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 (162) credit hours distributed as follows

Number	Type of requirement	credit hours
First	University Requirements	27
Second	Faculty Requirements	23
Third	Department Requirements	112
Total		162

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 number

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

First: University Requirements:

<table>
<tr><td colspan="5">Preparation Program Requirements
All students admitted to the university must apply for a degree examination in Arabic, English and computer is prepared or approved by the university to determine their level. Based on the results of the examinations, the student will study one or more of the requirements of the preparatory program
(0 - 15 Credit Hours)</td></tr>
<tr><th>No.</th><th>Course Title</th><th>Course No.</th><th>Credit Hours</th><th>Prerequisites</th><th>Notes</th></tr>
<tr><td>1</td><td>Basics of Arabic</td><td>3201099</td><td>3</td><td></td><td>Pass/Fail</td></tr>
<tr><td>2</td><td>Arabic Languages Skills</td><td>3201100</td><td>3</td><td>3201099</td><td>Pass/Fail</td></tr>
<tr><td>3</td><td>Basics of English</td><td>3202099</td><td>3</td><td></td><td>Pass/Fail</td></tr>
<tr><td>4</td><td>English Language Skills</td><td>3202100</td><td>3</td><td>3202099</td><td>Pass/Fail</td></tr>
<tr><td>5</td><td>Basics of Computing</td><td>1932099</td><td>3</td><td></td><td>Pass/Fail</td></tr>
</table>

<table>
<tr><td colspan="6">Compulsory Requirements

(18 Credit Hours)</td></tr>
<tr><th>No.</th><th>Course Title</th><th>Course No.</th><th>Credit Hours</th><th>Prerequisites</th><th>Notes</th></tr>
<tr><td>1</td><td>Military Science</td><td>2220100</td><td>3</td><td></td><td></td></tr>
<tr><td>2</td><td>National Culture</td><td>3400100</td><td>3</td><td></td><td></td></tr>
<tr><td>3</td><td>Learning & Research Skills</td><td>3400101</td><td>3</td><td>3202099, 3201099, 1932099</td><td></td></tr>
<tr><td>4</td><td>Communication Skills</td><td>3400102</td><td>3</td><td>3400101</td><td></td></tr>
<tr><td>5</td><td>Introduction to Philosophy and Critical Thinking</td><td>3400103</td><td>3</td><td>3400101</td><td></td></tr>
<tr><td>6</td><td>Human Civilization</td><td>3400104</td><td>3</td><td></td><td></td></tr>
<tr><td>7</td><td>Campus Life and Ethics</td><td>3400105</td><td>(Zero credit; one-hour weekly meeting)</td><td></td><td></td></tr>
</table>

Study Plan- Bachelors

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	0300102	3		
3	Physical Fitness Culture	1100100	3		
4	Islamic Culture	0400102	3		
5	Health Culture	0720100	3		

Electives
(Third Group)

No.	Course Title	Course No.	Credit Hours	Prerequisites	Notes
1	Entrepreneurship & Creativity	3400109	3		
2	Foreign Language	2200103	3		
3	Electronic Commerce	1600100	3		
4	Social Media	1900101	3		
5	Appreciation of Arts	2000100	3		
6	Special Subject	3400106	3		
7	Management skills	1601105	3		3

Second: School courses: distributed as follows:

    A. **Obligatory school courses: (23) credit hours**

    B. **Elective school courses: (Zero) credit hours**

    A. **Obligatory school courses: (23) credit hours:**

Course No.	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0301101	Calculus I	3	-	3	-
0301102	Calculus II	3	-	3	0301101
0302101	General Physics I	3	-	3	-
0302111	Practical Physics I	-	3	1	0302101 or co-requisite
0901420	Engineering Economy	3	-	3	90 Cr. Hours
0904131	Engineering Graphics & Descriptive Geometry	2	2 Drawing 2 Computer	3	
0908200	Introduction to Engineering	2	-	2	
0966111	Engineering Workshops	-	3	1	-
0966201	Technical Writing	1	-	1	3202100
1931102	Computer Skills for Scientific Faculties	3	-	3	1932099

