Syllabus Description
For
Department of Control and Computer Engineering
College of Engineering
Almaaqal University
Basrah, Iraq

1. Graduation Requirements

Requirements	*Units*	*Total hours/Year*	*%Units*	*%Hrs*
University Requirements	*12*	*180*	*8%*	*5%*
College Requirements	*23*	*555*	*15%*	*17%*
Department Requirements + Department Electives	*117*	*2595*	*77%*	*78%*
Total	*152*	*3330*		

2. University Requirements: 12 Units

Subject Code	*Subject*	*Units*	*Weekly hours*		
			Th.	*Prac.*	*Tut.*
U101	*Physics I*	*3*	*3*	*-*	*-*
U102	*Physics II*	*3*	*3*	*-*	*-*
U103	*English Language*	*2*	*2*	*-*	*-*
U104	*Technical Writing*	*2*	*2*	*-*	*-*
U201	*Human Rights & Democracy*	*1*	*1*	*-*	*-*
U202	*Ethics*	*1*	*1*		
Total		*12*	*12*		

3. College Requirements: 23 Units

No.	*Subject Code*	*Subject*	*Units*	*Weekly hours*		
				Th.	*Prac.*	*Tut.*
1	*E101*	*Mathematics I*	*3*	*3*	*-*	*1*
2	*E102*	*Mathematics II*	*3*	*3*	*-*	*1*
3	*E103*	*Engineering Drawing I*	*1*	*-*	*3*	*-*
4	*E104*	*Engineering Drawing II*	*1*	*-*	*3*	*-*
5	*E105*	*Mechanical Engineering (Statics & Dynamics)*	*3*	*2*	*2*	*1*
		Total for 1st Year	*11*	*8*	*8*	*3*
6	*E201*	*Engineering Mathematics I*	*3*	*3*	*-*	*1*
7	*E202*	*Engineering Mathematics II*	*3*	*3*	*-*	*1*
		Total for 2nd Year	*6*	*6*	*0*	*2*
		Total for 3rd Year	*0*	*0*	*0*	*0*
8	*E401*	*Engineering Project* I*	*2*	*1*	*3*	*-*
9	*E402*	*Engineering Project*II*	*2*	*1*	*3*	*-*
10	*E403*	*Industrial Engineering*	*2*	*2*	*-*	*-*
		Total for 4th Year	*6*	*4*	*6*	*0*
	Total		*23*	*18*	*14*	*5*
				37		

4. Department Requirements: 113 Units

Subject Code	Subject Title	Units	Weekly hours		
			Th.	Prac.	Tut.
CC101	Basic of Electrical Engineering I	3	3	-	1
CC102	Basic of Electrical Engineering II	3	3	-	1
CC103	Digital Technique	3	3	-	1
CC104	Computer Programming I	2	2	-	-
CC105	Computer Programming II	2	2	-	1
CC106	Laboratories 1	2	-	4	-
CC107	Laboratories 2	3	-	6	-
	Total for 1st Year	18	13	10	4
CC201	Measurements & Instrumentation	2	2	-	-
CC202	Database Management System	2	2	-	-
CC203	Computer Graphics	2	2	-	-
CC204	Electronic Circuits I	2	2	-	1
CC205	Electronic Circuits II	2	2	-	1
CC206	Programming Language C++	2	2	-	-
CC207	Data Structure & Algorithms	2	2	-	1
CC208	DC Machines	2	2	-	1
CC209	AC Machines & Power Electronics	2	2	-	1
CC210	Digital System Design I	2	2	-	1
CC211	Digital System Design II	2	2	-	-
CC212	Control Theory I	2	2	-	-
CC213	Laboratories 3	3	-	6	-
CC214	Laboratories 4	3	-	6	-
	Total for 2nd Year	30	24	12	6
CC301	Engineering Analysis	3	3	-	1
CC302	Engineering Numerical Methods	3	3	-	1
CC303	Computer Architecture	2	2	-	1
CC304	Microprocessor	2	2	-	1
CC305	Control Theory II	3	3	-	1
CC306	System Identification	3	3	-	-
CC307	Analog Electronics	2	2	-	1
CC308	Digital Electronics	2	2	-	1
CC309	Fundamentals of Communication	2	2	-	1
CC310	Digital Signal Processing	2	2	-	1
CC311	Programmable Logic Controller	2	2	-	1
CC312	Software Engineering	2	2	-	1
CC313	Soft Computing	2	2	-	
CC314	Laboratories 5	3	-	6	-
CC315	Laboratories 6	3	-	6	-
	Total for 3rd Year	38	32	12	12

CC401	*Java Programing*	*2*	*2*	*-*	*-*
CC402	*Digital control*	*3*	*3*	*-*	*-*
CC403	*Control Theory III*	*3*	*3*	*-*	*-*
CC404	*Operating Systems*	*3*	*3*	*-*	*-*
CC405	*Principles of Robotics*	*3*	*3*	*-*	*-*
CC406	*Computer Networks I*	*3*	*3*	*-*	*-*
CC407	*Computer Networks II*	*3*	*3*	*-*	*-*
CC408	*Advanced Computer Architecture*	*2*	*2*	*-*	*1*
CC409	*Embedded Computing Systems*	*2*	*2*	*-*	*1*
CC410	*Laboratories 7*	*2*	*-*	*6*	*-*
CC411	*Laboratories 8*	*2*	*-*	*6*	*-*
	Total for 4th Year/CS	*28*	*24*	*12*	*2*
TOTAL		*114*	*95*	*50*	*22*
			167		

5. Electives: (4) Units and (6) hours/week

Subject Code	*Subject Title*	*Units*	*Weekly hours*		
			Th.	*Prac.*	*Tut.*
CC412	*Adaptive Control*	*2*	*2*	*-*	*1*
CC413	*Nonlinear Control*	*2*	*2*	*-*	*1*
CC414	*Optimal Control & Filtering*	*2*	*2*	*-*	*1*
CC415	*Biomedical Engineering*	*2*	*2*	*-*	*1*
CC416	*Introduction to Nanotechnology*	*2*	*2*	*-*	*1*
CC417	*Mechatronics*	*2*	*2*	*-*	*1*
CC418	*Electrical Transportation Systems*	*2*	*2*	*-*	*1*
CC419	*Electrical Design & Sustainability*	*2*	*2*	*-*	*1*
CC420	*Industrial Automation*	*2*	*2*	*-*	*1*
CC421	*Process Control*	*2*	*2*	*-*	*1*

Summer Training

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

6. CC Curriculum / Units Requirements

- 4 - Years Program (Full - Time Study)
- 152 Units for the **Control and Computer Engineering** included**:**

Total CC Requirements: 152 Units	
Requirements	**%Units**
Humanities and Social Sciences	5%
Mathematics and Basic Sciences	15%
Control and Computer Engineering and others	80%
Total	**152**

7. CC Program: Curriculum

Typical degree program is shown in the following Table for Control and Computer Engineering, where recommended CC course plan by semester is presented.

