Study Plan for the Bachelor's Degree

1.	School	**Engineering**
2.	Department	**Computer**
3.	Program title (Arabic)	**بكالوريوس في هندسة الحاسوب**
4.	Program title (English)	**B.Sc. in Computer Engineering**

5. Components of Curriculum:

The curriculum for the bachelor's degree in Computer Engineering consists of (161) credit hours distributed as follows:

Number	Type of requirement	credit hours
First	University Requirements	27
Second	Faculty Requirements	27
Third	Department Requirements	107
Total		161

6. Numbering System:

A- Department number

Number	Department
1	Civil Engineering
2	Architectural Engineering
3	Electrical Engineering
4	Mechanical Engineering
5	Chemical Engineering
6	Industrial Engineering
7	Computer Engineering
8	Mechatronics Engineering

B- Course Speciality Number in Computer Engineering Courses

Domain number	Domain title
1	General
2	Communication and Networks
3	Computer Systems
4	Computer Software
5	Artificial Intelligence and Neural Networks
6	Electronics
7	
8	
9	Project

C- Course number consists of 7 digits

School		Department		Level	Specialty	Serial
0	9	0	7	2	3	1

Study Plan- Bachelors

First: University Requirements:

All students admitted to the university must apply for a degree examination in Arabic and English and the computer is prepared or approved by the university to determine their level. Based on the results of the examinations, either the student will study one or more of the requirements of the preparatory program

	Preparation Program Requirements				
	All students admitted to the university must apply for a degree examination in Arabic and English and the computer is prepared or approved by the university to determine their level. Based on the results of the examinations, either the student will study one or more of the requirements of the preparatory program				
	(0 - 15 Credit Hours)				
No.	**Course Title**	**Course No.**	**Credit Hours**	**Prerequisites**	**Notes**
1	**Basics of Arabic**	3201099	3		**Pass/Fail**
2	**Communication Skills using Arabic Languages**	3211100	3	3201099	
3	**Basics of English**	3202099	3		**Pass/Fail**
4	**Communication Skills using English Languages**	3202100	3	3202099	
5	**Basics of Computing**	1932099	3		**Pass/Fail**

	Compulsory Requirements				
	(18 Credit Hours)				
No.	**Course Title**	**Course No.**	**Credit Hours**	**Prerequisites**	**Notes**
1	**Military Science**	**2220100**	**3**		
2	**Ethics and Human Values**	**3410100**	**3**		
3	**National Culture**	**3400100**	**3**	**3410100**	
4	**Entrepreneurship & Creativity and Scientific Research**	**3410101**	**3**	**3410100 1932099**	
5	**Life and Practical Skills**	**3410102**	**3**	**3410100 1932099**	
6	**Introduction to Philosophy and Critical Thinking**	**3400103**	**3**	**3400101**	

Electives

(9 Credit Hours)

Elective courses: (9) credit hours to be chosen from the first, second and third groups mentioned below. The student has to choose one course from each of the groups.

(First Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Great Books	3400107	3		
2	Islam and Current Issues	0400101	3		
3	Arab-Islamic Civilization	2300101	3		
4	Jordan: History and Civilization	2300102	3		
5	Jerusalem	3400108	3		

Electives

(Second Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Legal Culture	1000102	3		
2	Environmental Culture and Development	0310102	3		
3	Physical Fitness Culture	1100100	3		
4	Islamic Culture	0400102	3		
5	Health Culture	0720100	3		
6	Digital Culture	1900102	3		

Electives
(Third Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Foreign Language	2200103	3		
2	Electronic Commerce	1600100	3		
3	Social Media	1900101	3		
4	Appreciation of Arts	2000100	3		
5	Special Subject	3400106	3		

Second: School courses: distributed as follows:

    A. Obligatory school courses: (27) credit hours

    B. Elective school courses: (Zero) credit hours

    A. Obligatory school courses: (27) credit hours:

Course No.	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0301101	Calculus (1)	3	-	3	-
0301102	Calculus (2)	3	-	3	0301101
0301201	Calculus (3)	3	-	3	0301102
0302101	General Physics (1)	3	-	3	-
0302111	Practical Physics (1)	-	3	1	0302101 or co-requisite
0302102	General Physics (2)	3	-	3	0302101
0302112	Practical Physics (2)	-	3	1	0302102 or co-requisite
0901420	Engineering Economy	3	-	3	90 Cr. Hours
0904131	Engineering Drawing and Descriptive Geometry	2	2 Drawing 2 Computer	3	-
0966111	Engineering Workshops	-	3	1	-
0907101	Computer Skills for Engineers	3	-	3	1932099

    B. Elective school courses: (Zero) credit hours

Third: Specialty courses: (107) credit hours distributed as follows:

    B. Obligatory specialty courses: (92) credit hours

    C. Elective specialty courses: (15) credit hours

    A. Obligatory specialty courses: (92) credit hours:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0301131	Principles of Statistics	3	-	3	-
1901101	Discrete Mathematics	3	-	3	-
0303101	General Chemistry (1)	3	-	3	-
0301241	Linear Algebra (1)	3	-	3	0301101
0913213	Electric Circuits	3	-	3	0302102
0913214	Electric Circuits Lab	-	3	1	0913213
0953221	Signals Analysis and Systems	3	-	3	0913213
0903261	Electronic (1)	3	-	3	0913213