    B. **Elective school courses: (Zero) credit hours**

Third: Specialty courses: (112) credit hours distributed as follows:

    A. **Obligatory specialty courses: (91) credit hours**

    B. **Elective specialty courses: (21) credit hours**

    A. **Obligatory specialty courses: (91) credit hours:**

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0301131	Principles of Statistics	3	-	3	-
0301201	Calculus III	3	-	3	0301102
0301202	Engineering Mathematics I	3	-	3	0301201
0302102	General Physics II	3	-	3	0302101
0302112	Practical Physics II	-	3	1	0302102 or co-requisite
0903211	Electrical Circuits I	3	-	3	0302102
0903212	Electrical Circuits II	3	-	3	0903211
0903219	Circuits Lab.	-	3	1	0903212 or co-requisite
0903253	Electromagnetics	3	-	3	0302102
0903261	Electronics I	3	-	3	0903211
0903361	Electronics II	3	-	3	0903261
0907231	Digital Logic	3	-	3	1902098 and 1932099
0907234	Digital Logic Lab	-	3	1	0907231

Study Plan- Bachelors

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0907235	Assembly Language and Microprocessors	3	-	3	0907231
0907311	Computer Applications Lab	-	3	1	1931102
0907333	Embedded Systems	3	-	3	0903261 & 0907231
0907334	Embedded Systems Lab	-	3	1	0907333 or co-requisite
0907335	Computer Organization	3	-	3	0907231 and 1931102
0907337	Microprocessors Lab	-	3	1	0907235
0907342	Object-Oriented Problem Solving	2	3	3	1931102
0907422	Computer Networks	3	-	3	0953321
0907432	Computer Design	3	-	3	0907335
0907439	Computer Design Lab	-	3	1	0907432 or co-requisite
0907441	Software Engineering & Ethics	3	-	3	1901231, 1901233
0907461	Digital Electronics	3	-	3	0903361
0907522	Networks and Internet Programming	3	-	3	0907422,1901473
0907528	Computer Networks Lab	-	3	1	0907422
0907529	Advanced Networks Lab	-	3	1	0907528
0933368	Electronics Lab	-	3	1	0903361 or co-requisite
0937332	Microprocessor System Design	3	-	3	0907235
0953221	Signals Analysis and Systems	3	-	3	0903211
0953321	Probability and Random Variables	3	-	3	0301202
0953421	Communications I	3	-	3	0953321 or co-requisite
0977598	Project (I)*	-	-	1	120 Cr. Hours
0977599	Project (II)*	-	-	2	0977598
0907500	Practical training	-	8 Weeks	0	115 Cr. Hours*
1901101	Discrete Mathematics	3	-	3	-
1901233	Data Structures -1	3	-	3	0907342
1901473	Operating Systems	3	-	3	1901231,1901233,1901234

* Project duration for Project (I)* and Project (II)* is two regular semesters.

B. Elective specialty courses: (21) credit hours:

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0907531	Special Topics in Computer Engineering	3	-	3	0907432 & 1901473
0907533	Real-Time Computer Systems	3	-	3	0907333 & 0937332
0907534	Digital System Design	3	-	3	0907333 & 0907335
0907541	Multimedia Engineering	3	-	3	1901473
0907542	Pattern Recognition	3	-	3	1901473
0907543	Optimizing Compilers	3	-	3	0907432
0907544	Digital Image Analysis and Processing	3	-	3	1901231&1901233

Study Plan- Bachelors

Course Number	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0907551	Neural Networks and Fuzzy Logic	3	-	3	1901231 & 1901233
0933341	Instrumentation & Measurement	3	-	3	0903212 & 0903261
0937433	Performance Evaluation and Modelling	3	-	3	0301131 & 0907432
0937521	Parallel and Distributed Systems	3	-	3	0907432
0937561	VLSI Design	3	-	3	0907461
0943424	Digital Signal Processing	3	-	3	0953321
0953422	Communications II	3	-	3	0953421
1901341	Theory of Algorithms	3	-	3	1901231,1901233, 1901234
1902223	Introduction to Database Systems	3	-	3	1901233,1901234
1932341	Artificial Intelligence	3	-	3	1901231,1901233, 1901234