First Year

First Semester					*Second Semester*				
Subject	*Units*	*Weekly hours*			*Subject*	*Units*	*Weekly hours*		
		Th.	*Prac.*	*Tut.*			*Th.*	*Prac.*	*Tut.*
English Language	*2*	*2*	*-*	*-*	*Technical Writing*	*2*	*2*	*-*	*-*
Mathematics-I	*3*	*3*	*-*	*1*	*Mathematics-II*	*3*	*3*	*-*	*1*
Basic of Electrical Engineering- I	*3*	*3*	*-*	*1*	*Basic of Electrical Engineering-II*	*3*	*3*	*-*	*1*
*Mechanical Engineering (Static & Dynamics)**	*3*	*2*	*2*	*1*	*Digital Technique*	*3*	*3*	*-*	*1*
Electronic Physics I	*3*	*3*	*-*	*-*	*Electronic Physics II*	*3*	*3*	*-*	*-*
Computer Programming-I	*2*	*2*	*-*	*-*	*Computer Programming-II*	*2*	*2*	*-*	*-*
Engineering Drawing I (Basic)	*1*		*3*	*-*	*Engineering Drawing-II (AutoCAD)*	*1*	*-*	*2*	*-*
Laboratories-1 [Basic of Electrical Engineering+ Computer Programming]	*2*	*-*	*2+2*	*-*	*Laboratories-2 [Basic of Electrical Engineering+ Computer Programming + Digital Logic]*	*3*	*-*	*2+2+2*	*-*
Total	*19*	*15*	*9*	*3*	*Total*	*20*	*16*	*8*	*3*
		27					*27*		

1st Year/1st Semester

Subject: English Language **Theoretical: 2 hr/wk**
Code: U103 **Practical: ---**
Class: 1st Year **Tutorial: ---**
Pre-requisite: None **Units: 2**

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This course is designed to enable the students to achieve academic oral and written communication to the standard required at university level. The course integrates all the language skills with emphasis on writing, and it stimulates students' imagination, and promotes personal expression. Students, in this course, are trained to apply critical thinking skills to a wide range of challenging subjects from diverse academic disciplines. Course activities include writing various types of academic essays, acquiring advanced academic vocabulary, and getting involved in group discussions and debates. In addition, the course also includes other skills to consolidate the main skills, such as further readings and use of the Blackboard Suite.

Subject: Mathematics-I **Theoretical: 3 hrs/wk**
Code: E101 **Practical: ---**
Class: 1st Year **Tutorial: 1 hr/wk**
Pre-requisite: None **Units: 3**

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Brief Review:

Trigonometry, Analytic Geometry, Sets, Relations, Functions (Algebraic and Trigonometric), Differentiation and Integration.

Transcendental Functions:

Inverse Trigonometric, Natural Logarithmic, Exponential and Power:
i. Definitions ii. Properties iii. Graphs iv. Derivatives and Integrals.

Application of the Definite Integral:

i) Areas between curves. ii) Volumes of revolution. iii) (Length of the curve.
iv) Surface Area of revolution.

Hyperbolic Function:

i) Definition, ii) Properties iii) Graphs iv) Inverse hyperbolic.
v) differentiation and Integration

Methods of Integration I:

Trigonometric Substitutions, Quadratics, Partial Fractions.

Subject: Basics of Electrical Engineering-I **Theoretical: 3 hrs/wk**
Code: CC101 **Practical: ---**
Class: 1st Year **Tutorial: 1 hr/wk**
Pre-requisite: None **Units: 3**

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Basic Concepts and Units:

Electricity & atomic structure of substance, current and current density, current flow, electric circuit, E.M.F & potential difference, international system of unit, abbreviation for multiples & sub – multiples, quantities derived from SI units, units of force – energy – torque and percentage efficiency, electromechanical equivalent of element.

Analysis of D.C Circuits:

Ohm s law, resistivity & conductivity, temperature effect, internal resistance of a source, open circuit & short circuit, equivalent resistance: Series – parallel – series/parallel – delta and star connections, equivalent voltage source: Series – parallel – circulating current method – floating source method & grouping of E.M.F. sources, double subscript, power calculation in D.C circuit, introduction currents (mesh analysis), nodal analysis, superposition theorem, Thevenin's theorem, Norton s theorem maximum power transfer theorem, Millman theorem, substation theorem, reciprocity theorem.

Alternating quantities:

Magnetic fields, magnetic fields due to electric current, magnetic fields in a coil, force in current carrying conductor a magnetic field, left hand rule, magnitude of the force electromagnetic induction, faraday s law, right hand rule, magnitude of induced e.m.f, value and real value, relation between time and angle, max – average & r. m. s. values of alternating and sinusoidal voltage and current, from factor and peak factor, phasor quantities, voltage and current relations in pure resistive – inductive and capacitive circuits.

Subject: Mechanical Engineering
(Statics and Dynamics)* **Theoretical: 2 hrs/wk**
Code: E105 **Practical: 2 hr/wk**
Class: 1st Year **Tutorial: 1**
Pre-requisite: None **Units: 3**

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Static:

Force system, units system, parallelogram law, force+ components, resultant of coplanar forces, components of force in space, moment of a force, moment of coupler, equilibrium, free body diagram, coplanar system, analysis of trusses, friction, nature of friction, theory of friction, coefficient of friction, centroids and center of gravity, centroids of area, centroids determined by integration, moments of inertia, parallel axes theorem, 2nd moment of area by integration, radius of gyration, moment of inertia of composite area.

Dynamics:

Kinetics of particle, rectilinear motion, curvilinear motion, rectangular components of curvilinear motion, normal and tangential component of acceleration, kinetics, force, mass and acceleration, kinetic of particle Newton's 2nd law.

Subject: Electronic Physics I **Theoretical: 3 hrs/wk**
Code: U101 **Practical: ---**
Class: 1st Year **Tutorial: -**
Pre-requisite: None **Units: 3**

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1. **The atomic structure:** Atomic Number, Silicon & Germanium, , Atom Shells, Energy levels, Energy gap, Energy gap in the semiconductors, Energy Field intensity, Electrical field intensity, Potential, Drift velocity & Mobility, Current density, Conductivity, Resistivity
2. **Semiconductors:** Intrinsic semiconductor, The hole, Extrinsic Semiconductor, N-type material (Donor), P-type material (Acceptors), Charge Densities in a Semiconductor, for N-type material, for P-type material, The Hall effect, Fermi distribution, density of states.
3. **p-n Junction:** Open circuit p-n junction, Depletion region, Diffusion, Einstein Relationship, Total current density in a p-n junction, Barrier potential voltage, p-n Junction as a diode, The biasing of p-n diode, forward biasing, resistance levels, D.C. or Static resistance, A.C. (Dynamic) resistance, Capacitances of the Diode, Diffusion Capacitance.