Study Plan- Bachelors

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0953321	Probability and Random Variables	3	-	3	0953221
0907231	Digital Logic	3	-	3	1932099 or 1902098
0907234	Digital Logic Lab	-	3	1	0907231
0907311	Computer Applications Lab	-	3	1	0907101
0907312	Technical Writing and Ethics	1	-	1	03202100
0907313	Practical Numerical Analysis	-	3	1	0301241
0907321	Data Communications Systems	3	-	3	0953321
0908321	Electrical Machines	3	-	3	0913213
0907333	Embedded Systems	3	-	3	0903261 & 0907231
0907334	Embedded Systems Lab	-	3	1	0907333
0917335	Computer Architecture and Organization (1)	3	-	3	0907231& 0907101
0907342	Object-Oriented Problem Solving	2	3	3	0907101
0907346	Data Structures and Algorithms	3	-	3	0907342
0907422	Computer Networks	3	-	3	0907231
0917432	Computer Architecture and Organization (2)	3	-	3	0917335
0917433	Computer Control systems	3	-	3	0907334 & 0953221
0907439	Computer Design Lab	-	3	1	0917335
0917443	Modern Operating Systems	3	-	3	0907346
1902223	Database Systems	3	-	3	0907346
0917451	AI and Machine learning	3	-	3	0907311 & 0301241
0917461	Digital Electronics and VLSI Design	3	-	3	0903261
0917462	Electronics and VLSI lab	-	3	1	0917461
0907520	Information and Network Security	3	-	3	0907422
0917522	Programming of Networks Protocols	3	-	3	0907342 & 0907422
0907528	Computer Networks Lab	-	3	1	0907422
0907529	Advanced Networks Lab	-	3	1	0907528
0907536	Parallel Processing	3	-	3	0907346 & 0917432
0907537	Parallel Processing Lab	-	3	1	0907536 or co-requisite
0907500	Practical training	-	-	3	115 Cr. Hours*
0977598	Project (1)*	-	-	1	0907500
0977599	Project (2)*	-	-	2	0977598

* Project duration for Project (1)* and Project (2)* is two regular semesters.

Study Plan- Bachelors

B. Elective specialty courses: (15) credit hours:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0917434	Advanced Digital Design	3	-	3	0917335
0917441	Software Engineering	3	-	3	0907342
0917521	Internet of Things	3	-	3	0907422 & 0907333
0907523	Cloud Computing	3	-	3	0907422
0907524	Wireless Networks	3	-	3	0907422
0907526	Digital Forensics	3	-	3	0907520
0907531	Special Topics in Computer Engineering	3	-	3	0917432 & 0907422
0907543	Optimizing Compilers	3	-	3	0917432 & 0907342
0907544	Digital Image Analysis and Processing	3	-	3	0907311 & 0953221
0907546	Data Analytics	3	-	3	1902223
0907547	Mobile Computing	3	-	3	1902223
0907548	Competitive Programming	3	-	3	0907346
0907549	Machine Vision	3	-	3	0917451
0907552	Advanced Topics in Machine Learning	3	-	3	0917451
0918562	Robotics and Autonomous Systems	3	-	3	0917433

Fourth: Courses offered by other faculties and departments

A. Courses offered by other faculties departments

Course No.	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0301101	Calculus (1)	3	-	3	-
0301102	Calculus (2)	3	-	3	0301101
0301201	Calculus (3)	3	-	3	0301102
0302101	General Physics (1)	3	-	3	-
0302111	Practical Physics (1)	-	3	1	0302101 or co-requisite
0302102	General Physics (2)	3	-	3	0302101
0302112	Practical Physics (2)	-	3	1	0302102 or co-requisite
0301131	Principles of Statistics	3	-	3	-
1901101	Discrete Mathematics	3	-	3	-
0303101	General Chemistry (1)	3	-	3	-
0301241	Linear Algebra (1)	3	-	3	0301101
1902223	Database Systems	3	-	3	0907346

B. Courses offered by other departments in School of Engineering

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0901420	Engineering Economy	3	-	3	90 Cr. Hours
0904131	Engineering Drawing	2	2 Drawing 2 Computer	3	-
0966111	Engineering Workshops	-	3	1	-
0913213	Electric Circuits	3	-	3	0302102
0913214	Electric Circuits Lab	-	3	1	0913213
0953221	Signals Analysis and Systems	3	-	3	0913213
0903261	Electronic (1)	3	-	3	0913213
0953321	Probability and Random Variables	3	-	3	0953221
0908321	Electrical Machines	3	-	3	0913213
0918562	Robotics and Autonomous Systems	3	-	3	0917433

Study Plan- Bachelors

Fifth: Advisory Study Plan
First Year

First Semester			Second Semester		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
0301101	Calculus (1)	3	0301102	Calculus (2)	3
0302101	General Physics (1)	3	0301131	Principles of Statistics	3
0302111	Practical Physics (1)	1	0302102	General Physics (2)	3
0303101	General Chemistry (1)	3	0302112	Practical Physics (2)	1
0904131	Engineering Drawing and Descriptive Geometry	3	0907101	Computer Skills for Engineers	3
0966111	Engineering Workshops	1		University Requirement	3
	University Requirement	3			
Total		**17**	**Total**		**16**

Second Year

First Semester			Second Semester		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
0301201	Calculus (3)	3	0301241	Linear Algebra (1)	3
0913213	Electric Circuits	3	0903261	Electronics (1)	3
0907231	Digital Logic	3	0913214	Electric Circuits Lab	1
1901101	Discrete Mathematics	3	0953221	Signal Analysis and Systems	3
	University Requirement	3	0907234	Digital Logic Lab	1
				University Requirement	3
				University Requirement	3
Total		**15**	**Total**		**17**

Third Year

First Semester			Second Semester		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
0953321	Probability and Random Variables	3	0907311	Computer Applications Lab	1
0907313	Practical Numerical Analysis	1	0907312	Technical Writing and Ethics	1
0907333	Embedded Systems	3	0907321	Data Communications Systems	3
0907342	Object-Oriented Problem Solving	3	0907334	Embedded Systems Lab	1
0908321	Electrical Machines	3	0917335	Computer Architecture and Organization (1)	3
	University Requirement	3	0907346	Data Structures and algorithms	3
				University Requirement	3
Total		**16**	**Total**		**15**