Fourth: Courses offered by other schools and departments

A. Courses offered by other schools and departments

Course No.	Course Title	Contact Hours		Credit Hours	Pre-Requisite
		Theoretical	Practical		
0301101	Calculus I	3	-	3	-
0301102	Calculus II	3	-	3	0301101
0302101	General Physics I	3	-	3	-
0302112	Practical Physics II	-	3	1	0302101 or co-requisite
0907101	Computer Skills for Engineers	3	-	3	1932099
0301131	Principles of Statistics	3	-	3	-
0301201	Calculus III	3	-	3	0301102
0301202	Engineering Mathematics I	3	-	3	0301201
0302102	General Physics II	3	-	3	0302101
0302112	Practical Physics II	-	3	1	0302102 or co-requisite
1901101	Discrete Mathematics	3	-	3	-
1901233	Data Structures -1	3	-	3	0907342
1901473	Operating Systems	3	-	3	1901231,1901233,1901234
1901341	Theory of Algorithms	3	-	3	1901231,1901233, 1901234
1902223	Introduction to Database Systems	3	-	3	1901233,1901234
1932341	Artificial Intelligence	3	-	3	1901231,1901233, 1901234

B. Courses offered by other departments in the 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 Graphics & Descriptive Geometry	2	2 Drawing 2 Computer	3	
0908200	Introduction to Engineering	2	-	2	
0966111	Engineering Workshops	-	3	1	-
0966201	Technical Writing	1	-	1	3202100
0903211	Electrical Circuits I	3	-	3	0302102
0903212	Electrical Circuits II	3	-	3	0903211
0903219	Circuits Lab.	-	3	1	0903212 or co-requisite
0903253	Electromagnetics	3	-	3	0302102
0903261	Electronics I	3	-	3	0903211
0903361	Electronics II	3	-	3	0903261
0933368	Electronics Lab	-	3	1	0903361 or co-requisite
0953221	Signals and Systems	3	-	3	0903211
0953321	Probability and Random Variables	3	-	3	0301202
0953421	Communications I	3	-	3	0953321 or co-requisite
0933341	Instrumentation & Measurement	3	-	3	0903212 & 0903261
0943424	Digital Signal Processing	3	-	3	0953321
0953422	Communications II	3	-	3	0953421
1901341	Theory of Algorithms	3	-	3	1901231,1901233, 1901234
1901473	Operating Systems	3	-	3	1901231,1901233, 1901234
1902223	Introduction to Database Systems	3	-	3	1901233,1901234
1932341	Artificial Intelligence	3	-	3	1901231,1901233, 1901234

Fifth: Advisory Study Plan

First Year

First Semester			Second Semester		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
0301101	Calculus I	3	0301102	Calculus II	3
0302101	General Physics I	3	0302102	General Physics II	3
0302111	Practical Physics I	1	0302112	Practical Physics II	1
0904131	Engineering Graphics & Descriptive Geometry	3	1931102	Computer Skills for Scientific Faculties	3
0966111	Engineering Workshops	1	0900010	Campus Life Ethics and Skills	0
	University Requirement	3		University Requirement	3
	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 III	3	0301131	Principles of Statistics	3
0903211	Electrical Circuits I	3	0301202	Engineering Mathematics I	3
0966201	Technical Writing	1	0903212	Electrical Circuits II	3
0908200	Introduction to Engineering	2	0903219	Circuits Lab	1
0907231	Digital Logic	3	0907234	Digital Logic Lab	1
1901101	Discrete Mathematics	3	0907235	Assembly Language and Microprocessors	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**
0903253	Electromagnetics	3	0953221	Signal Analysis and Systems	3
0903261	Electronics I	3	0903361	Electronics II	3
0953321	Probability and Random Variables	3	0933368	Electronics Lab	1
0907311	Computer Applications Lab	1	0907333	Embedded Systems	3
0937332	Microprocessor Systems Design	3	0907334	Embedded Systems Lab	1
0907337	Microprocessor Lab	1	0907335	Computer Organization	3
0907342	Object-Oriented Problem Solving	3	1901233	Data Structures - 1	3
Total		**17**	**Total**		**17**

