The Curriculum
Computer Engineering Department
College of Engineering
University of Mosul
2018-2019

اسم التدريسي رقم الهاتف عنوان البريد الاليكتروني

University of Mosul **Computer Engineering Dept.**

2018

First Class(First Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
3		1	3	Math. I	ENCO10l
3		1	3	Physical Electronics	ENCO102
3			3	Digital Logic Fundamentals	ENCO103
1	3			Electrical & Digital Lab.I	ENCO104
3	1		3	Introduction to Computer Science	ENCO105
3	1	1	3	Algorithms and Programming Methodologies	ENCO106
1	3			Engineering Drawing	ENCO107
2			2	Democracy	ENCO108
19	8	3	17	Summation	
	28				

First Class(Second Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
3		1	3	Math. II	ENCO109
4		1	5	Electrical Circuits	ENCO110
3		1	3	Digital System Design	ENCO111
1	3			Electrical & Digital LabII	ENCO112
4	1	1	4	C++ and OOP	ENCO113
1	3			Eng. Drawing Using PC	ENCO1l4
2			2	Human Rights	ENCO115
18	7	4	17	Summation	
	28				

Second Class(First Semester)

University of Mosul **Computer Engineering Dept.**

2018

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
4		1	3	Math III	ENCO201
4		1	4	Electronics Circuits	ENCO202
4	2		3	Programmable Logic Devices(PLD)	ENCO203
1	3			Electronics Lab1	ENCO204
4	2	1	3	Data Structures	ENCO205
2			2	Engineering Economics	ENCO206
19	7	3	15	Summation	
	25				

second Class(Second Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
2		1	2	Numerical Analysis	ENCO207
4		1	3	Engineering Analysis	ENCO208
4		1	4	Digital Electronics	ENCO209
3		1	3	Magnetics and Energy Conversion	ENCO210
1	3			Electronics Lab II	ENCO211
4	2		3	Fundamentals of Micro-processor	ENCO2l2
2			2	Engineering Management	ENCO213
20	5	4	17	Summation	
	26				

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2018

Third Class(First Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
2		1	2	Signal and System	ENC030l
5	3		3	Computer Interface	ENCO302
3		1	3	Computer Architecture	ENCO303
3		1	3	Data Communication	ENCO304
1	3			Communication Lab	ENCO305
2		1	2	VLSI	ENCO306
4	2	1	3	Operating System	ENCO307
20	7	4	16	Summation	
	27				

Third Class(Second Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
2		1	2	Statistics & Probabilities	ENCO308
3	2		2	Embedded System	ENCO309
3		1	3	Computer Architecture II	ENC0310
2		1	2	Fundamentals of Computer Networks	ENCO311
1	3			Network Lab	ENCO312
	2		2	Sensors and Measurements	ENCO313
3	2		2	Digital Signal Processing	ENCO314
2		1	2	Data Bases Systems	ENCO3l5
3		1	3	Elective (Advanced Micro-Processor)	ENCO3l6
19	7	5	16	Summation	
	28				

University of Mosul **Computer Engineering Dept.**

2018

Fourth Class(First Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
3	2		2	Real Time Systems	ENCO401
2			2	Advanced Computer Architecture	ENCO402
3		1	3	Control Engineering Fundamental	ENCO403
3	2	1	2	Wireless Networking	ENCO404
1	3			Control Lab I	ENCO405
2	3		2	Engineering Project*	ENCO406
2			2	Elective (Computer Graphics)	ENCO407
2			2	ElectiveEngineering Ethics	ENCO408
18	10	2	14	Summation	
	26				

Fourth Class(Second Semester)

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
3		1	3	Parallel and distributed Computing	ENCO409
3		1	3	Digital Control Systems	ENC0410
3	2	1	2	Network Security	ENCO411
1	3			Control Lab II	ENCO412
2	3		1	Engineering Project*	ENCO406
2			2	Software Engineering	ENCO413
2			2	Elective (Image Processing)	ENCO414
1			2	Elective (Advanced Micro-Processor)	ENCO415
17	8	3	15	Summation	
	26				

*The Engineering Project is an annual Course with a total Credits equal to four

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2018

Elective Courses

Units	Teaching Hours			Subject	Code
	Practical	Tutorial	Theoretical		
2			2	Computer Graphic	ENCO407
2			2	Ethics	ENCO408
2			2	Image Processing	ENCO414
2			2	Advanced Micro- Processor	ENCO415
2			2	Antenna & Propagation	ENCO416
2			2	Artificial Intelligent	ENCO417
2			2	Optimization	ENCO4I8
2			2	Soft Computing	ENCO419
2			2	Network Management	ENCO420
2			2	ASP(Application SpecificProcessor)	ENCO421
2			2	Optical Communication	ENCO422
2			2	Advance MP	ENCO423
2			2	Reconfigurable Computing	ENCO424
2			2	Industrial Network	ENCO425
2			2	Biomedical Computing	ENCO426
2			2	Intelligent Control System	ENCO427
2			2	Network Applications	ENCO428
2			2	Computer Security	ENCO429

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College of Engineering
Computer Engineering Dept.

Mathematics I (ENCO101)

Lab	Tutorial	Theory
	1	3

Course Objectives:	
The purpose of this course, besides making it possible to learn the mathematics of calculus, is to teach the students how to use it effectively. This course is to give a brief review for the basics in differentiation (taken in secondary school) then to give the following: Integration, methods of integration, matrix algebra and determinate.	
Course Details:	
Article	**Week**
1. Absolute value, limits, derivatives,application of derivatives	2
2. Determinate	2
3. Matrix: solving equations, matrix algebra and operations , Gausselimination " Gauss-Seidel	3
4. Integrals : Indefinite. Definite	2
5. Methods of integration	4
6. Multiple Integration	2
Text Books	
Calculus by Thomas Finny 10th Edition, Person Publisher,2001	

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College of Engineering
Computer Engineering Dept.

Physical ElectronicsI (ENCO102)

Lab	Tutorial	Theory
	1	3

Course Objectives:	
Learning the characteristics of materials including (Insulators, Semiconductors, and Conductors). Also, study the P-N Junctions, and Transistors.	
Course Details:	
Article	Week
1. Atomic Structure, effect of gravitational, effect of electric field, energy bands, crystalline structure, bond types.	2
2. Fermi-dirac function, Fermi level, electron distribution in semiconductors.	1
3. Conductors, mobility, conductivity, resistivity, current density.	2
4. Semiconductors, p-type, n-type, mobility, conductivity, resistivity. current density.	2
5. PN-junction diode, potential barrier, drift current, depletion layerand capacitor, forward and reversebias, temperature effect on diode characteristics.	2
6. Types ofdiodes and their applications.	3
7. Transistors, PNP, NPN, transistor currents, biasing of transistors, characteristic curves.	3
Text Books	
Electronic Devices. Floyd. 2012, Prentice Hall	
Material Science . Kakani	

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Computer Engineering Dept.