Study Plan- Bachelors

Fourth Year

<table>
<tr><th colspan="3">First Semester</th><th colspan="3">Second Semester</th></tr>
<tr><th>Course Number</th><th>Course Title</th><th>Credit Hours</th><th>Course Number</th><th>Course Title</th><th>Credit Hours</th></tr>
<tr><td>0907422</td><td>Computer Networks</td><td>3</td><td>0901420</td><td>Engineering Economy</td><td>3</td></tr>
<tr><td>0917432</td><td>Computer Architecture and Organization (2)</td><td>3</td><td>0917443</td><td>Modern Operating Systems</td><td>3</td></tr>
<tr><td>0917433</td><td>Computer Control Systems</td><td>3</td><td>0917451</td><td>AI and Machine Learning</td><td>3</td></tr>
<tr><td>0907439</td><td>Computer Design Lab</td><td>1</td><td>0917462</td><td>Electronics and VLSI lab</td><td>1</td></tr>
<tr><td>1902223</td><td>Database Systems</td><td>3</td><td>0907520</td><td>Information and Network Security</td><td>3</td></tr>
<tr><td>0917461</td><td>Digital Electronics and VLSI design</td><td>3</td><td></td><td>University Requirement</td><td>3</td></tr>
<tr><td colspan="2">Total</td><td>16</td><td colspan="2">Total</td><td>16</td></tr>
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Fifth Year

<table>
<tr><th colspan="3">First Semester</th><th colspan="3">Second Semester</th></tr>
<tr><th>Course Number</th><th>Course Title</th><th>Credit Hours</th><th>Course Number</th><th>Course Title</th><th>Credit Hours</th></tr>
<tr><td>0917522</td><td>Programming of Networks Protocols</td><td>3</td><td>0907529</td><td>Advanced Networks Lab</td><td>1</td></tr>
<tr><td>0907528</td><td>Computer Networks Lab</td><td>1</td><td>0977599</td><td>Project (2)</td><td>2</td></tr>
<tr><td>0907536</td><td>Parallel Processing</td><td>3</td><td></td><td>CPE Elective</td><td>3</td></tr>
<tr><td>0907537</td><td>Parallel Processing Lab</td><td>1</td><td></td><td>CPE Elective</td><td>3</td></tr>
<tr><td>0977598</td><td>Project (1)</td><td>1</td><td></td><td>CPE Elective</td><td>3</td></tr>
<tr><td></td><td>CPE Elective</td><td>3</td><td></td><td>University Requirement</td><td>3</td></tr>
<tr><td></td><td>CPE Elective</td><td>3</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Total</td><td>15</td><td colspan="2">Total</td><td>15</td></tr>
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Study Plan- Bachelors

Department of Computer Engineering
Course Description

0301101   Calculus (1)   (3 Credit Hours)
Prerequisite: (None)
Functions: domain, operations on functions, graphs of functions; trigonometric functions; limits: meaning of a limit; computational techniques, limits at infinity, infinite limits; continuity; limits and continuity of trigonometric functions; the derivative: techniques of differentiation, derivatives of trigonometric functions; the chain rules; implicit differentiation; differentials; Roll's Theorem; the mean value theorem; the extended mean value theorem; L'Hopital's rule; increasing and decreasing functions; concavity; maximum and minimum values of a function; graphs of functions including rational functions (asymptotes) and functions with vertical tangents (cusps); antiderivatives; the indefinite integral; the definite integral; the fundamental theorem of calculus; the area under a curve; the area between two curves; transcendental functions: inverse functions, logarithmic and exponential functions; derivatives and integrals; limits (the indeterminate forms); hyperbolic functions and their inverses; inverse trigonometric functions.

0301102   Calculus (2)   (3 Credit Hours)
Prerequisite: 0301101
Techniques of integration: integration by substitution; integration by parts, integrating powers of trigonometric functions, trigonometric substitutions, integrating rational functions, partial fractions, rationalization, miscellaneous substitution; improper integrals; application of definite integral: volumes, length of a plane curve, area of a surface of revolution polar coordinates and parametric equations: polar coordinates, graphs in polar coordinates, area in polar coordinates; infinite series: sequences, infinite series, convergence tests, absolute convergence, conditional convergence; alternating series; power series: Taylor and Maclurine series, differentiation and integration of power series.

0301201   Calculus (3)   (3 Credit Hours)
Prerequisite: 0301102
Three dimensional space and vectors rectangular coordinates in 3-space; spheres, cylindrical surfaces; quadric surfaces; vectors: dot product, projections, cross product, parametric equations of lines. Planes in 3-spaces; vector-valued functions: calculus of vector valued functions, change of parameters, arc length, unit tangent and normal vectors, curvature, functions of two or more variable: domain, limits, and continuity; partial derivatives; differentiability; total differentials; the chain rule; the gradient; directional derivatives; tangent planes; normal lines; maxima and minima of functions of two variables; Lagrange multipliers; multiple integrals: double integral, double integrals in polar coordinates; triple integrals; triple integrals in cylindrical and spherical coordinates; change of variables in multiple integrals; Jacobian.

Study Plan- Bachelors

0302101   General Physics (1)   (3 Credit Hours)
Prerequisite: None
Motion in one dimension; motion in two dimensions; the laws of motion; circular motion; conservation of energy; linear momentum and collisions; rotation of a rigid object about a fixed axis; angular momentum; static equilibrium; universal gravitation; fluid mechanics; oscillatory motion.

0302111   Practical Physics (1)   (1 Credit Hour)
Prerequisite: 0302101 or co-requisite
11 experiments each of 3 hrs/week duration: collection and analysis of data; measurements and uncertainties; vectors: force table; kinematics of rectilinear motion; force and motion; collision in two dimensions; rotational motion; simple harmonic motion: simple pendulum; gas's Laws; ballistic pendulum; specific heat capacity of metals.