Study Plan- Bachelors

Fourth Year

First Semester			Second Semester		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
0953421	Communications I	3	0901420	Engineering Economy	3
0907432	Computer Design	3	0907422	Computer Networks	3
0907439	Computer Design Lab	1		CPE Elective	3
0907441	Software Engineering and Ethics	3		CPE Elective	3
0907461	Digital Electronics	3	1901473	Operating Systems	3
	University Requirement	3			
Total		**16**	**Total**		**15**

Fifth Year

First Semester			Second Semester		
Course Number	**Course Title**	**Credit Hours**	**Course Number**	**Course Title**	**Credit Hours**
0907522	Networks and Internet Programming	3	0907529	Advanced Networks Lab	1
0907528	Computer Networks Lab	1		CPE Elective	3
	CPE Elective	3		CPE Elective	3
	CPE Elective	3	0977599	Project (II)	2
	CPE Elective	3		University Elective	3
0977599	Project (I)	1		University Elective	3
	University Elective	3			
Total		**17**	**Total**		**15**

Study Plan- Bachelors

0301101   **Calculus I**   **(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 II**   **(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.

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.

0301201   **Calculus III**   **(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.

0301202 **Engineering Mathematics I** **(3 Credit Hours)**
Prerequisite: 0301201
Ordinary differential equations, linear differential equations of second and higher order, systems of differential equations, phase plane, stability, series solutions of differential equations, orthogonal functions, Laplace transforms, linear systems of equations, matrices and determinants.

0302101 **General Physics I** **(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 I** **(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 II** **(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 II** **(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 Graphics & Descriptive Geometry** **(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.

0908200   Introduction to Engineering   (2 Credit Hours)
Prerequisite: None
This course covers several topics including the history of engineering, Mechatronics engineering: evolution and relationship with other disciplines mainly planning and management, types of engineering, engineering design, engineering ethics, the proper use of engineering tools including computers and computer simulations, as well as tools for inventive problem solving, creative and critical thinking including mind mapping, team work skills and an introduction to project management.

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.

0966201   Technical Writing   (1 Credit Hour)
Prerequisite: 3202100
Basic technical writing concepts and techniques including report writing. Presentation skills.

1931102   Computer Skills for Scientific Faculties   (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.

0903211   Electrical Circuits I   (3 Credit Hours)
Prerequisite: 0302102
Units, definitions, and simple circuits. Circuit analysis techniques. Inductance and capacitance. Source-free RL and RC circuits. The application of unit-step forcing functions. The RLC circuits. The sinusoidal forcing function. The phasor concept.
The phasor relationships for R, L, and C. Impedance/admittance. The sinusoidal steady state response. Circuit analysis using MATLAB and SPICE.

0903212   Electrical Circuits II   (3 Credit Hours)
Prerequisite: 0903211
Average power and rms values. Polyphase circuits. Three phase Y- and Delta-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.

0903219   **Circuits Lab.**   **(1 Credit Hour)**
Prerequisite: 0903212 or Co-requisite
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.

0903253   **Electromagnetics**   **(3 Credit Hours)**
Prerequisite: 0302102
Introduction. vectors and coordinate systems. Charges. Electric field, potential and electric flux density. Gauss law. Electric characteristics of materials. Capacitors. Boundary conditions. Currents. Magnetic fields. Ampere's law. Magnetic properties of materials and the B-H curve. Boundary conditions. Inductors. Magnetic circuits. Time varying fields and Maxwell's equations. Waves in lossless and conducting media. Transmission lines (TL). Transient and steady state analysis of TL. Matching in TL. Introduction to optical fibers. Electromagnetic effects in high speed digital systems. Practical applications.

0903261   **Electronics I**   **(3 Credit Hours)**
Prerequisite: 0903211
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.