Digital Logic Fundamental(ENCO103)

Lab	Tutorial	Theory
		3

Course Objectives:	
Giving a thorough understanding of the binary system, Boolean algebra, Karnaugh map, Sequential Circuit, and their applications.	
Article	**Week**
Number System	1
Boolean Algebra	2
Logic Circuit	2
Minimization by Karnaugh maps	2
Digital Components: Adders, Comparators, Decoder, Multiplexer,..etc…	4
Sequential Circuit and their applications.: Counters, registers.	4
Text books:	
1- Digital Fundamental, 10th Edition, Thomas L. Floyd,UBS,2011. 2- Digital Design, Moshe Mano, prentice Hall,2002	

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Computer Engineering Dept.

Introduction to computer science(ENCO104)

Lab	Tutorial	Theory
1	`	3

Course Objectives:	
An introductory ideas about the computer system with both branches (Software & Hardware). Also, providing student with basic tools to start their learning journey to be successful computer engineer.	
Course Details:	
Article	Week
l. Introduction to Computers, Number Systems, and Logic Gates	1
2. Computer Architecture	1
3. Primary memory. heaps. stacks	1
4. Introduction to C Programming , Simple Program, Memory Concepts, Arithmetic in C	1
5. Structured Program Development Algorithms. Problem Solving Techniques, Control Structures	2
6. Program Control More Control Structures, Logical Operators	1
7. Program loops : For,Whiles, do-Whiles	1
8. Input Devices/Output Devices for C-languages.	1
9. Computer Software's Editors, Translator,. Linkers, and loader	2
10. C-languages Operating interrupts Functions	1
11. Data Communication and Computer Network	2
12. Internet Basics	1
Text Books	
1- Introduction to Computer Science ,By :ITL Education Solutions Limited Publisher: Person Education,2011 2- C++ How to Program, 8th Edition, by :Paul Deitel Prentice Hall,2011	

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College of Engineering
Computer Engineering Dept.

Algorithms and Programming methodologies (ENCO106)

Lab	Tutorial	Theory
1	1	3

Course Objectives:

Introduction to the algorithm thinking and the art programming, this course teaches students how to think algorithmically and solve problems efficiently. Topics include algorithm design, flowcharts, mapping algorithm to C-languages, C-languages structure, files pointers.

Course Details:

Article	Week
1-Algorithms Expressing Algorithms, General Approaches in Algorithm Design' Analysis of Algorithms	1
2-Algorithm Design Methodologies' Top-down. Hierarchical modularization, Stepwise refinement.	2
3-Flowcharts Advantages of Using Flowcharts, Flowchart Symbols & Guidelines. and Types of Flowchart	1
4-Program Design Activities involved in Program Design, Object-oriented Formulations	2
5-Functions	1
6-Arrays	1
7-Pointers	1
8- Files	1
9- Searching Algorithms Sequential search, Binary search	1
10- Sorting Algorithms selection sort, Bubble sort, Insertion sort, Merge sort, Non- comparison-base sorting.	2
11-Introduction to Algorithm Analysis algorithm comparison, Big O notation, Orders of magnitude.	2

Text books:

1. Mastering algorithm with C, by Kyle Loudon 1990
2. Introduction to algorithms, second edition, by Thomas h. Cormen, 2002

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College of Engineering
Computer Engineering Dept.

Engineering Drawing(ENCO107)
Lab Tutorial Theory
3

Course Objectives:	
Guiding students to draw using instruments and improve their imagination to draw different engineering objects. Moreover, teaching them the modeling of various kind of hardware	
Course Details:	
Article	**Week**
1. Instruments and their uses	1
2. Basic of lettering	2
3. Graphic Geometry	3
4. Orthographic projection	5
5. Isomeric Drawing	4
Text Books	
Engineering Drawing &GraphicTechnology /By French, I. McGraw-Hill,1993	

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College of Engineering
Computer Engineering Dept.

Mathematics (ENCO108)

Lab	Tutorial	Theory
	1	3

Course Objectives:	
This course is to make the student with the different coordinates, vectors, complex numbers, transcendental functions and multiple Integrals with their engineering applications.	
Course Details:	
Article	**Week**
1. Polar, Cartesian, cylindrical , andspherical coordinates	3
2. Vectors, Vector functions	4
3. Complex numbers	2
4.Transcendental functions and its application	2
5. Functions of two or more variables, partial derivatives	2
6. Eigen Values & Eigen Vectors	2
Text Books	
Calculus By Thomas Finney 10th Edition, person publisher, 2001	

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College of Engineering
Computer Engineering Dept.

Electrical Circuits (ENCO110)

Lab	Tutorial	Theory
-	1	5

Course Objectives:

To give a thorough understanding of the fundamental concepts of circuit analysis and their applications to real world problem.

Course Details:

Article	Week
l. Basic Concepts	1
2. Basic Laws	1
3. Methods of Analysis	2
4. Circuit Theorems	3
5. Capacitors and Inductors	1
6. First-Order Circuits	2
7. Sinusoids and Phasors	1
8. Sinusoidal Steady-State Analysis	2
9. AC Power Analysis	2

Text Books

Basic Engineering Circuit Analysis, J. David Irwin' Robert M. Nelms, John Wiley & Sons, Nov l' 2011.

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Computer Engineering Dept.

Digital System Design (ENCO111

Lab	Tutorial	Theory
	1	3

Course Objectives:	
To introduce sequential logic circuit (analysis and design_ and programmable logic devices.	
Course Details:	
Article	**Week**
1. PLDs	3
2. SD, ASM chart, transition Map, Timing Diagram	2
3. Synchronous sequential cct, Meaty and Moor, implicit table, state reduction and assignment.	3
4. Synchronous design using PLD	2
5. Asynchronous cct. Fundamental mode and pulse Mode. Design steps	3
6. Hazards	2
Text Books	
1- Modern digital design by Richard S. Sandige (McGraw-Hill1990)	

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College of Engineering
Computer Engineering Dept.