0302102   General Physics (2)   (3 Credit Hours)
Prerequisite: 0302101
Electric field; Gauss's law; electric potential; capacitance and dielectrics, current and resistance; direct current circuits; magnetic field; sources of the magnetic field; Faraday's law, inductance; alternating current circuits; the nature of light and the principles of ray optics; image formation.

0302112   Practical Physics (2)   (1 Credit Hour)
Prerequisite: 0302102 or co-requisite
12 experiments each of 3 hrs/week duration: electric field mapping; specific charge of copper ions; power transfer; potentiometer; capacitors: RC time constant; Kirchoff's laws; magnetic field of a current; lenses; Young's double slit experiments; electromagnetic induction; Ohm's law; Wheatstone bridge.

0901420   Engineering Economy   (3 Credit Hours)
Prerequisite: (Passing 90 Cr. Hrs.)
Major elements of feasibility studies. Principles of engineering economy. Equivalence and compound interest formulas. Single payment model. Uniform payment model. Gradient payment model. Exponential payment model. Decision criteria for single and multiple alternatives: present worth, annual worth, future worth, internal rate of return, benefit cost ratio and payback methods. Income-tax effect on decision making.

0904131   Engineering Drawing   (3 Credit Hours)
Prerequisite: None
Drawing equipment and use of instruments. Lettering, Geometric construction, Sketching and shape description. Basic descriptive geometry, Developments and intersections. Axonometric, oblique and perspective drawings, Multiview projection, Principal views, Conventional practice, and sectional views. Auxiliary views. Dimensioning techniques. Parallel: Introduction to computer drawing, Drawing aids, Geometrical construction, and the appropriate commands of text, editing, plotting, sections, layers, pictorial views, and dimensioning. Auxiliary views.
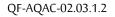
0966111   **Engineering Workshops**   **(1 Credit Hour)**
           Prerequisite: None
           General safety, materials and their classifications, measuring devices and their
           accuracy, fits and tolerances, theoretical background for the practical exercises
           including fitting, forging, carpentry, casting, welding, mechanical saws, shearers,
           drills, lathes, milling machines, shapers and grinders.

0907101   **Computer Skills for Engineers**   **(3 Credit Hours)**
           Prerequisite: 1932099
           This course presents the fundamental concepts of programming using one high level
           programming language like C++, Java, or Python. It covers the basic structures of the
           programming language such as variables; data types; control structures; arrays;
           functions; and introduction to records (struct) and object oriented programming
           (classes and objects). The course will focus on providing the students with practical
           programming skills through home works and exams which require writing whole
           programs. Also the course prepares the students to the global programming
           competitions.

0301131   **Principles of Statistics**   **(3 Credit Hours)**
           Prerequisite: None
           Describing statistical data by tables, graphs and numerical measures, Chebychev's
           inequality and the empirical rule, counting methods, combinations, permutations,
           elements of Probability and Random Variables, the binomial, the Poisson, and the
           normal distributions, sampling distributions, elements of testing hypotheses,
           statistical inference about one and two populations parameters.

1901101   **Discrete Mathematics**   **(3 Credit Hours)**
           Prerequisite: None
           This course studies the mathematical elements of computer science. Topics include
           propositional logic; predicate logic; mathematical reasoning; techniques of proof;
           mathematical induction; set theory; number theory; matrices; sequences and
           summations; functions, relations and their properties, elementary graph theory, and
           tree.

0303101   **General Chemistry (1)**   **(3 Credit Hours)**
           Prerequisite: None
           Measurements and significant figures, chemical reactions; stoichiometry; the
           gaseous state; thermochemistry; electronic structure and periodicity; chemical
           bonding; molecular shapes; states of matter and intermolecular forces.

0301241   **Linear Algebra (1)**   **(3 Credit Hours)**
           Prerequisite: 0301101
           Systems of linear equations; matrices and matrix operations; homogeneous and non-
           homogeneous systems; Gaussian elimination; elementary matrices and a method for
           finding A^{-1}; determinants; Euclidean vector spaces; linear transformations from R^n to
           R^m and their properties; general vector spaces; subspaces; basis; dimension; rwo
           space; column space; null space of a matrix; rank and nullity; inner product spaces;
           eigen values and diagonalization; linear transformations.

                              Study Plan- Bachelors

0913213   **Electrical Circuits**   **(3 Credit Hours)**
Prerequisite: 0302102
Average power and rms values. Polyphase circuits. Three phase Y and Δ connections. Complex frequency. The damped sinusoidal forcing function. Frequency response. Parallel and series resonance. Magnetically coupled circuits. General two port networks. Impedance, admittance, hybrid and transmission parameters. Principles of basic filtering. Basic passive and active filters.

0913214   **Electrical Circuits Lab.**   **(1 Credit Hour)**
Prerequisite: 0913213
The DC circuits. Kirchhoff's voltage law (KVL). Network theorems. Transient analysis in RL, RC, and RLC circuits. Impedance concept. Power and power factor (PF). Series and parallel resonance. Quality factor. Three phase circuits. Power measurement. Parameters of two-port networks. Coupled circuits. Filters.

0953221   **Signal Analysis and Systems**   **(3 Credit Hours)**
Prerequisite: 0913213
Signal and system model and classification. Continuous time signals. Signals and vectors. Generalized Fourier series representation. Amplitude and phase spectra of signals. Energy and power content of signals. Bandwidth of signals. The Fourier transform and its applications. Sampling of signals. Convolution of signals. Power and energy spectral densities. Correlation functions. Time-domain analysis of continuous time systems. The system impulse response. Communication channels. Filters: LPF, HPF and BPF. Discrete time signals. The discrete Fourier transform (DFT) and the Fast Fourier transform (FFT). Spectral analysis of DFT systems. Unit sample response and response to arbitrary input sequences. Introduction to the Z-transform. Project.