Subject: Computing Programming I **Theoretical: 2 hrs/wk**
Code: CC104 **Practical: ---**
Class: 1st Year **Tutorial: -**
Pre-requisite: None **Units: 2**

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1. **Problem solving algorithms**
   Data structures, searching and sorting algorithms
2. **V. Basic Variables**
   1) Variable types
   2) Variable Names
   3) Declarations
3. **Assignment statements and expressions in V. Basic**
   Logical expressions and operators
   Mathematical expressions and operators
4. **Conditional Decisions and Loops**
   (a) Conditional Decisions
      1) If/Then/End If statement
      2) If/Then/Else/End If statement
      3) If/Then/ElseIf/End If statement
      4) Select Case statement
      5) Switch statement
      6) IIf statement
      7) Choose statement
   (b) Loops
      1) For-Next statement

2) While-Wend statement
3) Do Until-Loop statement
4) Do While-Loop statement
5) Do-Loop Until statement
6) Do-Loop While statement

5. ARRAYS

1) Declaring Arrays
2) Input and Output Arrays
3) Generate Specific Array Elements
4) Computational (mathematical) processes that take place on the matrices (arrays)

Subject: Engineering Drawing-I (Basics) **Theoretical: ---**
Code: E103 **Practical: 3 hrs/wk**
Class: 1st Year **Tutorial: ---**
Pre-requisite: None **Units: 1**

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Introduction

- Graphic Instruments and Their Use
- Lettering
- Graphic Geometry
- Multi View Ortho Graphic Projection in First and Third Angle Projection
- Dimensions
- Third View
- Isometric Drawing and Sketching
- Oblique Drawing
- Section of Isometric Drawing Sectional View

Subject: Laboratories-1 **Theoretical: ---**
Code: CC106 **Practical: 4 hrs/wk**
Class: 1st Year **Tutorial: ---**
Pre-requisite: None **Units: 2**

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This course contains two laboratories:

1- Electrical Engineering Lab 2 hrs/wk
2- Computers Programming Lab. 2 hrs/wk

1st Year/2nd Semester

Subject: Technical Writing **Theoretical: 2 hr/wk**
Code: U104 **Practical: ---**
Class: 1st Year **Tutorial: ---**
Pre-requisite: U103 **Units: 2**

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Technical writing is an advanced academic writing course which provides an opportunity for the students to learn and practice the skills needed for a guided university-level academic paper related to their field of study. The course emphasizes the development of academic writing skills as well as the ability to read and think critically. Students will learn to use the library and appropriate online resources to find and evaluate sources to inform, develop and support their ideas in term paper writing. They will also learn skills for reading analysis, such as comprehension and inference. Assessment tools will include a common mid-term examination and two term papers (a total of approximately 2,500 words). Emphasis will be on the process of developing and improving academic papers over time, informed by peer and instructor feedback.

Subject: Mathematics-II **Theoretical: 3 hrs/wk**
Code: E102 **Practical: ---**
Class: 1st Year **Tutorial: 1 hr/wk**
Pre-requisite: E101 **Units: 3**

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1) Methods of Integration II: **6 hrs**
Integration by parts, Further Substitutions.

2) Approximation Integral: **6 hrs**
i) Trapezoidal ii) Simpson

3) Vector Algebra: **6 hrs**
i) Representation of Vectors in space (I,j.k) (unit vectors ii) Scalar Product iii) Vector product.

4) Complex Numbers: **9 hrs**
i) Invented number systems ii) The Argand diagram. iii) Addition, Subtraction, product, Qutient, Power and Roots. iv) Demoivers theorem.

5) Polar Coordinates: **9 hrs**
i) The polar coordinate system. ii) Graphs of polar equations. iii) Plane area in polar coordinates.

6) Matrices and Determinants: **9 hrs**
i) Definition ii) Properties. iii) Inverse of a matrix. iv) Solution of Equations (Cramer's rule).

Subject: Basics of Electrical Engineering-II **Theoretical: 3 hrs/wk**
Code: CC102 **Practical: ---**
Class: 1st Year **Tutorial: 1 hr/wk**
Pre-requisite: CC101 **Units: 3**

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1- Analysis of single phase a.c circuits: **(10 hrs)**

Resistance, reactance and impedance, conductance – suspactance and admittance, the phasor diagram, series – parallel – and series / parallel circuits, power calculation in a.c. circuits, power factor & power factor correction.

2- Complex number & its application to a.c circuits: **(10 hrs)**

Equivalent impedance : series – parallel – series / parallel – delta and star connections introduction to network theorems, Kirchoff's laws : KVL – KCL, Maxwell s circulating currents (mesh analysis) nodal analysis, super position theorem, Thevenin's theorem, Norton s theorem, maximum power transfer theorem, Millman's theorem, substitution theorem, reciprocity theorem, power calculation (complex power).

3- Resonance: **(10 hrs)**

Series resonance : quality factor – selectivity – half power – frequency and bandwidth, parallel resonance : quality factor – selectivity – half power – frequency and bandwidth, series / parallel resonance circuits.

4. Magnetic circuit: **(15 hrs)**

Magnetic field, direction of magnetic field, characteristics of lines of magnetic field , magnetic field due to electric, magnetic field in a coil, force in current carrent carrying conductor across a magnetic field, left hand rule, magnitude of the force, electromagnetic induction, faraday s law, right hand rule, magnitude of induced e.m,f magnitude of e.m.f. in a coil, mmf a magnetic field strength, magnetic constants, reluctance, magnetic leakage and fringing, magnetic factors, magnetic circuit: series – parallel and series / parallel , kirchoff 's laws for magnetic circuit, hysteresis and factors on its loop, hysteresis loss and eddy current loss, condition for minimum volume of a permanent magnet, load line of a permanent magnet, force between two magnetic poles, magnetic pull between two iron surfaces.

Subject: Digital Technique **Theoretical: 3 hrs/wk**
Code: CC103 **Practical: ---**
Class: 1st Year **Tutorial: 1 hrs/wk**
Pre-requisite: None **Units: 3**

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1- Introduction to Digital Techniques:

2- Number Systems:

General number formula: binary, octal, decimal and hexadecimal numbers

3- Numbers Base Conversion:

Arithmetic operations in different number systems, complements, binary codes, DCB, Ex-3, and Gray codes,

4-Boolean Algebra:

Basic definitions, basic theorem and properties, Boolean functions.

5- Canonical and Standard forms:

6- Karanough Maps:

7- Combinational Logic Analysis:
Basic combinational logic circuits, implementation combinational logic, the universal property of NAND and NOR Gates, combinational logic using NAND and NOR gates, and logic circuit operation.

Subject: Electronic Physics II **Theoretical: 3 hrs/wk**
Code: U102 **Practical: ---**
Class: 1st Year **Tutorial: ---**
Pre-requisite: U101 **Units: 3**

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1. **Diodes circuits:** Diode operation and i-v characteristics, Regions of operation, models, and limitations, Tunnel, Zener, Varicap, LED, Photo, Laser, Microwave diodes, Single diode circuits, the load line, Multi-diode circuits, Rectifiers, dc-dc converters, Clipping and clamping, Electronic gates, Diode logic (AND & OR functions).
2. **Bipolar transistors and logic families:** NPN and PNP transistor operation, i-v characteristics, Regions of operation, models, and limitation, Transfer characteristic of BJT with load resistor, Biasing for logic and amplifier applications, Logic level definitions, The differential pair as a current switch, Transistor-transistor logic – inverters, NAND, other functions, Emitter-coupled logic – OR/NOR gate, other functions, Low voltage bipolar logic families.
3. **MOS transistors and biasing:** Field-effect transistor operation, i-v characteristics NMOS, Regions of operation, models, and limitations, Enhancement and depletion-mode devices, PMOS devices, Transfer characteristic of FET with load resistor, Biasing for logic and amplifier applications. MOSFETS, MESFET, and BIMOS transistors.