C++ and OOP (ENCO113)

Lab	Tutorial	Theory
1	1	4

Course Objectives:

1. leaning Object Oriented Programming through C++.
2. Understanding the effort needed to successfully develop engineering-oriented software.

Course Details:

Article	Week
l. introduction	1
2, G++ Programming basics	2
3. Functions	1
4. Object and Classes	2
5. Arrays and string allays fundamentals and Arrays as class Member Data	1
6. Operator overloading	1
7. inheritance	2
8. Pointer	1
9. Virtual Function	1
10. Streams and Files	1
11. Templates and Exceptions	1
12. The standard template library	1

Text Books

1- Object Oriented Programming in C++ by Robert LaforeTechmedia Publication.2001.
2- Object Oriented Programming in C++SauravSahayOxford University Press. 2012.
3- Object Oriented programming and c++, Rajaram, R2013.

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Computer Engineering Dept.

Engineering Drawing Using PC
(ENCO114)
Lab **Tutorial** **Theory**
3

Course Objectives:	
Guiding student to draw using computer Aided design (CAD) tools. The course enhanced drawing quality and reduce designing time.	
Course Details:	
Article	**Week**
1. introduction[to AutoCAD	2
2. CAD commands	3
3. Basic of 2T) Drawing	3
4. Isomeric Drawing	3
5. Basic of 3D Drawing	4
Text Books	
The AutoCAD® book: Drawing, Modeling, by J. M. Kirkpatrick, 2004.	

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Computer Engineering Dept.

Mathematics III (ENCO201)

Lab	Tutorial	Theory
	1	3

Course Objectives:

This course is to give the student some more advanced subjects as partial derivative, differential equations, series and Fourier series and transform, this is to prepare the student for the next stage which is the numerical and engineering analysis.

Course Details:

Article	Week
1. Differential Equation	5
2. Introduction to partial differential equation	2
3. Infinite series	2
4. Fourier series	3
5. Fourier transforms and is inverse (Continuous and describe)	3

Text Books

1. Advanced Engineering Mathematics 9th Edition, By Reyszig ERWIN, Publisher
2. Calculus By Thomas Finny 10th Edition, Person Publisher, 2001

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Computer Engineering Dept.

Electronics Circuits (ENCO202)

Lab	Tutorial	Theory
	1	4

Course Objectives:	
To introduce the analysis and design of analog electronic circuits and subsystems using BJT, FET transistors, operational amplifiers.	
Course Details:	
Article	**Week**
1. Amplifier: bipolar transistors: Biasingcct. AC cct,, frequency response	4
1. Field Effect Transistors : JFET, MOSFET, Biasing and AC cct.	2
2. Feed Back: a- Negative b- Positive	2
4, Operational Amplifiers	4
5. Power Amplifiers	2
6. Introduction to IC fabrication	1
Text Books	
1-Electronic devices and circuit theory' Robert L. Boylestad' Louis Nashelsky, Prentice Hall, 1991. 2-Electronic Devices. By Floyd.2012. Prentice Hall	

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Computer Engineering Dept.

Programmable Logic Device (ENCO203)

Lab	Tutorial	Theory
2		3

Course Objectives:

To instruct the student in the use of VHDL (very high speed Circuit hardware description language) for designing the behavior of digit systems

Course Details:

Article	Week
1. Basic principles of digital Systems, PAL., PLD review	1
2. FPGA structure	1
3. VHDL Language	2
4. Circuit Design in VHDL	1
5. code structure of VHDL	1
6. Data type of VHDL	2
7. Operator and attributes of VHDL	1
8. Concurrent statement of VHDL	1
9. Sequential statement of VHDL	2
10. State machine of VHDL	2
11. System design of VHDL	1

Text Books

1- Voinci A. pedroni, "Circuit design with VHDLL", MIT press, Cambridge, London 2004.
2- Thom A.S. "digital with CPLA application and VHDL.
3- Brain Hold : "digital logic Design", 4th Edition, Newmans, 2002

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Computer Engineering Dept.

Data Structure (ENCO205)

Lab	Tutorial	Theory
2	1	3

Course Objectives:

Review algorithms for solving problems that use data structures such as arrays linked lists, stacks, queues, graphs and trees, and those that are used for list manipulation, graph manipulation (e.g., depth-first search), and tree traversals. Moreover, implementing algorithms in C++ using good programmingstyle for data structures.

Course Details:

Article	Week
Introduction and review	1
information hiding, Encapsulation, Design and implementation of list ADTS using arrays and linked lists	1
Recursion in Programming and Problem Solving Recursive valued functions: Factorial, Classical problems: Ackermann's function, 8-Queens problem, Towers of Hanoi, detecting palindromes Relation to mathematical induction	2
Stacks Stack ADT, implementation using arrays, linked lists, and list ADTS, Applications: Checking balanced braces, recognizing strings, depth-first searches on graphs	2
Queues Queue ADT, implementation using arrays, linked lists, and list ADTS, Applications: breadth-first searches, recognizing palindromes	2
Trees introduction, Terminology, Traversals, Applications: Binary Trees, Tree ,Huffman's algorithm	2
introduction to Graph theory	1
Hashing Techniques	2
Speed memory Trade off	2

Text Books

1- M.A. Weiss, Data structure and algorithm analysis in c++ Addison Wesley, 2006.
2- Michael T. Goodrich, Roberto Tamassia, David M. Mount , Data structure and algorithm in C++,2011.

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Computer Engineering Dept.

Numerical Analysis (ENCO207)

Lab	Tutorial	Theory
-	1	2

Course Objectives:

To develop and investigate of numerical methods, which provide the transition from the mathematical model of a problem(the equations or functions obtained in calculus or algebra., etc. to an algorithm which we can be solved numerically and programmed to get fast solution

Course Details:

Article	Week
l. Numerical Analysis basic concepts	1
2, Roots Finding	2
3. Numerical Integration and Differentiation	2
4. Finite Difference and Interpolation	2
5. Curve Fitting	2
6. Solution of Simultaneous equations	2
7. Numerical Methods of Differential Equations	2
8. Eigen values and Eigen vectors	2

Text Books

1- Kreyszig " Advanced" engineering mathematics" 10th edition, Whilly and Sons Inc, 2011.
2- John H. Mathews, Kurtis D. Fink " Numerical Method using MATLAB, 4th, edition prentice Hall, 2004.

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Computer Engineering Dept.