0903261   **Electronics (1)**   **(3 Credit Hours)**
Prerequisite: 0913213
Introduction to semiconductors. Conduction in metals. Intrinsic and extrinsic semiconductors. Electrical properties of semiconductors. Diffusion process in semiconductors. The PN junction diode. Open-circuited junction. Forward, reverse biased junction. VI static characteristics. Temperature effects. Small and large-signal models. Junction capacitance and switching times. Diode types and applications. Rectification. Rectifier filters. Clipper and clamper circuits. Voltage multipliers. Zener, varactor and Schottky diodes. LED and Photodiode applications. Bipolar Junction Transistors (BJT): Ebers-Moll mode. CB and CE characteristics. DC biasing and analysis. BJT as a switch and amplifier. Small-signal models. Transistor ratings. Field-effect Transistor (FET): VI characteristics of JFET and MOSFET. FET transistor as a switch and amplifier. Small-signal models. The MOSFET transistor. Transistor ratings.

0953321   **Probability and Random Variables**   **(3 Credit Hours)**
Prerequisite: 0953221
Introduction to Probability and Random Variables. Discrete random variables. Continuous random variables. The probability density function. The probability distribution function. Statistics of random variables. Random processes. Ergodicity and stationarity. Auto-correlation function. Power spectral density. Estimating the autocorrelation function and power spectral density from raw data. Input output relations of linear systems.

0908321   **Electrical Machines**   **(3 Credit Hours)**
Prerequisite: 0913213
Magnetic circuits; single-phase transformers: Principles, analysis, performance characteristics and testing; DC motors: principle of operation; methods of starting and control; Three phase AC induction motors: principle of operation; starting, testing and speed control; AC three phase synchronous motors: principle of operation; starting, testing and control; Stepper motors: principle of operation; methods of control; servo-motors (AC and DC): principle of operation; methods of control; Criteria for selection of the different types of motors for various applications; Sizing calculations for several applications.

0918562   **Robotics and Autonomous Systems**   **(3 Credit Hours)**
Prerequisite: 0917433
This course presents a general high level overview of robotic systems, with real life applications in industry. The course will concentrate on using MATLAB modelling to make the concepts of the course accessible to the students.

0907231   **Digital Logic**   **(3 Credit Hours)**
Prerequisite: 1932099
Number Systems and digital waveforms. Basic gates and logic functions. Boolean algebra, Boolean expressions. Logic minimization techniques. VHDL basics. Design, simulation and synthesis tools for programmable logic devices. Combinational logic building blocks including decoders, encoders, multiplexers, demultiplexers, magnitude comparators. VHDL for combinational circuits. Digital arithmetic, adders, subtractors. VHDL for arithmetic circuits. Basics of sequential circuits. Basic latches and flip-flops. Timing parameters and diagrams. Counters, shift registers. Basic PLDs, CPLDs and FPGAs architectures. VHDL for binary counters and shift registers. State machines. System design with state machines using VHDL. Memory devices and systems including RAM, ROM, FIFO, LIFO and dynamic RAM.

0907234   **Digital Logic Lab**   **(1 Credit Hour)**
Prerequisite: (0907231)
Experiments on basic TTL and CMOS logic gates, including simulations to explore functionality and timing parameters. Experiments using both simulation and practical hardware implementation on CPLDs or FPGAs, using VHDL for combinational and sequential circuits including multiplexers, demultiplexers, decoders, encoders counters, shift registers, latches and memory. Experiments in logic design using state machines. Design project using CPLDs or FPGAs.

0907311   **Computer Applications Lab**   **(1 Credit Hour)**
Prerequisite: (0907101)
Computer packages for mathematical and symbolic manipulation; graphics and user interface; data processing and analysis; or web pages' development. Programming languages may include Python, SQL, CSS and HTML.

0907312   **Technical Writing and Ethics**   **(1 Credit Hour)**
Prerequisite: (3202100)
Introduction to technical writing. Structure of technical reports. Writing process. Writing style. Grammar, punctuation, and usage. Requirements of effective

presentations. Examples from computer organization and computer architecture. Introduction to Engineering Ethics. Moral reasoning. Confronting moral dilemmas. Codes of ethics and honor. Responsibilities to employers and society. Computer ethics. Introduction to software engineering. The system engineering process. Project management: activities, planning, scheduling, tracking, and risk management.

0907313   Practical Numerical Analysis   (1 Credit Hour)
Prerequisite: (0301241)
This course analyzes the basic techniques for efficient numerical solutions of problems in the engineering domain. Topics span root finding, interpolation, approximation of functions, integration, differential equations, and direct and iterative methods in linear algebra. The course focuses on using Matlab to apply the learned numerical analysis techniques.

0907321   Data Communications Systems   (3 Credit Hours)
Prerequisite: (0953321)
Communication System block diagram. Channel impairments: attenuation, distortion and noise. Noise sources/characteristics, AWGN noise. Modulation and demodulation techniques. Mixers, coherent detection, and frequency conversion. Multiplexing: TDM, TDMA, FDM and FDMA. Digital transmission: sampling of signals, quantization, line coding and pulse shaping. Landline Telephony, Pulse Cod Modulation (PCM), PDH and SDH standards. Basics of cellular telephony standards: GSM, 3G, and 4G. Basics of Analog and digital TV Broadcasting Standards. AM and FM Radio standards and receivers. Basics of ADSL standards.

0907333   Embedded Systems   (3 Credit Hours)
Prerequisite: (0903261 & 0907231)
Embedded systems characteristics. Microprocessors versus micro controllers. Micro controller characteristics. General-purpose micro controllers. Examples of micro controller architectures. Interrupts, counters/timers, Input/output ports. Micro controller programming. Instruction set. Program development and use of assemblers. Memory maps and addressing modes. Digital to analogue and analogue to digital conversion in micro controllers. Data acquisition and distribution. Serial and parallel communications. Real-time system and its constraints. Interfacing to external devices. Power consumption consideration. Applications.