0903361   **Electronics II**   **(3 Credit Hours)**
Prerequisite: 0903261
Amplification. Biasing of transistor (BJT and FET). Single-stage amplifier. Cascaded BJT and FET amplifiers. Composite transistor stages. Operational amplifiers and Applications: Differential amplifier. Operational amplifier architectures. Gain with active load. DC level shifting. Output stage. Offset voltages and currents. Frequency response of amplifiers. The high-frequency response of all amplifier configurations. The low-frequency response of all amplifier configurations. the frequency response of cascaded stages. Feedback Amplifiers. Properties of negative-feedback amplifiers. Properties of feedback amplifier topologies. Analysis of feedback amplifiers.

0907231   **Digital Logic**   **(3 Credit Hours)**
Prerequisite: 1902098 and 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.

3

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.

0907235   **Assembly Language and Microprocessors**   **(3 Credit Hours)**
Prerequisite: 0907231
Introduction to microprocessors and microcomputers. Evolution, architecture, and software model. Introduction to Real-mode and protected-mode memory addressing. Addressing modes. The PC and its DEBUG program. Move, stack, load-effective address, and string instructions. Arithmetic instructions. Addition, subtraction and comparison. Multiplication and division. Logic instructions. Shifts and rotates. Counters and time delays. String comparisons. Jump instructions. Code conversion. Stacks and subroutines. Program and machine control instructions. Software interrupts. Program development. The microprocessor and its bus architecture. Introduction to memory and I/O interface.

0907311   **Computer Applications Lab**   **(1 Credit Hour)**
Prerequisite: 1931102
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.

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.

0907335   **Computer Organization**   **(3 Credit Hours)**
Prerequisite: 0907231, 1931102
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.

0907337   **Microprocessors Lab**   **(1 Credit Hour)**
Prerequisite: 0907235
Writing, assembling, executing, and debugging various x86 programs to cover the basic concepts of microprocessor usage. Designing, implementing and troubleshooting various microprocessor-based applications. Experiments in building and programming microprocessor-based systems. Microcomputer interfacing experiments.

0907342   **Object-Oriented Problem Solving**   **(3 Credit Hours)**
Prerequisite: 1931102
Problem solving techniques for engineering problems, primarily from the fields of electrical and computer engineering; object-oriented programming concepts; object-oriented program development, editing, compiling, linking, and debugging using the Object Oriented Programming languages. Introduction to Object-oriented analysis and design (concepts, methodologies and UML).

0907422   **Computer Networks**   **(3 Credit Hours)**
Prerequisite: 0953321
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.

0907432   **Computer Design**   **(3 Credit Hours)**
Prerequisite: 0907335
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.

0907439   **Computer Design Lab**   **(1 Credit Hour)**
Prerequisite: 0907432 or co-requisite
Using CAD tools, the student designs and simulates the main parts of a computer:

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

0907441   Software Engineering & Ethics   (3 Credit Hours)
Prerequisite: 1901231 and 1901233
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. Software functional and non-functional requirements. System models: context, behavioral, and object models. Issues in the development of software systems: problem definition and specification, planning, structuring principles, and design and analysis methodologies. Essential software attributes: maintainability, dependability, efficiency, and reusability.

0907461   Digital Electronics   (3 Credit Hours)
Prerequisite: 0903361
Electronic devices. Diodes and transistors. BJT gates. RTL basic gates. RTL buffer. DTL basic gate. TTL Structure: operation, I/O characteristics, power dissipation, low power TTL, High-speed TTL, open-collector TTL, and Shottkey TTL. Main features of basic ECL gates. MOS gates. NMOS inverter and gates. CMOS inverter and gates. CMOS tri-state gates. Bilateral switches. Comparison and interfacing of logic families. Semiconductor ROM and RAM. A/D and D/A conversion. Timing circuits. Monostable and astable multivibrators. IC multivibrators.