Engineering Analysis (ENCO208)

Lab	Tutorial	Theory
-	1	3

Course Objectives:	
The development and investigation of transforming the continuous and discrete time signals from the time domain to another domain (such as frequency domain, s-domain and Z-domain respectively)by using a suitable transformation rules, in doing so, we will gain an advantage in that some signal processing problems will be easier to solve. Also, the signal can be analyzed and more information of the signal can be gained and investigated	
Course Details:	
Article	**Week**
1. Review of Fourier series and transform	2
2. Laplace transform properties and application	4
3. Introduction to discrete systems	2
4. Z-transform properties and applications	4
5. Residue Theorem and its application for inverse Z-transform	3
Text Books	
1- Neff "Continuous and discrete linear systems " HarperCollins Publishers, 1984. 2- CH. Philips & J. Parr" Signal System and transform " Prentice Hall , 1995	

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Computer Engineering Dept.

Digital Electronics (ENCO209)

Lab	Tutorial	Theory
-	1	4

Course Objectives:	
Study logic families, timing cct., A/D and DA converters and memory Devices.	
Course Details:	
Article	**Week**
1- Logic families and their electronic circuit: DRL,DTL,TTL,……	3
2. IIL, ECL, logic	1
3. CMOS Logic	2
4. Timing Circuits :Astable, Bistable, Monostable, Schmitt,555 Timer.	2
5. D/A Convertor	1
6. A/D Converters	3
7. Memory Devices	3
Text Books	
1- Digital Fundamental by T.L. Floyd,2012, Prentice Hall 2- Integrated Electronic by Millman and Halkias, McGraw Hill	

University of Mosul
College of Engineering
Computer Engineering Dept.

Magnetics and Energy Conversion (ENCO210)

Lab	Tutorial	Theory
-	1	3

Course Objectives:

This course introduces the principle of electrostatic, electromagnetic, theory, transforms circuit and test, DC machine and motors, it also covers the energy conversion circuit's topology and the new topics of energy harvesting and renewable energy.

Course Details:

Article	Week
1. Energy Types and Transducers	2
2. Electrostatic	1
3. Properties of electric field-electric flux	1
4. Electromagnetic Theory	1
5. Electromagnetic circuit	1
6. Maxwell laws	1
7. Transforms, Equivalent circuit transform and transform test	1
8. Motors and DC machine	1
9. Energy Conversion, AC/D, DC/DC conversion	2
10. Renewable Energy	2
11. Energy Harvesting	2

Text Books

1- Electromagnetism: Principles and application, by : Paul Lorrian
2- Fundamental of power Electronics, By: Robert W. Erickson and DraganMaksimovic
3- Energy Harvesting System: principles, Modeling and applications, By: Tom J. Kazmierski and Steve Beeby

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Computer Engineering Dept.

Fundamental of Microprocessor (ENCO212)

Lab	Tutorial	Theory
2		3

Course Objectives:

Learning the fundamentals of microprocessor in terms of architecture, assembly language, instructions, machine programming and interrupts.

Course Details:

Article	Week
1. 8086 Architecture	1
2. Machine cycle (read,write, interrupt)	1
3. Addressing modes	1
4. Assembly language programming for 8086 micro process	1
5. Data transfer instructions	1
6. Simple input and output port transfer instructions:	1
7. Special address transfer instructions	1
8. Flag transfer instructions	1
9. Arithmetic instructions, Logic and Bit manipulation instructions	1
10. String instruction	1
11. Program execution transfer instructions	1
12. Interrupt instruction	1
13. Processor control instruction	1
14. Execution control instruction	1
15. Architecture Co- processor (8087) programming with 8087	1

Text Books

1- Walter Triebel and Avtar Singh, The 8088 and 8086 Microprocessors: programming, Interfacing, software, Hardware, Applications, 4th edition, prentice-Hall, 2002.
2- Barry B. Brey, The Intel Microprocessors 8086/8088, 80,86,80286,80386,80486, Pentium , Pentium pro processor, Pentium II, Pentium III, Pentium 4 , Architecture, programming and interfacing, prentice Hall of india private Limited, new Delhi, 2003

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College of Engineering
Computer Engineering Dept.

Signal and system (ENCO301

Lab	Tutorial	Theory
-	1	2

Course Objectives:	
This course aims to explain to the students the fundamentals and properties of discrete-time signals and systems, digital signal formats, time-domain representations, difference equation, , impulse response of discrete-time LTI systems, digital convolution, frequency- domain representations, describing the random sequences, and MATLAB experiments=	
Course Details:	
Article	**Week**
1. Review' of Continuous-Time Signals, Signal Classification, Convolution, Correlation Function andSampling Theory,	2
2- Discrete-Time Signals and Systems	1
3. Difference Equation (D.E) Representation	2
4. Time-Domain Representations and impulseResponse	2
5. Convolution and De-convolution	2
6. Frequency-Domain Representation andFrequency Response	2
7. Describing random sequences	2
8. MATLAB experiments on digital signal processing (discrete-time signal generation and properties, random sequences	2
Text Books	
1- Digital signal processing with computer applications, By : P. A. Lynn. 2- Fundamental of Digital Signal Processing, By : L. C. Ludeman	

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College of Engineering
Computer Engineering Dept.

Computer Interface (ENCO302)

Lab	Tutorial	Theory
3		3

Course Objectives:	
Learn both hardware and software aspect of I/O interfaces into microprocessor-based systems: and gain hands- on experience with, common microprocessor peripherals such as PPL. URATs. Timers. ADC and DAC, DMA, PIC.Understanding the main I/O chips in terms of (internal architecture, I/O programming and applications.	
Course Details:	
Article	**Week**
1. Basic I/O Interfacing	1
2. Programming 8255, Modes of operation(0,1,2)	1
3. Interface example –keyboard matrix, 7-segment Display, Printer	1
4. 8253, 8254 Timer Interfacing	2
5. ADC and DAC chips and their interfacing	1
6. Direct Memory Access	1
7. Serial I/O Interface	1
8. USART 8251,UART 16650	1
9. Serial I/O devices-mouse, modem	1
10. Interrupts programming 8259	2
11. 8279 programmable keyboard/Display controller	1
12. PC bus standards & interface	2
Text Books	
1- Barry B. Bray, The Intel Microprocessors 8086/8088, 80,86,80286,80386,80486, Pentium , Pentium pro processor, Pentium II, Pentium III, Pentium 4 , and core2 with 64bit Extension:Architecture, programming and interfacing, prentice Hall2008. 2- Walter Triebel and Avtar Singh, The 8088 and 8086 Microprocessors: programming, Interfacing, software, Hardware, Applications, 4th edition, prentice-Hall, 2002. 3-Intel 80x86 and other chips hardware reference manuals, Intel.	

