Introduction:** Necessity of high performance, constraints of conventional architecture, Von Neuman architecture, limitations, evolution of parallel processors.
2. **Parallelism:** parallelism of Uniprocessor architecture, parallel processing mechanisms, multiple function units, parallelism and pipelining within CPU, overlapped CPU, use of memory hierarchy system.
3. **Architectural Classifications of parallel computers:** Flynn's classifications (SISD, SIMD, MISD, and MIMD) computer organizations, classification based on computing between processing elements, SIMD.
4. **Memory architecture of Parallel Processing:** shared, distributed, and hybrid distributed- shared memory, UMA and NUMA, COMA.
5. **Multiprocessor Architecture:** multiprocessor systems, loosely coupled, tightly coupled, multiprocessor characteristics, inter processor communication networks (time shared buses, crossbar switches).
6. **Vector and array Processors:** basic vector architecture, vector processor, vector instruction types, array processors (array, wave front array, systolic array, bus architecture), matrix multiplication systolic array, processors, switching methodology, network topology. Multithread architecture.
7. **Pipeline Mechanism:** instruction pipelining, multiple function units, internal data forwarding, linear pipeline processors, speedup, efficiency, throughput, classification of pipeline processors (arithmetic, instruction). Hazard types (data, structural, and control), hazards handling and reducing, role of cache memory on pipeline system.
8. **Branch Handling:** Techniques of branch handling(pipelining, looping, out of order execution, software scheduling), predicted execution, speculative loading, superscalar processors, very large instruction word processor VLIW, case study (Pentium Processor).
9. **Interconnection Networks:** static versus dynamic SIMD networks, network performance static networks (linear, tree, torus, cube, hypercube, mesh, ring). Dynamic interconnection networks; switches versus links, single stage network (shuffle exchange), multistage interconnection networks MIN (perfect shuffle, inverse shuffle, bit reversal, and butterfly) Omega MIN.



University of Basrah
College of Engineering
Computer Engineering Department



Subject : CoE E3x Elective courses
(x= 1,2,3,9)

Units “Credit Hours”: 3
Theoretical : 3 Hr/wk
Practical :
Tutorial :

Pre-requisite:

x= 1- Computer-Aided Analysis.

2- Electronics Design.

3- Information Theory.

4- Image Processing.

5- Knowledge Engineering

6- Cloud Computing.

7- Discrete Control.

8- Data Mining.

9- Security