0907522   Networks and Internet Programming   (3 Credit Hours)
Prerequisite: 0907422, 1901473
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

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0933368   **Electronics Lab**   **(1 Credit Hour)**
Prerequisite: 0903361 or co-requisite
Rectification. Regulation and clipping. BJT characteristics. BJT biasing and large signal amplification. BJT as an amplifier. FET as an amplifier. Cascaded amplifiers. Frequency response of amplifiers. Feedback amplifier. Differential amplifier. Op-Amp Applications.

0937332   **Microprocessor System Design**   **(3 Credit Hours)**
Prerequisite: 0907235
Introduction to x86 microprocessor systems. Memory devices, circuits, and subsystem design. Memory addressing and data formats. Memory-mapped and isolated I/O techniques. Basic and programmable parallel I/O interface. Keyboard and display interface. ADC and DAC interface. Timer interfacing and programming. Serial communications interfacing and programming. Hardware and software interrupts. Interrupt controller interfacing and programming. Real-time clock. DMA operation, controller interfacing and programming. Math coprocessors and MMX technology. Bus interface: ISA (EISA), VESA, PCI, and USB. Term project on microcomputer hardware design.

0953221   **Signals and Systems**   **(3 Credit Hours)**
Prerequisite: 0903211
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.

0953321   **Probability and Random Variables**   **(3 Credit Hours)**
Prerequisite: 0301202
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.

0953421   **Communications I**   **(3 Credit Hours)**
Prerequisite: 0953321 or co-requisite
Continuous-wave modulation (CW). Amplitude Modulation (AM). Angle modulation. Frequency and phase modulation (FM, PM). Bandwidth estimation in CW-modulation. AM and FM receivers. Noise in CW Modulation. Noise Sources. Interference and noise representation. Signal to noise ratio (SNR). Pulse modulation. Time division multiplexing (TDM). Pulse code Modulation (PCM). Delta modulation, DPCM. Baseband transmission : Pulse shaping and line coding. Nyquist's criterion for distortionless transmission. Digital transmission techniques:

Binary ASK, FSK and PSK. Performance of digital modulation schemes in the presence of noise.

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.

1901233   **Data Structures -1**   **(3 Credit Hours)**
Prerequisite: 0907342
The course covers the basics of data structures like: Records. Classes and data abstraction. Inheritance and composition. Templates. Contiguous list. Stacks, Stack operations and Implementation of Stacks as arrays. Queues, Queue operations and Implementation of Queues as arrays.

1901473   **Operating Systems**   **(3 Credit Hours)**
Prerequisite: 1901231,1901233,1901234
This course enables students to understand and implement operating systems functions in managing computer systems component. It includes the following major topics: Introduction to Hardware and Software Concepts; Process and CPU Scheduling, Threads, Synchronous and Concurrent Execution, Deadlock and Indefinite Postponement; Memory Management: Physical and Virtual Memory; Management of External Storage and I/O Devices: Files Management; Performance and Optimization; Security and Protection; and Distributed Systems.

0907531   **Special Topics in Computer Engineering**   **(3 Credit Hours)**
Prerequisite: 0907432 & 1901473
Special topics of current interest in computer engineering.

0907533   **Real-Time Computer Systems**   **(3 Credit Hours)**
Prerequisite: 0907333 & 0937332
Introduction to feedback control systems. Basic elements and benefits of computer-controlled systems. Overview of real-time systems: definition, classification, time constraints, programs, complexity, reliability and challenging issues. Concepts of computer control: sequence, loop, supervisory and centralized control, and human-computer interface (HCI). Computer hardware requirements for real-time systems: features of microprocessors/microcontrollers and process-related interfaces. Data transfer techniques: polling, interrupt and direct memory access. Direct digital control algorithms and their implementation: choice of sampling interval and the PID controller in the z-transform form. Real-time operating systems: single and multi-tasking OS, scheduling strategies, priority structures and task management. Design of real-time systems: single-program and multi-tasking approaches. Industrial applications on real-time computer control.

0907534   **Digital System Design**   **(3 Credit Hours)**
Prerequisite: 0907333 & 0907335
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.