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College of Engineering
Computer Engineering Dept.

Computer Architecture I
(ENCO303)

Lab	Tutorial	Theory
	1	3

Course Objectives:	
This course provides the basic knowledge necessary to understand the hardware operation of digital computers. It presents the various digital components used in organization and design of digital computers and it shows the necessary steps that designer must go through in order to design an elementary basic computer	
Course Details:	
Article	**Week**
1. Digital Logic Circuit and Components	1
2. Data Representation	2
3. Register Transfer and Micro-operations	4
4. Computer Organization and Design	2
5. Control Unit Design	2
6. Micro Programmed control	2
7. Central processing unit design	2
Text Books	
Computer System Architecture, by M. Morris Mano, Prentice-Hall, 1982.	

University of Mosul
College of Engineering
Computer Engineering Dept.

Data Communication (ENCO304)

Lab	Tutorial	Theory
	1	3

Course Objectives:

This is an under graduate level course on data communication. The course involves both a reading/lecture/discussion and a term project. We will read and discuss topics on various aspects of data communication: Data & Signals, Digital & Analog transmission, Transmission Media, Switching, Error Detection and Correction and Data Link Control

Course Details:

Article	Week
1. Data and Signals	1
2. Digital Transmission	1
3. Analog Transmission	1
4. Bandwidth Utilization: Multiplexing and Spreading	2
5. Transmission Media	1
6. Switching	1
z. Using Telephone and Cable	1
8. Networks for Data Transmission	1
9. Error Detection and Correction	2
10. Data Link Control	2
11.Multiple Access	2

Text Books

1. Tanenbaum A.S. , "Computer Network",4th, Edition, Prentice-Hall Publishing,2003l
2. Stallings W. , "Data & Computer Communications", Sixth Edition , Prentice-Hall Publishing,2003 .
3. ForouzanB.,"Data, Communications and Networking", '4th Edition McGraw-Hill Publishing,2006.

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VLSI design (ENCO306)

Lab	Tutorial	Theory
	1	2

Course Objectives:	
Providing introductory of basic aspects of Integrated-Circuits (IC) Engineering: Materials, Fabrication, device behaviors. The aim of the course is to cover mainly the digital circuits and briefly the linear circuit.	
Course Details:	
Article	Week
l. History and overview	1
2. Electronic characteristic of material	1
3. Function of the basic inverter structure and combinational logic structures	3
4.. Sequential logic structures	2
5. Semiconductors for memories and array structures	2
6. Chip Input/ Output circuits	2
7. Circuit characterization and performance	2
8. Processing, lay-out, and design	2
Text Books	
1-Analysis And Design Of Digital Integrated Circuits, In Deep Submicron Technology (special Indian Edition), David A. Hodges, David McGraw-Hill Education Pvt Limited, 2005. 2-Basic Integrated Circuit Engineering by Hamilton and Howard, McGraw-Hill.	

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Operating systems (ENCO307)

Lab	Tutorial	Theory
2	1	3

Course Objectives:

To study and apply concepts relating to operating, such as concurrency and control of asynchronous process, deadlocks, memory management, processor and disk scheduling, parallel processing, and file system organization. Also, learning how to preventing and/or avoiding conflicts among computer resources

Course Details:

Article	Week
l. Introduction	1
2. System Structures	1
3. Process Concept	1
4. Multithreading	1
5. Scheduling (Process, I/O, and devices)	2
6, Synchronization	2
7. Deadlocks	1
8. Memory-Management strategies	1
9. Virtual-Memory Management	1
l0.Filesystem	1
11.Secondary-Storage Structure	1
12.I/O management	2

Text Books

1. Silberschatz, Galvin and Gagne., " Operating System Concepts",8'th Edition, John Wiley & Sons, 1nc.,2009.
2. Andrew Tanenbaum, " Modem Operating Systems", 2'nd. Edition , Pearson Publishing,2003.

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Statistic and Probabilities
(ENCO308)

Lab	Tutorial	Theory
	1	2

Course Objectives:	
To understand the concepts and facilities in the use of probability tools for the complexity of the systems encountered in Electrical and Computer Engineering	
Course Details:	
Article	**Week**
1. Basic Concepts of Probability theory	2
2. Probability models in Electrical and computer Engineering	1
3. Random variable and Random variable function	2
4. Multiple random variables	2
5. Random process	2
6. Analysis and processing of random signals	2
7. Markov chains	2
8. Queuing theory	2
Text Books	
1- Alberto Leon-Gacia, " Probability and Random process for Electrical Engineering 2nd Edition, 1994, Addison Wily.	

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Embedded Systems (ENCO309)

Lab	Tutorial	Theory
2		2

Course Objectives:

Introduce the fundamentals of embedded system design and implementation, including specifications and modeling of embedded systems, hardware/software partition and co-design: validation and implementation, peripherals and interfacing :memory : development methodologies and tools.

Course Details:

Article	Week
1- Micro-controllerMicro-controller vs. Microprocessor, families	1
2- AT89C51 Micro-controllerArchitecture	1
3- Addressing modes, instruction set	1
4- AT89C51 timer/Counter modes	1
5- AT89C51 Serial Communication modes of operation	1
6- AT89C51 Interrupts	1
7- Micro-controller Networking protocol, Advanced Buses	1
8- Micro-controller power management	1
9- Micro-controller features and applications	1
10- AVR,ARM, Arduino	2
11- Co-Design	2
12- USB, embedded multiprocessors	2

Text Books

1- The 8051 Micro-controller, I. Scott MacKenzie, Raphael Chung- Wei Phan, Prentice Hall, Jun 1.2008
2- Embedded system Design: Embedded systems Foundations of Cyber-Physical Systems, Peter Marwedel, Spriner Nov. 16, 2010

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Computer Architecture II
(ENCO310)

Lab	Tutorial	Theory
	1	3

Course Objectives:	
Providing the necessary knowledge to design a new programmable/non programmable computer system; to improve an existing one ; to develop fast parallel computing algorithms and systems toward supercomputer	
Course Details:	
Article	**Week**
1- Computer speed: factors and improvements (processor, memory,buses)	1
2- Architectural classification schemes	1
3- Measures of cost/performance	1
4- Principle of linear pipelining	2
5- Cache Memory	2
6- Memory interleaving	1
7- Architecture of Carry Save Adder and Multiplier	2
8- Vector Processing	2
9- Array Processor: Digital Signal Processors (DFT and FFT)	2
10- Array Processor: Systolic idea (FIR)	1
Text Books	
1- K. Hwang and F.A. Briggs"computer Architecture and parallel processing", McGraw-Hill, 1984. 2- Peter Pirch "Architectures for DSP", Wiley and Sons, 1998.	