0907334   Embedded Systems Lab   (1 Credit Hour)
Prerequisite: (0907333)
Introduction to embedded systems design tools and hardware programmers. Experiments using both simulation and practical implementation of the basic building blocks of a microcontroller including timers, counters, PWM generation, I/O techniques and requirements, A/D conversion, serial communications. Experiments to explore the system design process using hardware-software co design process. Design project.

0917335   Computer Architecture and Organization (1)   (3 Credit Hours)
Prerequisite: (0907231 & 0907101)
Introduction to computer organization. Computer instruction set. Machine language. Data processing. Arithmetic unit: Carry look-ahead adders, subtractors, and shifters. Logic unit. Combinational and sequential multipliers and dividers. Floating-point number representation and arithmetic.   Data path design. Control unit design. Microprogramming. Pipelining.

0907342   Object-Oriented Problem Solving   (3 Credit Hours)
Prerequisite: (0907101)
Using a language that supports object-oriented programming concepts, the following topics are covered: classes, objects, properties, indexers, attribute encapsulation, data abstraction, inheritance, polymorphism, generalization, specialization, exception handling, aggregation, and associations. Weekly laboratory experiments will provide hands-on experience in topics covered in this course. A project for solving engineering problem will be given.

0907346   Data Structures and Algorithms   (3 Credit Hours)
Prerequisite: (0907342)
Concepts, representations and use of elementary data structures: pointers, arrays, linked lists, stacks, queues, graphs, trees, heaps and hash tables. Asymptotic complexity analysis. Divide and Conquer design and analysis. Binary Search. Recurrences Methods. Sort algorithms: selection sort, merge sort, quick sort, radix sort. Greedy Algorithms. Shortest Path algorithms. Breadth and Depth First Search. P and NP problems.

0907422   Computer Networks   (3 Credit Hours)
Prerequisite: (0907231)
Introduction to computer networks. Network topologies. Network architecture and the OSI reference model. Circuit switching and packet switching. Switched networks and broadcast networks. The physical layer. Data transmission basics: Asynchronous and synchronous modes. Error control. Local area networks (LANs). Data link layer and protocols. Medium access control (MAC). IEEE 802 series of standards and MAC protocols. High-speed and bridged LANs. Repeaters, switches, hubs, bridges, routers, and gateways. Introduction to wide area networks.

0917432   Computer Architecture and Organization (2)   (3 Credit Hours)
Prerequisite: (0917335)
Exploiting instruction level parallelism, hardware and software approaches. Pipelined, Vector, Super scalar, and VLIW processors. Predication, Branch Prediction, and Control and Data Speculation. Case Studies of Modern Processors. Hierarchical Memory Design. Virtual memory. Input/Output Interfacing and System Integration. Introduction to Parallel Processing. Flynn's classification. Symmetric Multiprocessors. Cache coherence.

0917433   Computer Control Systems   (3 Credit Hours)
Prerequisite: (0907334 & 0953221)
This course aims to introduce concepts of modelling and control design for engineering systems. The approach is to present an engineering methodology that, while based on mathematical fundamentals, stresses real applications of modern embedded computer control systems. In addition to the basic theory of feedback control systems, steady state, filtering and control design systems, the course includes embedded system control applications such as stepper motor, sensors, LCDs, real-time clocking, DAC and ADC conversion, direct memory access, multitasking and digital signal processing.

0907439   Computer Design Lab   (1 Credit Hour)
Prerequisite: (0917335)
Using CAD tools, the student designs and simulates the main parts of a computer: the

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ALU, registers, control unit, cache memory, system bus, memory, and I/O devices. Integration and simulation of computer design.

0917443 **Modern Operating Systems** **(3 Credit Hours)**
Prerequisite: (0907346)
Theories and implementation of modern operating systems including operating system interface (system calls), process and thread management, CPU and disk scheduling, synchronization, deadlock, memory management and virtual memory, file system, device management and I/O handling. Case studies for modern operating systems such as Android and iOS.

1902223 **Database Systems** **(3 Credit Hours)**
Prerequisite: (0907346)
Introduction to Database Systems: Databases, Concepts, and Architecture. Relational Model: Data Model and Algebra. Query Language. Functional Dependencies and Normalization. Data Storage, Indexing, and Physical Design. Conceptual Data Modeling, Database Design, and Data Model Mapping. Query Processing and Optimization. Transaction Processing, Concurrency Control, and Recovery. Object-relational Database Systems.

0917451 **AI and Machine learning** **(3 Credit Hours)**
Prerequisite: (0907311 & 0301241)
The course helps the student gain understanding and skills in Artificial Intelligence (AI) and Machine Learning (ML) applications and algorithms. It also covers the basics of data preparation, training, and evaluation. The course concentrates on the practical skills to use AI and ML to solve real-life problems and includes a term project on designing and implementing a ML solution to solve a problem of the student choice.

0917461 **Digital Electronics and VLSI Design** **(3 Credit Hours)**
Prerequisite: (0903261)
Review of Electronics Basics. Diodes and transistors as switches. I/O characteristic. Fan out. Loading factors. Noise immunities. Paralleling gates. TTL gates. I/O characteristic. Fan out. Loading factors. Noise immunities. Paralleling gates. Emitter Coupled Logic. I/O characteristic. Fan out. Loading factors. Noise immunities. Paralleling gates. FETs. MOSFETs. MOSFET gates. Transmission gates and compound gates CMOS gates. CMOS processing technology, photolithography, and fabrication steps. Inverter layout and CMOS design rules. Stick diagrams. Layout strategies Basics of CMOS fabrication and layout. Analog to Digital and Digital to analog converters. Weighted-resistor D/A converter. R-2R D/A converter Parallel A/D converter. Successive approximation A/D converter. The Dual slope A/D converter. A converter using voltage to frequency. A converter using voltage to time. Delta modulation and adaptive delta modulation. CMOS multi-vibrators. Integrated circuit multi vibrators.