0907541   Multimedia Engineering   (3 Credit Hours)
Prerequisite: 1901473

Introduction to Audio and Video signals. Transducer, Memory processing concepts. Audio and Video Signal Compression. Audio tools, Computer graphic tools and Video Production tools. Design fundamentals: Points, lines, design and creativity. Multimedia Processors. Introduction to multimedia Synchronization. Multimedia Networks and Applications: Audio and Video Conferencing. Multimedia application over the Intranet and the Internet.

0907542   Pattern Recognition   (3 Credit Hours)
Prerequisite: 1901473

Basic concepts in pattern recognition. Classifiers, data mining, and knowledge discovery. Basic concepts of decision functions. Linear decision functions, generalized decision functions, and orthogonal functions. Classification by distance functions and clustering. Minimum distance classification. Single prototypes, multi-prototypes, and nearest-neighbor classification. Clustering and clusters: threshold order-dependent clustering algorithm, Max-Min distance method, c-means iterative algorithm (CMI). The ISODATA algorithm. Classification using statistical approaches. A general Bayes classifier. Normally distributed patterns: univariate, multivariate, multiclass multivariate. Estimation of probability density functions. Feature selection: introduction, distance measures, and clustering transformations. Feature selection methods: entropy minimization, and functional approximation. Fuzzy concepts: fuzzy set theory, the extension principle, and fuzzy relations. Fuzzy and crisp classification. Fuzzy clustering: fuzzy c-means iterative algorithm (FCMI), and fuzzy partitioning. Fuzzy pattern recognition. Syntactic pattern recognition: grammar types, selecting primitives, syntax analysis for recognition, and stochastic languages. Introduction to NNs, the McCulloch-Pitts (MP) neuron, Hebb NN, the Perceptron, the ADALINE, and Backpropagation NN and its applications: Pattern classification using Neural Networks (NNs).

0907543   Optimizing Compilers   (3 Credit Hours)
Prerequisite: 0907432

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: 1901231,1901233
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.

0907551   **Neural Networks and Fuzzy Logic**   **(3 Credit Hours)**
Prerequisite: 1901231 & 1901233
Neural versus conventional computing. The biological neuron. NN paradigm: topology (architecture), nodes, and learning (training) algorithm. General discussion of various NN paradigms. General learning/training processes: supervised, unsupervised, and reinforcement. NN learning representations: decision boundary, weight space, and error space (augmented weight space). The Perceptron and Perceptron learning rule. Hebbian learning algorithm and its variations: Hebb rule, pseudoinverse rule, filtered learning rule, and delta rule. Widrow-Hoff learning algorithm and its applications to adaptive filtering, noise cancellation, and echo cancellation. The back propagation (BP) learning algorithm. Variations on BP. Unsupervised Learning. Various Associative learning rules: Unsupervised Hebb rule, Instar rule, and outstar rule. Radial basis functions. Self-organizing maps. Recurrent neural networks. Reinforcement learning using Approximate Dynamic Programming (ADP). Introduction to fuzzy logic. Fuzzy sets and membership functions. Fuzzy relations, fuzzy implications, fuzzification, and defuzzification. Fuzzy rule base and fuzzy inference engine. Introduction to neuro-fuzzy systems. Reinforcement learning using neuro-fuzzy systems. Introduction to Evolutionary Computations (EC). Basic genetic-neuro-fuzzy learning systems. Applications in control systems, robotics, machine (artificial) intelligence, and data mining.

0933341   **Instrumentation & Measurement**   **(3 Credit Hours)**
Prerequisite: 0903212 & 0903261
General electric and magnetic units. Experimental data and error. Analogue and digital instrumentation of current, voltage and power. R, L, C components measuring instruments. RF power and voltage measurement. Oscilloscopes. Signal generation and analysis. Wave and spectrum analyzers. Transducers. Digital data acquisition and test systems. Capacitive interference. Grounding. Projects on use of 7216 and 7217 chips in digital multimeters.