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Fundamentals of Computer Networks(ENCO311)

Lab	Tutorial	Theory
	1	2

Course Objectives:

This is an under graduate level course on computer networking. The course involves both a reading/lecture/discussion and a term project. We will read and discuss topics on various aspects of computer networking: Internet design principles, LAN/MAN/WAN, congestion/flow control, network topology, routing, TCP/IP, Performance analysis and Network applications.

Course Details:

Article	Week
l – Wired LANs: Ethernet	1
2. Connecting LANs, Backbone Networks, and Virtual LANs	1
3. Virtual-Circuit Networks: Frame Relay and ATM	1
3. Network Layer: Logical Addressing	1
5. Network Laver: Internet Protocol	1
6. Network Layer: Address Mapping, Error Reporting. and Multicasting	1
7. Network Layer: Delivery, Forwarding, and Routing	1
8. Transport Layer : Process-to-Process Delivery: UDP. TCP. and SCTP	2
9. Transport Layer : Congestion Control and Quality of Service	1
10. Application Layer: Domain Name	1
11. Application Layer :Remote Logging, Electronic Mail, and File Transfer	2
l2,Application Layer: WWW and HTTP	1
13.Network Management: SNMP	1

Text Books

1- Tanenbaum A.A., " Computer Networks", 4th Edition, Prentice-HallPublising2003.
2- Stalling W., "Data & Computer Communications" Sixth Edition, Prentice-Hall Publishing. 2003
3- Forouzan B., " Data Communications and Networking" 4th Edition McGraw-Hill Publishing ,2006

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Computer Engineering Dept.

Sensors and Measurements (ENCO313)

Lab	Tutorial	Theory
2		2

Course Objectives:	
The Main aim is to convert physical quantities to digital data that can be processed, adjusted, and transmitted by digital devices.	
Course Details:	
Article	**Week**
1. Sensors Material and Characteristics	2
2. Types of Sensors	4
3. Signal Conditioning circuits	2
4. Measuring devices, Tele-measurements	4
5. Calibrations	1
6. Errors in measurements	2
Text Books	
1- Measurement, Instrumentation, and Sensor Handbook, Second Edition: Spatial Mechanical, Thermal, and Radiation Measurement. January 29,2014 by CRC Press By : John G. Webster, HalitEren 2- Measurement and Instrumentation system by W. Bolton, Newmans, 1996	

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Digital Signal Processing (ENCO314)

Lab	Tutorial	Theory
-	1	2

Course Objectives:
This course aims to explain to the students the principle of Z- Transform and Inverse Z- Transform, Analogue filter design methods, IIR and FIR digital filter design method, IIR and FIR digital filter structures, Fourier transform (frequency response), discrete Fourier transform (DFT) and fast Fourier transform (FFT), and filter design based on MATLAB.

Course Details:	
Article	**Week**
1- Fundamental of Z-transform properties applications on signals and systems	1
2- Analogue filter design	1
3- IIR Digital Filter design	2
4- FIR Digital Filter Design	2
5- IIR Filter Structures: (Direct form I, Direct Form II. Cascade Structure, Parallel Form Structure)	2
6- FIR Filter Direct Structure	2
7- Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) Algorithms, Development of the FFT Algorithm with Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithm with Radix	3
8- MATLAB experiments on Digital signal processing IIR and FIR filter design examples DFT and FFT.	2

Text Books
1- Digital Signal Processing System Analysis and Design, By Paulo S.r.Diniz, Eduardo A.B. da Silva and Sergio L. Netto.
2- Fundamentals of Digital Signal Processing , By : L.C.Ludeman

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Database Systems (ENCO315)

Lab	Tutorial	Theory
	1	3

Course Objectives:

Introducing the theory of the relational model and relational, and its languages. Writing data manipulation and data definition commands in SQL. Specifying the functional and data requirements for typical database applications. Producing detailed data models and their associated logical schemas. Designing the structure and functionality of a form based user interface for a database application

Course Details:

Article	Week
1. Introduction Database Environment Database Development	2
2. Modeling Data in the Organization	1
3. Logical Database Design and the Relational model, Physical Database Design and performance	1
4. SQL Advanced SQL Getting Started with SQL in access Beginning SQL Commands in access	2
5. Client/Server Database Environment internet Database Environment, Data Warehousing, Creating and Populating	2
6. SQL Joins SOL Functions	1
7. SQL Query Development and Derived structures, SQL set Operations	2
8. Data and Database Administration Distributed Database	2
9. Object-Oriented Data Modeling Object-Oriented Database Development	2

Text Books

1- Hoffer, Prescott& McFadden, (2005). " Modern Database Management" , (7th ed.) Prentice- Hall, Inc. ISBN: 0-13-145320-3.
2- Bagui, S. & Earp, R(2004). "learning SQL A Step-Step Guide using Access" Addison-Wesley Publishing. ISBN: 0-32-111904-5

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Real-time Systems (ENCO401)

Lab	Tutorial	Theory
2		2

Course Objectives:	
Understanding the main concepts of the real time system and its theory. Focusing on the real time operating Systems. Learning how to evaluate the real time system.	
Course Details:	
Article	**Week**
1. Introduction to real time systems	1
2. Data Transmission in Digital Instruments (RS232, RS422, RS485, USB, IR, Bluetooth, GPIB)	1
3. Introduction to Embedded Systems: Relationship Between Real-Time Systems and Embedded Systems	1
4. Operating Systems &Real time Operating Systems	1
5. Real time OS design: Data flow design, transition states, The Kernel, Resources, Tasks, Semaphores, Massage queue, Pipes, Signals, Condition variable,……..	2
6. Foreground/background Systems, Spooling	1
7. Real-time operating systems The Scheduler, Schedulable entities, Multitasking , Context, switching, Dispatcher Scheduling algorithm	1
8. Real-time Tasks, Preemptive vs. Non-Preemptive scheduling	1
9. Real time Scheduling Algorithm: RMS,EDF.	1
10. Priority Inversion Problem, Priority inheritance protocol, priority ceiling protocol	1
11. Deadlock and Starvation	1
12. The R-T system design process(an application)	1
13. Energy Aware Real time systems	1
14. Real time Database & Language	1
Text Books	
1- Real-time systems by C.M. Krishha and Kang G. Shin (MC-Graw Hill 1997) 2- Real-Time workshop, Modeling, Simulation, Implementation with Simulink, The Math works Inc.	