Subject: Computer Programming-II **Theoretical: 2 hrs/wk**
Code: CC105 **Practical: ---**
Class: 1st Year **Tutorial: 1**
Pre-requisite: CC104 **Units: 2**

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1. Review of basic instructions of V. Basic to prepare for advanced V. basic
2. Built in Functions
3. User defined functions and subroutines
4. Sequential files
5. Random Files
6. MS chart
7. MS flex grid
8. Tree
9. Data base control
10. Picture control
11. Image Control

Subject: Engineering Drawing-II (AutoCAD) **Theoretical: ---**
Code: E104 **Practical: 3 hrs/wk**
Class: 1st Year **Tutorial: ---**
Pre-requisite: E103 **Units: 1**

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The use of CAD in engineering drawing. Description of menu Bar and toolbars. Drawing Ellipse, Rectangle, line, Ray, Circle, point, Arc, etc.
CAD Electrical, Mechanical/ Special features
The use of various layers. Drawing electrical symbols on simple architectural plans.
3-D Drawing, render, orthogonal projections and sectional views.

Subject: Laboratories-2 **Theoretical: ---**
Code: CC107 **Practical: 6 hrs/wk**
Class: 1st Year **Tutorial: ---**
Pre-requisite: None **Units: 3**

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This course contains two laboratories:

1- Electrical Engineering Lab. 2 hrs/wk
2- Computer Programming Lab. 2 hrs/2wk
3- Digital Logic 2 hrs/2wk

Second Year

First Semester					*Second Semester*				
Subject	*Units*	*Weekly hours*			*Subject*	*Units*	*Weekly hours*		
		Th.	*Prac.*	*Tut.*			*Th.*	*Prac.*	*Tut.*
Human Rights and Democracy	*1*	*1*	*-*	*-*	*Ethics*	*1*	*1*	*-*	*-*
Engineering Mathematics -I	3	*3*	*-*	*1*	*Engineering Mathematics- II*	*2*	*2*	*-*	*1*
Database Management System	*2*	*2*	*-*	*-*	*Measurements & Instrumentation*	*2*	*2*	*-*	*-*
Computer Graphics	*2*	*2*	*-*	*-*	*Control Theory-I*	*3*	*3*	*-*	*1*
Electronic Circuits I	*2*	*2*	*-*	*1*	*Electronic Circuits II*	*2*	*2*	*-*	*1*
Programming Language C++	*2*	*2*	*-*	*-*	*Data Structure & Algorithms*	*2*	*2*	*-*	*-*
Machines I	*2*	*2*	*-*	*1*	*Machines II*	*2*	*2*	*-*	*1*
Digital System Design I	*2*	*2*	*-*	*1*	*Digital System Design II*	*2*	*2*	*-*	*-*
Laboratories-3 [Electronic Circuits I+ Computer Programming+ Digital Logic-II]	*3*	*-*	*2+2+2*	*-*	*Laboratories-4 [Electronic Circuits II+ Matlab Programming]*	*3*	*-*	*2+2+2*	*-*
Total	*19*	*16*	*6*	*4*	*Total*	*19*	*16*	*6*	*4*
		26					*26*		

2nd Year/1st Semester

Subject: Human Rights and Democracy **Theoretical: 1 hr/wk**
Code: U201 **Practical: ---**
Class: 2nd Year **Tutorial: ---**
Pre-requisite: None **Units: 1**

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Introduces students to the philosophic and political background of the concept of human rights. Discusses important documents as part of the history of the development of human rights theories. Examines important issues in current political and ethical debates about human rights. Reviews core legal documents and the work of the most important governmental and nongovernmental institutions currently involved in human rights protection and promotion. Examines at least one current problem area in human rights protection.

Subject: Engineering Mathematics-I **Theoretical: 3 hrs/wk**
Code: E201 **Practical: ---**
Class: 2nd Year **Tutorial: 1 hr/wk**
Pre-requisite: E103, E104 **Units: 3**

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i) **Vector**; scalars and vectors, component of a vector, rules of vector arithmetic, norm of a vector, normalizing of vectors, dot product, cross product, product of three or more vectors, equations of lines in space, planes in 3-space.
(ii) **Vector-valued functions**: limits and continuity, derivatives, forms of a curve equation in space, parametric representation, unit tangent and normal vectors, curvature, radius of curvature, motion along a curve, velocity, acceleration and speed, normal and tangential components of acceleration.
(iii) **Partial differentiation**: Function of two or more variables, limits and continuity, partial derivatives, partial derivatives of functions of two variables, partial derivatives of functions with more than two variables, the chain rule, the chain rule for derivatives, the chain rule for partial derivatives, directional derivatives and gradients, directional derivatives, the gradient, tangent plans and normal vectors, maxima and minima of functions of two variables, Lagrange multipliers.
(iv) **Multiple integrals**: Double integral, areas and volumes, double integral in polar coordinates, parametric surfaces, surface area, surface integrals, evaluation of volume and triple integral.

Subject: Database Management System **Theoretical: 2 hrs/wk**
Code: CC202 **Practical: ---**
Class: 2nd Year **Tutorial: -**
Pre-requisite: **Units: 2**

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1. **Data Structures:** Pointers and references, Linked structures, Implementation strategies for stacks, queues, and hash tables, Implementation strategies for graphs and trees, Strategies for choosing the right data structure.
2. **Database systems:** definition and role in computer engineering, Components, Database management system (DBMS), Database architectures (possibilities, concept, data independence), and query.
3. **Data modeling:** Concepts (key, foreign key, record, relation), Conceptual models (possibilities, entity-relationship model and UML; strengths and weaknesses), and object oriented models.
4. **Structured query language (SQL)**: Fundamental concepts including data definition, query formulation, update sub-language, constraints, and integrity.

Subject: Computer Graphics **Theoretical: 2 hrs/wk**
Code: CC203 **Practical: ---**
Class: 2nd Year **Tutorial: 0 hr/wk**
Pre-requisite: -- **Units: 2**

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What Is Computer Graphics
Graphic System, Image Processing, Graphics Software
Line-Drawing Algorithms, Bresenham's Line Algorithm, Parallel Line Algorithms
Circle-Generating Algorithms, Ellipse Drawing Methods, OpenGL Programming
Polygon, Representation of the polygon, An inside test algorithms, Polygon filling algorithms, Character display, Anti-aliasing, OpenGL Programming.