0937433   **Performance Evaluation and Modelling**   **(3 Credit Hours)**
Prerequisite: 0301131 & 0907432
Introduction to floating-point arithmetic and error analysis. Fundamentals of computer design. Technology trends. Performance metrics. Performance evaluation. Measurement techniques and tools. Workload characterization. Data presentation. Statistical methods for analyzing measured data. The quantitative

approach: experimental design and analysis. Model types. Hardware Description Languages. Event-driven simulation. Introduction to queuing theory and Modelling. Modelling and simulation packages and tools. Term project in simulation.

0937521   **Parallel and Distributed Systems**   **(3 Credit Hours)**
Prerequisite: 0907432
Introduction to parallel processing and distributed systems. Multicomputers, multiprocessors, network of workstations, and scalable systems. Interconnection networks: topologies, routing, and protocols. Distributed systems design for scalability, reliability, availability, and security. Communication paradigms including shared memory, message passing, RPC, and distributed objects. Distributed system services including replication, caching, file system management, naming, clock synchronization, and multicast communication. Sample applications. Development of programs and applications for parallel and distributed systems.

0937561   **VLSI Design**   **(3 Credit Hours)**
Prerequisite: 0907461
Design techniques for rapid implementation of Very Large Scale Integrated (VLSI) circuits. MOS devices and basic circuits. IC fabrication. Algorithmic and system design. Structural and logic design. Transistor-level design. Design rules and checking. Layout design and procedures. Logic and circuit simulation. Timing. Design of combinational and sequential circuits. Design of simple structures. Design of modular and array-type systems. System-level design using hardware description language. Design projects to cover specification, layout, logic simulation, and design verification of a simple VLSI system using an interactive layout system.

0943424   **Digital Signal Processing**   **(3 Credit Hours)**
Prerequisite: 0953321
Introduction to DSP. Discrete time signals and systems. Z-transform. Modelling and implementation forms of DT systems. Time and Frequency domain analysis of digital processors. Design and analysis of finite impulse response filters (FIR). Analog filter approximations. Design and analysis of infinite impulse response (IIR) filters. Digital filter networks. Digital equalizers. The DFT and FFT algorithms. DSP algorithms and applications.

0953422   **Communications II**   **(3 Credit Hours)**
Prerequisite: 0953421
Introduction. Digital modulation formats. Optimum receiver design. Matched filter derivation and design of digital modulation formats. Signal space representation. Performance evaluation for digital modulation formats in AWGN channel. Probability of symbol and bit error for the different modulation formats. Fading channel models. Evaluation of the probability of symbol and bit error in fading channel. Read Spectrum Communication: Channel Coding. Hamming Codes. Convolutional Codes. Linear block codes. Error correcting capability of linear block codes.

1901341   **Theory of Algorithms**   **(3 Credit Hours)**
Prerequisite: 1901231,1901233, 1901234
Definition of an algorithm; Algorithm design and techniques, such as sequential

Concept of worst, best, and average case analysis; Complexity analysis: big O, Omega and Theta notations; Recurrence equations and recursive algorithms; Searching and sorting algorithms; Concept of graphs; Graph algorithms.

1902223   Introduction to Database Systems   (3 Credit Hours)
Prerequisite: 1901233,1901234
The course objectives are to provide students with an overview of database management system architecture and environment, an understanding of the basic database design and implementation techniques, and a practical experience of designing and building a relational database. Other objectives of this course are to make the student able to discuss and explain the importance of the data, the difference between file management and database. Furthermore, it enables applying conceptual design methodologies for databases and learning about the architecture and environments of the database management system (the Ansi-Sparc model). It also enables the student to design and evaluate suitable security and integrity levels for database schemas. This course requires a practical training which is assessed by producing small individual and group projects.

1932341   Artificial Intelligence   (3 Credit Hours)
Prerequisite: 1901231,1901233, 1901234
Introduction to artificial intelligence (concepts, research areas and applications), Propositional logic, First order logic, Representing simple domains in First order logic, Resolution refutation proofs; Logic programming (Prolog), Exhaustive search methods; Heuristic search methods; Production systems; Architecture of expert systems.

0977598   Project (I)   (1 Credit Hours)
Prerequisite: 120 Credit hours
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 (II)   (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.

Study Plan- Bachelors