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Advanced Computer Architecture (ENCO402)

Lab	Tutorial	Theory
-		2

Course Objectives:
This course will enable the student learning pipeline design techniques, learning the parallel computer models. Understanding the multiprocessor technology and memory organizations, learning the various parallel and scalable architectures,

Course Details:

Article	**Week**
1. Pipeline review, Super pipeline, Super scalar, Super pipeline super scalar	3
2. Introduction to Multiprocessors (SIMD,MIMD)	2
3. Multiprocessors Interconnection Network	3
4. Memory Hierarchy and Cache	2
5. Shared Memory Architecture	1
6. Cache Coherency methods	2
7. Multi-core Processors Performance Analysis of Multiprocessor Architecture	1
8. Performance Analysis of Multiprocessor Architecture	1

Text Books

1- Hesham El-Rewini, MostafaAbd-El-Bary" Advanced Computer Architecture and parallel processing" WILEY & SONG, 2005
2- K. Hwang " Advanced Computer Architecture", McGraw-Hill, 2003

اسم التدريسي رقم الهاتف عنوان البريد الاليكتروني

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Control Engineering Fundamentals (ENCO403)

Lab	Tutorial	Theory
-	1	3

Course Objectives:

This course addresses the principle control system modeling, analysis and design. The students will be familiar with the control systems analysis tools such as root locus method, frequency response method and stability analysis. These tools will be used in analogue control design. Finally, it explains procedure and techniques that used for designing a different types of classical analogue controllers such as PID controller, lead and lag compensator

Course Details:

Article	Week
1- Differential equations of physical systems open & closed loop systems	2
2- Transfer function of linear systems Block diagram models	1
3-Signal flow graph models	1
3-State variables of dynamic systems, state equation and controllability &Observability	2
4-Analysis of state variable models design with state feedback	2
5-Time response and dynamic performance of 2nd order systems	1
6-Steady state error analysis of feedback system	1
7-The concept of stability Routh-Hurwritz	2
8-The root locus concept	1
9-Frequency response plots, Nyquist criterion, Gain margin & Phase margin, Closed loop frequency response	1
10-Analogue control design	1

Text Books

1- "Modern Control Systems", 10th Edition, Richard C. Dorf, Robert H Bishop, Prentice Hall, April 18, 2004.
2- Automatic Control systems, FaridGolnaraghi, Benjamin C. Kuo, Wiley, Jul 7, 2009

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Computer Engineering Dept.

Wireless Networking (ENCO404)

Lab	Tutorial	Theory
2	1	2

Course Objectives:

This is an under graduate level course on Wireless networking. The course involves both a reading/lecture/discussion and a term project. We will read and discuss topics on various aspects of Wireless networking: EM waves principles, PAN/WAN/BAN, WMN, WSN, congestion/flow control, routing, TCP/IP, Performance analysis and Network applications

Course Details:

Article	Week
l- Introduction to Electromagnetic waves,	1
2- Antenna and propagation	2
3- Wireless LANs (IEEE 802.llx)	2
4- Personal Area Network (IEEE 802.15x)	1
5-Broadband Area Network (BAN) (IEEE 802.16x)	1
6- Wireless WANs: Satellite Networks	1
7- Cellular Systems	2
8- Wireless mesh networking (WMN)	2
9- Wireless sensor Network	2
l0-Wireless networks applications	1

Text Books

1-Tanenbaum A.S. , "Computer Network",4'th Edition, Prentice-Hall ,2003
2- Stallings W. , "Data& Computer 2001,Communications", Sixth Edition , Prentice-Hall Publishing, 2003
3- Forouzan B. ,"Data Communications and Networking" , 4th. Edition , McGraw-Hill Publishing, 2006

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Computer Graphics (ENCO407)

Lab	Tutorial	Theory
-	-	2

Course Objectives:

To introduce the basics of pixel generation and display of two dimensional objects and ho\r to transform their image.

Course Details:

Article	Week
1. Introduction	2
2. scan conversion	3
3. 2D& 3D Transformations	3
4. 3D- projection	3
5. Open GL	4

Text Books

1- Computer Graphics: Principles and Practice (2nd Ed.), J. D. Foley, A' van Dam, S. K. Feiner, J. F. Hughes. Addison-Wesley, 1997.
2- Computer Graphics (2nd Ed.), D. Hearn et M. Baker. Prentice-Hall' 1994.
3- Principles of Interactive Computer Graphics (2nd Ed.), William Newman, Robert Sproull. McGraw Hill, 1979.
4- OpenGL, reference manual: The official reference document OpenGL architecture review board Addison Wesley.
5- M. Woo, J. Neider, T. Davis, D. Shreiner OpenGL@ Programming Guide: The Official Guide to Learning OpenGL, Version 1.2. (3rd Ed.), Addison-Wesley, 1997 .

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Engineering Ethics (ENCO408)

Lab	Tutorial	Theory
-	-	2

Course Objectives:	
To give a thorough understanding of the fundamental concepts of ethical and law analysis and to real world issues related engineer,	
Course Details:	
Article	**Week**
1. History and Overview	1
2. Public policy	2
3. Methods and tools of analysis	2
4. Professional and Ethical responsibilities.	2
5. Risks and liabilities	1
6. Intellectual properties	2
7. Computer crime	2
8. Economic issues in computing	1
9. Philosophical frameworks	2
Text Books	
1- Engineering Ethics – Concepts, Viewpoints, Cases and Codes 2nd edition - ©2008 2- Engineering Ethics in Practice: a Guide for Engineers, August 2011 Published by The Royal Academy of Engineering.	

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Parallel and distributed Programming (ENCO409)

Lab	Tutorial	Theory
-	1	3

Course Objectives:

The ubiquity of multicore and many-core architectures on current computers ranging from laptops to supercomputers is majing extreme-scale computing a reality. To realize the latter, new approaches to software design, programming techniques and tools are essential. The primary goal of this course is to introduce an array of such approaches including MPI, openMP, MapReduce, CUDA, and OpenCl.