Subject: Electronic Circuits I **Theoretical: 2 hrs/wk**
Code: CC 204 **Practical: ---**
Class: 2nd Year **Tutorial: 1**
Pre-requisite: U101, CC 101 **Units: 2**

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Amplifier design:

Characteristics and properties of a linear amplifier, voltage gain, current gain, power gain, dB scale, frequency domain characteristics, distortion, Definition of small-signal in transistor, Bias circuits for linear amplification, voltage, current, power gain, input/output resistances, Amplifier configurations: BJT common-emitter, common-base and common-collector, MOSFET common-source, common gate, Common drain.

Differential and Multistage Amplifiers:
The MOS differential pair: small signal operation, The BJT differential pair, the differential amplifier with active load, Multistage amplifiers (voltage gain, current gain, etc.…), types of multistage amplifiers (cascade, … etc..)

Others Two-Terminal Devices:
Schottky Diodes, Power diodes, Photoconductive Cells, IR Emitters, Liquid-Crystal Displays, solar cells.

pnpn and other Devices:
Description and operation of silicon controlled rectifier, Diac, Thyristor, GTO, and Triac, Unijunction transistor, phototransistors, opto-isolators, programmable unijunction transistor.

Subject: Programming Language C++ **Theoretical: 2 hrs/wk**
Code: CC206 **Practical: ---**
Class: 2nd Year **Tutorial: ---**
Pre-requisite: CC104, CC105 **Units: 2**

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1. **Programming in C++:** Basic syntax and semantics, variables, types, expressions, assignment, mathematical functions, logical and arithmetic operations, simple I/O, functions and parameter passing, procedure programming.
2. **Control structures**: Conditional and iterative control structures, loops, sequencing, selection, and iteration functions.
3. **Basic Data Structures:** Primitive types, Arrays, Strings and string processing, Records, stack, and heap allocation.
4. **Structure programming**: static and dynamic structure programming.
5. **Recursion:** Recursive mathematical functions, Divide-and-conquer strategies, Recursive backtracking, Implementation of recursion in C++.

Subject: Machines I **Theoretical: 2 hrs/wk**
Code: CC208 **Practical: ---**
Class: 2nd Year **Tutorial: 1**
Pre-requisite: CC101, CC102 **Units: 2**

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DC Machines
General principle of rotating electrical machines, and calculation of induced emf, energy, power, and torque in DC machines, constriction of DC machines, and function of commutator, type of armature windings calculation of mmf per pole, type of excitation connections, armature reaction, commutation, type and characteristics of DC generators, parallel operation of DC generators, losses and efficiency of DC machines.

Motors
Principle of operation of DC motors, calculation of speed, calculation of torque, starting of DC motors, characteristics of DC motors and their type, speed control of DC motors & electric breaking, testing of a DC machines

Subject: Digital System Design I **Theoretical: 2 hrs/wk**
Code: CC210 **Practical: --**
Class: 2nd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC103 **Units: 2**
==========

1- Adders Arithmetic Operations: Subtractions, half and full adders and subtractions, binary parallel address. **2- Code Conversio**n: Even and odd party logic, decoders, encoders, comparators, multiplexers and demultiplexers. **3- Sequential Logic:** Sequential Logic; base of flip-flops, RS flip-flops, J-K flip-flops, T and D flip-flops, Synchronous Sequential Logic, Excitation tables of SR flip-flops, J-K flip-flops, T and D flip-flops for design.
4- Counters and registers. 5- Memory units. **6- Asynchronous Sequential Logic, 7- Algorithmic State Machines (ASM).**

Subject: Laboratories-3 **Theoretical: ---**
Code: CC213 **Practical: 6 hrs/wk**
Class: 2nd Year **Tutorial: ---**
Pre-requisite: None **Units: 3**
==========

This course contains four laboratories:

1. Electrical and Electronic Circuits Lab. 2 hrs/wk
2. Computer Programming Lab. 2 hrs/2wk
3. Digital Techniques-II Lab. 2 hrs/2wk

2nd Year/2nd Semester

Subject: Ethics **Theoretical: 1 hr/wk**
Code: U202 **Practical: ---**
Class: 2nd Year **Tutorial: ---**
Pre-requisite: None **Units: 1**
==========

Course Objectives: Prepare students to understand the foundation of classical moral theory and decision making in the context of science and engineering applications. Help students to recognize and evaluate ethical challenges that they will face in their academic and professional careers through knowledge and exercises that deeply challenge their decision-making processes and ethics. Assist students in improving their effective communications and presentation skills.

1- Introduction: Background Ideas , Why Study Engineering Ethics?, Engineering Is Managing the Unknown , Personal vs. Professional Ethics , The Origins of Ethical Thought , Ethics and the Law , Ethics Problems Are Like Design Problems , Case Studies ,Summary.

2- Professionalism and Codes of Ethics: Introduction, Is Engineering a Profession? Codes of Ethics.

3- Understanding Ethical Problems: Introduction , A Brief History of Ethical Thought , Ethical Theories non-Western Ethical Thinking.

4- Ethical Problem-Solving Techniques: Introduction, Analysis of Issues in Ethical Problems , Line Drawing , Flow Charting , Conflict Problems, An Application of Problem-Solving Methods: Bribery/Acceptance of Gifts.

5- Risk, Safety, and Accidents: Introduction, Safety and Risk, Accidents.

Subject: Engineering Mathematics-II **Theoretical: 2 hrs/wk**
Code: E202 **Practical: ---**
Class: 2nd Year **Tutorial: 1 hr/wk**
Pre-requisite: E101, E102, E201 **Units: 2**

==========

Differential Equations

(i) First Order: variable separable, exact, linear, Bernoulli.

(ii) second and Higher Order: Linear equation with constant coefficients, linear homogeneous equations with constant coefficients, non-homogenous equations, solving of non-homogenous equations, variation of parameters, higher order linear equations with constant coefficients, D-operator, Cauchy equation.

Introduction to Laplace Transform

Laplace Transform Properties, Inverse Laplace Transform Properties, Laplace Transform of Periodic Function, Differential Equation using Laplace Transform.

Sequences and series

Convergence and Divergence Test, Geometric Series and Partial Sum, Integral, Comparison, Ratio and Root Tests, Alternating series, Power Series, Taylor and Maclaurin Series, Applications of Power Series.

Matrix Analysis

Review of matrix theory, linear transformation, Eigen values and Eigen vectors, Laplace transform of matrices.

Subject: Measurement & Instrumentation **Theoretical: 2 hr/wk**
Code: CC201 **Practical: ---**
Class: 2nd Year **Tutorial: -**
Pre-requisite: None **Units: 2**

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1. **Introduction to Measurement:**
   Measurement units and standards of measurements
2. **Instrument Types and Performance Characteristics:**
   Review of instrument types, static & dynamic characteristics.