0917462 **Digital Electronics and VLSI Lab** **(1 Credit Hour)**
Prerequisite: (0917461)
The Electronics and VLSI lab is an introductory lab that introduces the students to Diode analysis and characteristics, basic MOS logic circuits, MOS voltage transfer characteristics and operation analysis, design the schematic and the layout of basic logic gates and complex combinational logic functions, delay and power analysis and optimization of combinational logic circuits, schematic of the basic sequential components like latches and Flip Flops .

0907520 Information and Network Security (3 Credit Hours)
Prerequisite: (0907422)

Basic concepts in network security. Fundamental techniques used in implementing secure network communications, common threats and attacks, as well as some practical experience in attacking and defending networked systems. Basics of cryptography, cryptographic hash functions, symmetric and public-key encryption, authentication and key establishment, buffer overflow attacks, web security, internet worms, viruses, spyware, Spam, phishing, denial of service (DOS), TCP/IP and DNS security, firewalls and intrusion detection systems, and Wireless security.

0917522 Programming of Networks Protocols (3 Credit Hours)
Prerequisite: (0907342 & 0907422)

The architecture of the Internet and TCP/IP. Application Protocols. Transport layer protocols. Internet Addressing. Domain Name System. Data Streams. User Datagram Protocol. Transmission Control Protocol. Socket Programming. Hypertext Transfer Protocol. Server-side Processing Languages. Multi-threaded applications. JavaMail (TM) API.

0907528 Computer Networks Lab (1 Credit Hour)
Prerequisite: (0907422)

The Computer Networks Lab consists of a Set of Experiments to Give the Student the Practical Experience on Building Basic Local Area Networks (LANs). Introduction to Personal Computers Hardware, Installing Network Interface Cards, Networks Cabling, Local Area Networks and Basic Topologies, Understanding Routers and Routing Principles, Configuring Routers and Routing Protocols, Securing Local Area Networks Using Access Lists, Understanding Switches and Switching Principles, Configuring Switches, Building Virtual Local Area Networks, Trunking Protocols, IP Networks Address Translation and Dynamic Host Control Protocol.

0907529 Advanced Networks Lab (1 Credit Hour)
Prerequisite: (0907528)

A set of experiments to give the student the practical experience on the following components: wireless networks and networks security, installing wireless adapters, building adhoc wireless networks, configuring access points, configuring wireless bridges, basic wireless networks security, advanced router security, basic PIX firewall security, basic VPN configuration.

0907536 Parallel Processing (3 Credit Hours)
Prerequisite: (0907346 & 0917432)

Varieties of parallelism in current hardware (e.g., multithreading, multicore, multiprocessors, and accelerators such as GPUs and vector instruction sets). Importance of locality, implicit vs. explicit parallelism, shared vs. non-shared memory, synchronization mechanisms (locking, atomicity, transactions, barriers). Parallel programming models (threads, data parallel, SIMD instructions, SPMD, message passing, SIMT, transactions, and nested parallelism). The course includes a significant parallel programming project.

0907537 Parallel Processing Lab (1 Credit Hour)
Prerequisite: (0907536 or Co-requisite)

The student performs a set of experiments to gain skills in developing parallel programs and using parallel hardware and parallel development environments. The student learns

how to effectively use parallel hardware and tackle parallel processing issues such as partitioning, coordination, and communications. The development environments include threads library, OpenMP, MPI, and CUDA.

0917434   Advanced Digital Design   (3 Credit Hours)
Prerequisite: (0917335)
Review of Digital Logic fundamentals. Combinational circuits: Representations (tables, maps, cubes, trees, diagrams), Analysis, Synthesis, and Optimization (MISO Minimization: Quine-McClusky, Espresso, SIS, and MIMO Minimization). Complex Registers, complex Counters, and Memory Units: SRAM and DRAM. Hardware Description Languages: VHDL and Verilog. FSM Minimization techniques: Graphical, Mealy FSM, Row Matching, and Implication Chart. Abstract (Algorithmic) State Machine (ASM) fundamentals. FSM partitioning methods. Asynchronous DSD techniques. Programmable logic devices (PLDs) and CPLDs. RAM and ROM systems and timing diagrams. PALs, GALs, and PLAs. Field Programmable Gate Arrays (FPGAs): Xilinx and Alterra FPGAs. Review of Computer Design fundamentals. Review of Microcontrollers and Embedded Systems fundamentals. Full FSM-based design and hardwired versus programmable implementations of a computerized digital system for: Control Unit, Data Path, Memory hierarchy, and Software and Hardware Interfacing. DSD using Systolic Architectures. Systems on chip (SOC). UC Berkeley CAD and optimization tools. Power considerations in DSD. Timing considerations in DSD. Testing and verification of digital systems. New DSD in emerging technologies.

0917441   Software Engineering   (3 Credit Hours)
Prerequisite: (0907342)
Introduction to Software Engineering; Essential Software Attributes; Socio-Technical Systems; Dependability; Software Processes; Project Management; Software Functional and Non-Functional Requirements; Requirements Engineering Processes; System Models: Context, Behavioural and Object Models; Critical Systems Specification; Formal Specification; Architectural Design; Distributed Systems Architecture; Application Architectures; UML Design Models; Object-Oriented Design; Real-Time Software Design; User Interface Design.

0907500   Practical Training
Prerequisite: 115 Credit hours
The student will train of the companies or organizations whether it is private or public for a period of 240 hours. This training will be of one of the different fields of Computer Engineering.

0917521   Internet of Things   (3 Credit Hours)
Prerequisite: (0907422 & 0907333)
Internet in general and Internet of Things (IoTs): layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, peer-to-peer, sensor networks, and multimedia, transport services, mobile networking which includes roaming and handoffs, mobile IP, and infrastructure-less networks, IoT definitions which include overview, applications, potential & challenges, and architecture, IoT examples such as case studies, e.g. sensor body-area-network and control of a smart home.