Course Details:

Article	Week
l. Review of Multicore and many-core computer architectures	1
2. MPI Distributed-memory programming model	2
3.OpenMPprogramming model	3
4. MapReduceprogramming model	1
5. CUDA model for Programming massively parallel processors	4
6. Open CL heterogeneous computing	4

Text Books

1. Multithreaded, parallel, and distributed programming, by : Gregory R. Andrews, Addison-Wesley, 2000
2. An Introduction to distributed and parallel computing, by: joel M. Crichlow, prentice Hall Europe, Jan 1, 1997.

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Digital Control Systems
(ENCO410)

Lab	Tutorial	Theory
-	1	3

Course Objectives:

This course introduces the principle of digital control system modeling, analysis and design. It address the concepts of control systems analysis methods such root locus methods, stability analysis using Jury's test. Also, it explain the procedure and techniques for digital control design such as PID controller. Finally, it introduces the concept of system identification

Course Details:

Article	Week
l. Introduction to the fundamental concept of digitalcontrolsystem	1
2. Digital control system modeling, Transfer function of linear systems and signal flow graph models	1
3. Discretization and overview of sampled-data systems, choice of sampling frequency for control system	1
4. Discrete time analysis and dynamic performance	1
5. Analysis of discrete state variable models	1
6. Steady state error analysis of digital feedback system	1
7. Stability analysis in the Z-plane/Jury's test	1
8. The root locus concept in digital system	2
9. Digital control design	2
10. Bases on system identification	2
11. MATLAB experiments on digital control design	2

Text Books

1- Ioan D. Landau, and GianlucaZito "Digital Control system Design, Identification and Implementation"
2- Charles L. Philips and H. Troy Nagle "Digital control Systems Analysis and design

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Network Security(ENCO411)

Lab	Tutorial	Theory
2	1	2

Course Objectives:

This is an under graduate level course on network security' The course involves both a reading /lecture/discussion and a term project' We will read and discuss topics on various aspects of network security: Ciphering &Encryption, block and stream ciphering, public key' cryptanalysis' key management and distribution and Applied security

Course Details:

Article	Week
1- Traditional Symmetric-Key Ciphers	1
2-Introductionto Modern Symmetric-Key Ciphers	1
3- Block and stream ciphering	1
4-Data Encryption Standard (DES)	1
5- Advanced Encryption Standard (AES)	1
6- Ciphering Using Modern Symmetric-Key Ciphers	1
7- Asymmetric-key cryptography	1
8-Message Integrity and Message Authentication'	1
9- Cryptographic Hash Functions	1
10- Digital Signature	1
11- Entity Authentication	1
12- security at the ,application Layer: PGP and S/MIME	1
13- Security at the Transport Layer: SSL and TLS	1
14- Security in the internet: IPSec, SSL/TLS,PGP,VPN, and Firewalls	2

Text Books

1. Tanenbaum A.S. , " Computer Networks" 4th Edition, Prentice-Hall Publishing, 2003
2. Stalling W., " Data & Computer Communications", Sixth Edition, Prentice-Hall Publishing, 2003.
3. Forouzan B. " Data Communications and Networking" 4th. Edition , McGraw-Hill Publishing, 2006

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Software Engineering
(ENCO413)
Lab Tutorial Theory
2

Course Objectives:

The main object of this course is to introduce engineering and to explain its importance in building large programs. Provide an software understanding of the various processes software engineers may employ in developing software and to critically asses their value for different types of software engineering problem and able to apply the waterfall software development lifecycle model to development project

Course Details:

Article	Week
1. Introduction of software & Software engineering	1
2. The software process and problem	1
3. Software engineering processes	1
4. The process for developing software	1
5. Software life cycle models (process and models)	1
6. Stepwise Refinement. Computer aided software engineering (CASE)	1
7. Computer-aided software engineering (CASE) tools	1
8. Object oriented analysis & Design	1
9. Data flow Diagrams design	1
10. Specifying requirements, analysis and design in the object-oriented	2
11. Planning	1
12. Implementation phase	1
13. Integration phase	1
14. Maintenance and software evaluation	1

Text Books

1. "Software Engineering with Java". Stephen R. Schach Irwin/McGraw-Hill. 1997
2. Roger S. pressman, software engineering A practitioner approach, sixth edition: McGraw hill

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Image processing(ENCO414)

Lab	Tutorial	Theory
		2

Course Objectives:	
The main object to getting start in image processing techniques, and learn how to deal with different issues in image and video processing	
Course Details:	
Article	**Week**
1. Introduction to image processing	1
2. Human Visual system	1
3. Image reorientations and digital image file formats	1
4. Int. to image analysis processing. ROI, image algebra and logic operation	1
5. Spatial filters	1
6. Histograms and image quantization Methods	1
7. Edge Detection, operators masks, Hough transform	1
8. Image restoration, system Model	1
9. Noise in images	1
10. Noise removal using spatial Filters	1
11. Noise removal Using frequency domain filter	1
12. 2-D Discrete transforms, FFT, Discrete Cosine transform	1
13. Image compression ,Lossless	1
14. Image Compression Lossy	1
15. JPEG Compression	1
Text Books	

1. Computer Vision and image processing , **By : Scott E. Umbaugh**
2. Digital image processing By: Rafael C.Gonzalez& Richard E. Moods, 2000, 5th. Edition, Edison Wesley.

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Advanced Microprocessors(ENCO415)
Lab Tutorial Theory 2

Course Objectives:	
Learning protected mode with understand advanced techniques deployed in state-of-the art microprocessors from Intel/AMD and other major industries	
Course Details:	
Article	**Week**
1. CPU 80386 architecture and functional pin diagram	1
2. Internal Architecture of 80386	1
3. Addressing modes and instruction set of 80386	1
4. Real mode and protected mode operation of 80386	1
5. Segmentation	1
6. Paging	1
7. Multitasking	1
8. Interrupts	1
9. Pentium architecture	1
10. Pentium pro	2
11. Pentium MMC	2
12. GPU architecture, AMD and NVidia GPU comparison	2
Text Books	
1. Barry B. Brey, The Intel Microprocessors 8086/8088, 80,86,80286,80386,80486, Pentium , Pentium pro processor, Pentium II, Pentium III, Pentium 4 , Architecture, programming and interfacing, prentice Hall of India private Limited, ne Delhi, 2003 2. Walter Triebel and Avtar Singh, The 8088 and 8086 Microprocessors: programming, Interfacing, software, Hardware, Applications, 4th edition, prentice-Hall, 2002.	