3. **Errors during measurement process:**
   Source of errors and reduction of errors.
4. **Measurement Noise and Signal Processing:**
   Sources of measurement noise, techniques for reducing measurement noise, and introduction to signal processing.
5. **Electrical Indicating and Test Measurement:**
   Digital meters (voltage to time conversion type, potentiometric type, dual slope integration type, voltage to frequency type and multi-meters), analog meters (electrodynamic type, clamp-on meters, and thermocouple meter), cathode ray oscilloscope and digital storage oscilloscope.
6. **Variable Conversion Elements:**
   Bridge circuits (Wheatstone, deflection type DC bridge and AC bridges), and their applications.
7. **Electrical Transducers:** Resistive, Inductive and Capacitive transducers, measurement of transducer output, modulation and demodulation in transducers.
8. **Industrial measurements:** Level measurement, Pressure measurement: Burden tube, Bellows, Diaphragms, Differential pressure measurement, Flow measurement, Temperature measurement, Force, Load cell.
9. **Digital Transducers:** Opt couplers and OID, optical detection, magnetic pickups, Speed measurement, Position measurement, and other digital transducers.

Subject: Electronic Circuits II **Theoretical: 2 hrs/wk**
Code: CC205 **Practical: ---**
Class: 2nd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC204 **Units: 2**

==========

Frequency Response:

Low frequency response of the CS and CE amplifiers, internal capacitive effects and the high frequency model of the MOSFET and the BJT, high frequency response of CS and CE amplifiers, high frequency response of the CG and cascade amplifiers, high frequency response of source and emitter followers, high frequency response of differential amplifiers, other wideband amplifier configurations.

Feedback Amplifier

Feedback concepts, types, effects and topologies, feedback analysis, voltage-series, voltage-shunt, current –series, and current-shunt, F.B. stability and response of feedback amplifiers.

Power Amplifiers

Series-fed class A amplifier, transformer-coupled Class A amplifier, class B amplifier, amplifier distortion, power transistor heat sinking, class AB and push-pull amplifiers, class C and class D amplifiers.

Subject: Data Structure & Algorithms **Theoretical: 2 hrs/wk**
Code: CC207 **Practical: ---**
Class: 2nd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC202 **Units: 2**

==========

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

Subject: Machines II **Theoretical: 2 hr/wk**
Code: CC209 **Practical: ---**
Class: 2nd Year **Tutorial: 1 hr/wk**
Pre-requisite: CC208 **Units: 2**

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-Three-Phase Induction Motors
-Single Phase Induction Motor
-Synchronous Machines
-Special Machines
-Introduction to power electronics
-Rectifiers
-Converter Operation
-Choppers
-Inverters

Subject: Digital System Design II **Theoretical: 2 hrs/wk**
Code: CC211 **Practical: --**
Class: 2nd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC103 **Units: 2**

==========

- **Introduction and Overview:** combinational versus sequential circuits, Hierarchical design of combinational circuits using logic modules, PLA, Random-access memory (RAM), realization of logic functions using PLA and/ or RAM.

- **Analysis of Sequential logic circuits:** Finite state machines (FSMs), clocked and unclocked, Mealy vs. Moore models of FSMs, Modeling FSM behavior: State diagrams and state tables, timing diagrams, algorithmic state machine charts, Analysis of synchronous and asynchronous circuits.
- **Design of Sequential logic circuits** Design of synchronous sequential circuits: State minimization, state assignment, next state and output equation realization. Sequential functional units: Data registers, shift registers, counters, sequence detectors, synchronizers, controllers.

Subject: Control Theory I **Theoretical: 3 hrs/wk**
Code: CC212 **Practical: ---**
Class: 2rd Year **Tutorial: 1 hrs/wk**
Pre-requisite: None **Units: 3**

==========

1-Introduction and review: **(4 hrs)**

Systems, plant, linear dynamical systems, open loop and closed loop (feedback) systems.

2-Modeling of Control Systems: **(10 hrs)**

Mathematical model of electrical systems, electromechanical systems, block diagrams, signal flow graph, Mason's rule.

Mathematical model of electrical systems, electromechanical systems, block diagrams, signal flow graph, Mason's rule.

3-Time domain analysis: **(10 hrs)**

Response of 1St order systems, response of 2nd order systems, step response analysis and performance specifications, static and dynamic error coefficient.

4-Stability Analysis: **(10 hrs)**

Stability of dynamical systems, the Routh-Hurwitz stability criterion, root locus analysis

5- Frequency domain Analysis: **(10 hrs)**

Frequency domain analysis, the Bode diagram, the stability in frequency domain, the Nyquist stability criterion.

Subject: Laboratories-4 **Theoretical: ---**
Code: CC214 **Practical: 6 hrs/wk**
Class: 2nd Year **Tutorial: ---**
Pre-requisite: None **Units: 3**

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This course contains four laboratories:

1- AC machines Lab. 2 hrs/wk
2- Measurements and Electronic Circuits Lab. 2 hrs/wk
3- Programming Lab. 2 hrs/wk

Third Year

First Semester					Second Semester				
Subject	Units	Weekly hours			Subject	Units	Weekly hours		
		Th.	Prac.	Tut.			Th.	Prac.	Tut.
Engineering Analysis	3	3	-	1	Engineering Numerical Methods	3	3	-	1
Computer Architecture	3	3	-	1	Microprocessor	2	2	-	1
Control Theory-II	3	3	-	1	System Identification	3	3	-	-
Analog Electronics	3	3	-	1	Digital Electronics	2	2	-	1
Fundamentals of Communication	2	2	-	1	Digital Signal Processing	2	2	-	1
Software Engineering	2	2	-	1	Programmable Logic Controller	2	2	-	1
Laboratories-5 Control+ Electronics & Communications	3	-	6	-	Soft Computing	2	2	-	1
					Laboratories-6 PLC+ Control+ Electronics	3	-	6	-
Total	19	16	6	6	Total	19	16	6	6
		28					28		

3rd Year/1st Semester

Subject: Engineering Analysis **Theoretical: 3 hr/wk**
Code: CC301 **Practical: ---**
Class: 3rd Year **Tutorial: 1**
Pre-requisite: E201, E202 **Units: 3**

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Fourier series

Periodic and non- Periodic Functions, Euler Formulas, Even and Odd functions, Half Range Expansion (Fourier Sine and Fourier Cosine), Complex Fourier Series (Exponential), Applications of Fourier Series in Electric Circuits

Fourier Transform

Properties, convolution theorem, power spectral, density and correlations, signals and linear systems, applications.

The Z-Transform

Region of convergence, properties of Z-transforms, Z-transform pairs, the inverse of Z-transform, analysis and discrete-time systems, applications.

Statistics

Definitions, frequency distribution (relative & cumulative, mean, standard deviation).

Probability Theorem

Definitions, mutually exclusive and conditional probability, permutations and combinations, probability distribution functions (Binomial, Poisson).

Complex Variable Theory

Functions of complex variables, complex differentiation, analytic functions and its properties, integration in the complex plane, Cauchy's theorem, Cauchy's integral formula for simply and multiply connected regions, Taylor's and Laurent series, the residue theorem.

Solution of Differential Equations using power series

Legendre's equation, Legendre's polynomials, Bessel function of the first and second orders, Bessel function properties.

Partial Differential Equations

Wave equation, Laplace equation, solution of boundary condition problems, general solution, solution by separation of variables.

Subject: Computer Architecture **Theoretical: 2 hr/wk**
Code: CC303 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hr/wk**
Pre-requisite: CC210 **Units: 2**

==========

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

Subject: Control Theory II **Theoretical: 3 hrs/wk**
Code: CC305 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC305 **Units: 3**

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1-Design of feedback control systems: **(6 hrs)**

Lead compensation, lag compensation, lead-lag compensation.