0907523   Cloud Computing   (3 Credit Hours)
Prerequisite: (0907422)
This course introduces students to topics and technologies related to cloud computing. The course first establishes the definition of cloud computing and advantages/disadvantages of adopting cloud computing. The course also describes the various service delivery models of cloud computing architecture (IaaS, PaaS, SaaS) and cloud computing architecture layers and methodologies. The concepts of virtualization and cloud orchestration are explored. The course also covers cloud application development and deployment using popular cloud platforms such as Google App Engine, IBM Bluemix and Amazon Web Service. The course also discusses the use of cloud storage, creation and configuration of virtual machines, data analysis on cloud using data mining tools, and security in cloud computing. The basic concepts of big data analysis on the cloud using the Hadoop's MapReduce paradigm are also overviewed.

0907524   Wireless Networks   (3 Credit Hours)
Prerequisite: (0907422)
Overview of wireless network architectures including cellular networks, local area networks, multi-hop wireless networks such as ad hoc networks, mesh networks, and sensor networks; capacity of wireless networks; medium access control, routing protocols, transport protocols for wireless networks; mechanisms to improve performance and security in wireless networks; energy-efficient protocols for sensor networks.

0907526   Digital Forensics   (3 Credit Hours)
Prerequisite: (0907520)
This course provides students with an introduction to Digital Forensic Science and the systematic process of acquiring, authenticating and analyzing digital evidence. Students will learn different techniques and procedures that enable them to perform a digital investigation. This course focuses mainly on the analysis of physical storage media, and covers the major phases of digital investigation such as preservation, analysis and acquisition of artifacts that reside in hard disks and random access memory.

0907531   Special Topics in Computer Engineering   (3 Credit Hours)
Prerequisite: (0917432 & 0907422)
Special topics of current interest in computer engineering.

0907543   Optimizing Compilers   (3 Credit Hours)
Prerequisite: (0917432 & 0907342)
Introduction to compiling techniques including parsing algorithms, semantic processing and optimization. In-depth study of compiler backend design for high-performance architectures. Topics include control-flow and data-flow analysis, optimization, instruction scheduling, and register allocation.

0907544   Digital Image Analysis and Processing   (3 Credit Hours)
Prerequisite: (0907311 & 0953221)
This course introduces the basics of digital image analysis and processing with emphasis on both theory and implementation. Image representation, image types, intensity transformations and spatial filtering, ,image enhancement, frequency domain processing, image restoration, geometric transformations and image registration, color image processing, image compression and vector quantization, morphological image

processing, image segmentation, edge detection, line detection using the Hough transform, representation and description, object recognition. Hands-on computer work using MATLAB will be a major part of the learning experience.

0907546   **Data Analytics**   **(3 Credit Hours)**
Prerequisite: (1902223)
Definitions and applications; Market trends; Data analytics lifecycle; Data exploration and preprocessing; Data visualization; Theory, tools and methods; Introduction to Big data management, warehousing and processing; Ethical issues.

0907547   **Mobile Computing**   **(3 Credit Hours)**
Prerequisite: (1902223)
This course introduces students to mobile computing and mobile application development. Students will be first provided with an introduction to mobility, wireless technologies and coverage mobile systems which include cellular networks (2G, 2.5G, 3G, 3G+, and 4G), mobile satellite communication networks, mobile IP, mobile TCP, digital audio-video broadcasting, and mobile TV. The mobile device architecture will be overviewed including processors and their instruction set architectures, bus and memory architectures, and I/O architectures. Students will be introduced to mobile device platforms including mobile OS, J2ME, mobile databases, client-server computing agents, application servers, and security protocols. User interface and user experience will be discussed and various application development guidelines will be discussed. Moreover, students will learn about common important topics in mobile computing such as energy management, mobility management, and location-based services.

0907548   **Competitive Programming**   **(3 Credit Hours)**
Prerequisite: (0907346)
Development of strategies, techniques, and skills used in competitive programming contests. Topics of the course include problem solving, advanced data structures, dynamic programming, graph algorithms, minimum spanning trees, shortest path algorithms, computational geometry, randomized algorithms, network flow problems, string algorithms, and number theory. Students will do significant amount of programming tasks.

0907549   **Machine Vision**   **(3 Credit Hours)**
Prerequisite: (0917451)
Introduction to computer vision; Fundamentals of image formation; Camera imaging geometry; Feature detection and matching; Stereo; Motion estimation and tracking; boundary detection; Recognition; Image classification; Scene understanding; Deep learning.

0907552   **Advanced Topics in Machine Learning**   **(3 Credit Hours)**
Prerequisite: (0917451)
Theory and implementation of state-of-the-art machine learning algorithms for large-scale real-world applications. Topics include supervised learning (regression, classification, kernel methods, neural networks, and regularization) and unsupervised learning (clustering, density estimation, and dimensionality reduction). The course focuses on modern techniques such as convolutional neural networks, recurrent neural networks, and deep learning.

0977598   Project (1)   (1 Credit Hours)
Prerequisite: (0907500)
A problem is assigned to the student in one of the different electrical engineering tracks. He will be asked to rely on himself to find a solution for the problem (which could be practical or theoretical). It is expected from the student to develop the abilities of research and independent work and to train himself to observe a timetable to perform his project and to be capable of explaining and expressing his findings in a professional manner.

0977599   Project (2)   (2 Credit Hours)
Prerequisite: (0977598)
The student is required to finish the work he started in the first part. The student is required, whenever it is possible, to use the appropriate and available software to solve his problem, simulate his solution, to build a prototype and perform all needed measurements. The student will be required to write down his final year project as a complete report (dissertation) according to the department instructions.