2-State space analysis: **(10 hrs)**

Definitions, state models (state variable form and diagonal form), Eigenvalues, transfer functions and transfer matrix for state models, solution of state space equations.

3- State feedback design: **(10 hrs)**

Controllability, observability, Optimal control systems, pole placement using state feedback.

4-PID Control Design: **(10 hrs)**

Tuning rules for PID controllers, PID control of plants, Ziegler-Nichols rules, Modifications of PID control schemes.

5-Robust Control Systems: **(9 hrs)**

System sensitivity, two degree of freedom control, the design of robust control systems.

Subject: Analogue Electronics **Theoretical: 2 hrs/wk**
Code: CC307 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hr/wk**
Pre-requisite: CC204, CC205 **Units: 2**

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Operational Amplifiers

The ideal OP amplifier, the inverting configuration, the non-inverting configuration, difference amplifiers, integrators and differentiators, DC imperfections, effect of finite open loop gain and bandwidth on circuit performance, large signal operation of OP Amps, the 741 OP-Amp circuit, some OP Amp applications.

Active Filters

Filters concept, types, direct realization approach, simulated inductance methods, variable frequency, scaling methods, state variable filter, cascading realization approach, single operation amplifier structures, voltage controlled voltage source circuits, multiple loop feedback circuits.

Oscillators

Oscillator concepts, Low frequency oscillators, RC-phase shift oscillators, Wien-bridge oscillators, High frequency oscillators, Hartley oscillators, Colpitts oscillators, Clapp and Meissner oscillators, Negative resistance oscillators, Crystal oscillators.

Voltage and Current Regulators
Zener diode stabilizers, line regulation, voltage regulators, series regulators, shunt regulators, switching regulators, current regulators, typical current, grounded load C.R.

Analogue Multiplexers
Analogue multiplier operation, characteristics and applications.

Analogue Multipliers
Logarithmic multiplier, quainter-square multiplier, triangle-averaging multiplier, time division multiplier, current rationing multiplier.

Subject: Fundamentals of Communication **Theoretical: 2 hrs/wk**
Code: CC309 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hr/wk**
Pre-requisite: None **Units: 2**

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1. Elements of Communication System
2. Signal Transmission and Filtering
3. Amplitude modulation: Standard AM, DSB, SSB, VSB, QAM AM transmission and reception.

4. Angle modulation: FM and PM transmission and reception.

5. Analogue Pulse Modulation Sampling theorem, Types of sampling, Ideal sampling, Natural sampling, PAM-generation and detection, PWM-generation and detection, PPM-generation and detection, TDM, Bandwidth requirements for TDM, Comparison of FDM and TDM.

6. Digital Pulse Modulation PCM, Uniform Quantization, Quantization noise, nonuniform quantization, Practical compression techniques, Output signal-to-quantizing ratio, Encoding, Delta modulation, adaptive delta modulation, comparison between PCM and DM, Signaling format, Types of line codes, Intersymbole Interference, digital carrier systems, ASK, FSK, PSK, DPSK.

Subject: Software Engineering **Theoretical: 2 hrs/wk**
Code: CC312 **Practical: ---**
Class: 3rd Year **Tutorial: ---**
Pre-requisite: **Units: 2**

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1. **Software life cycle and process models**: life cycle, life cycle model, quality, phases, Process improvement, Process assessment models, metrics, standards and guidelines.
2. **Software requirements and specifications:** Requirements analysis modeling techniques, Prototyping, formal specification techniques, functional and non-functional requirements.

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

Subject: Laboratories-5 **Theoretical: ---**
Code: CC314 **Practical: 6 hrs/wk**
Class: 3rd Year **Tutorial: ---**
Pre-requisite: None **Units: 3**
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This course contains three laboratories:

1. Digital System Design Lab 2 hrs/2wk
2. Electronics and Communications Lab. 2 hrs/2wk
3. Control Lab 2 hrs/wk

3rd Year/2nd Semester

Subject: Engineering Numerical Methods **Theoretical: 3 hr/wk**
Code: CC302 **Practical: ---**
Class: 3rd Year **Tutorial: 1**
Pre-requisite: CC301 **Units: 3**

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Introduction: why numerical methods,
Solution of non-linear equations (roots finding): graphical method, bisection method, method of iteration, Newton's method, the secant method.
Solving sets of linear equations: matrix notation, Gaussian elimination method, evaluation of the inverse of a matrix, matrix inverse method, LU factorization method, Gauss-Seidel iteration method, Eigen values and Eigenvectors. Solving set of set of nonlinear equations.
Numerical interpolation: polynomial interpolation, linear interpolation, quadratic interpolation, higher degree interpolation (LaGrange's interpolation), error in polynomial interpolation.
Numerical differentiation and integration: derivatives from interpolating polynomials, trapezoidal & Simpson's rules for numerical integration.

Subject: Microprocessors **Theoretical: 2 hrs/wk**
Code: CC304 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hr/wk**
Pre-requisite: **Units: 2**

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THE 8086 MICROPROCESSOR

Introduction to 8086 – Microprocessor architecture – Addressing modes – Instruction set and assembler directives – Assembly language programming – Modular Programming – Linking and Relocation – Stacks – Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

8086 SYSTEM BUS STRUCTURE

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

I/O INTERFACING

Memory Interfacing and I/O interfacing – Parallel communication interface – Serial communication interface – D/A and A/D Interface – Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller

Subject: System Identification **Theoretical: 3 hrs/wk**
Code: CS306 **Practical: ---**
Class: 4th Year **Tutorial: 0 hrs/wk**
Pre-requisite: CC305 **Units: 3**

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Models for Identification:

Models of LTI systems: Linear Models-State space Models-OE model- Model sets, Structures and Identifiability-Models for Time-varying and Non-linear systems: Models with Nonlinearities – Non-linear state-space models-Black box models, Fuzzy models.

Non-Parametric and Parametric Identification:

Transient response and Correlation Analysis – Frequency response analysis – Spectral Analysis – Least Square – Recursive Least Square –Forgetting factor- Maximum Likelihood – Instrumental Variable methods.

Non-Linear Identification and Model Validation:

Open and closed loop identification: Approaches – Direct and indirect identification – Joint input-output identification – Non-linear system identification – Wiener models – Power series expansions - State estimation techniques – Nonlinear identification using Neural Network and Fuzzy Logic.

Subject: Digital Electronics **Theoretical: 2 hrs/wk**
Code: CC308 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC204, CC205 **Units: 2**

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Integrated Circuit Technologies

Basic operational characteristics and parameters, CMOS Circuits, TTL Circuits, practical considerations in the use of TTL, comparison of CMOS and TTL performance, Emitter coupled logic (ECL) circuits, BiCMOS digital circuits, PMOS, NMOS, and E^2MOS.

Memory Circuits:

Semiconductor memories: Types and architectures.

Programmable Logic Devices

FPD (Field Programmable Device), PLD (Programmable Logic Device), PLA (Programmable Logic Arrays), PAL (Programmable Array Logic), SPLD/CPLD (Simple/Complex Programmable Logic Device), GAL (Generic Array Logic), PLD Programming, ASIC, Digital System Applications, and introduction to the FPGA.

Digital systems design: Hierarchical, modular design of digital systems. Synthesis of digital circuits from HDL models. Design principles and techniques: Bridging conceptual levels – top down/bottom up, iteration, satisfying a behavior with a digital structure. Functional units, building blocks and LSI components: Adder, shifter, register, and control circuits, tri-state devices and buses.

Realization using field-programmable gate arrays (FPGAs): Control concepts: Register transfer notation, major control state, sequences of micro-operations, conditional execution of micro-operations. Timing concepts: System timing dependencies, sequencing, clock generation, distribution, and skew. Programmable logic devices (PLDs) and field-programmable gate arrays (FPGAs), PLAs, ROMs, PALs, complex PLDs.

System Modeling: Schematic capture. Hierarchical schematic modeling for complex systems. Digital system modeling with hardware description languages HDL. Other modeling techniques (timing diagrams, register transfer languages, state diagrams, algorithmic state machines).
System Simulation: Functional simulation of combinational and sequential circuits. Timing models of digital circuit elements: Propagation delay, rise/fall time, setup and hold times, pulse widths. Timing simulation to measure delays and study signals subject to timing constraints.
Formal verification: Relationship of good design practice to formal verification. Comparison and contrast of formal verification, validation, testing. Verification by model checking. Verification by proofs. Verification by equivalence checking. Verification by assertions and verification languages. Verification by testing.

Linear Digital ICs:
Introduction, comparator unit operation, D/A convertors (Binary weighted D/A converters, R/2R D/A converters, IC D/A converters), A/D convertors (parallel encoded A/D converters, counter ramped A/D converters, successive approximation A/D converters, IC A/D converters), Timer IC unit (Astable, Monostable and Bistable using 555 timer), Voltage controlled oscillator, Phase locked loop, interfacing circuitry.

Subject: Digital Signal Processing **Theoretical: 2 hrs/wk**
Code: CC310 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC301 **Units: 2**

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

Subject: Programmable Logic Controllers **Theoretical: 2 hrs/wk**
Code: CC311 **Practical: ---**
Class: 3rd Year **Tutorial: 1 hrs/wk**
Pre-requisite: **Units: 2**

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Introduction to PLCs: 2 hrs
Definition and history of PLC, PLC types and selection criteria for PLC.
PLC Architecture and Its Operation: 4 hrs
PLC architecture, Scanning process, sourcing and sinking
PLC Ladder Programming: 18 hrs
PLC contact and coil instructions, PLC basic functions, PLC timer instructions, PLC counter instructions, rotate and shift instructions and miscellaneous instructions.
Structured Text Programming: 5 hrs
Sequential Function Chart Programming: 6 hrs
PLC Applications 10 hrs

Subject: Soft Computing **Theoretical: 2 hrs/wk**
Code: CC313 **Practical: ---**
Class: 3rd Year **Tutorial: ---**
Pre-requisite: **Units: 3**

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1. INTRODUCTION:
Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems.
2. ARTIFICIAL NEURAL NETWORKS:
Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron. Learning and Training the neural network. Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations. Hopfield network, Self-organizing network and recurrent network. Neural Network based controller
3. FUZZY LOGIC SYSTEM:
Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control.
Structure and operation of a fuzzy controller: Fuzzy rules processing, Mamdani-type fuzzy processing, fuzzy rules firing, the applicability degree, clipping of the output, Sugeno-type processing, fuzzy controller operations (fuzzification, defuzzification……), PD-like fuzzy controller, PI-like fuzzy controller, PID-like fuzzy controller, stability and performance of fuzzy controllers.
Fuzzy controller parameters choice: Iterative design procedure of fuzzy controllers, scaling factor choice, membership function choice, fuzzy rules formulation, defuzzification methods.
Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.
4. GENETIC ALGORITHM:

Evolutionary computing: Background of genetic algorithm (GA), working principle of GA, search space. Encoding: Binary, Octal, Fitness function, single objective and multi objective optimization. Reproduction: Roulette –wheel selection, Tournament selection. Genetic operators: cross-over, single point and multi-point, mutation, inversion, elitism.

5. Bio-inspired computing:

Basic concepts on ant colony optimization (ACO), bacteria colony optimization (BCO), particle swarm optimization (PSO). Application of PSO and GA in solving travelling sales man problem, Introduction to Hybrid models.

5. APPLICATIONS:

Subject: Laboratories-6 **Theoretical: ---**
Code: CS315 **Practical: 6 hrs/wk**
Class: 3rd Year **Tutorial: ---**
Pre-requisite: None **Units: 3**

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This course contains four laboratories:

1- PLC Lab. 3 hrs/2wk
2- Electronics and Communications Lab. 3 hrs/2wk
3- Control Lab 3 hrs/2wk
4- Microprocessors 3 hrs/2wk

Forth Year

First Semester					Second Semester				
Subject	Units	Weekly hours			Subject	Units	Weekly hours		
		Th.	Prac.	Tut.			Th.	Prac.	Tut.
Engineering Project*I	2	1	3	-	Engineering Project*II	2	1	3	-
Java Programing	2	2	-	-	Industrial Engineering	2	2	-	-
Digital control	3	3	-	-	Control Theory III	3	3	-	-
Operating Systems	3	3	-	-	Principles of Robotics	3	3	-	-
Computer Networks I	3	3	-	-	Computer Networks II	3	3	-	-
Advanced Computer Architecture	2	2	-	1	Embedded Computing Systems	2	2	-	1
Elective I	2	2	-	1	Elective II	2	2	-	1
Laboratories-7	2	-	6	-	Laboratories-8	2	-	6	-
Total	19	16	9	2	Total	19	16	9	2
		27					27		

4th Year/1st Semester

Subject: Engineering Project I **Theoretical: 1 hr/wk**
Code: E401 **Practical: 3**
Class: 4th Year **Tutorial: ---**
Pre-requisite: None **Units: 2**

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This is an independent study under the supervision of department members. Each student is expected to do research trying to explore and define a potential study area suitable for a senior design project. A specific engineering problem must then be identified from within the selected study area. Results from this study must be documented and submitted in the form of a design project proposal.

Subject: Java Programming **Theoretical: 2 hr/wk**
Code: CC401 **Practical: -**
Class: 4th Year **Tutorial: ---**
Pre-requisite: None **Units: 2**

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Chapter 1 Introduction to Computers, Programs, and Java
Chapter 2 Elementary Programming
Chapter 3 Selections
Chapter 4 Logical Operators
Chapter 5 Loops
Chapter 6 Methods
Chapter 7 Single-Dimensional Arrays
Chapter 8 Objects and Classes

Subject: Digital Control Systems **Theoretical: 3 hrs/wk**
Code: CC402 **Practical: ---**
Class: 4th Year **Tutorial: ---**
Pre-requisite: CC305, CC306 **Units: 3**

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Introduction to Digital Control:
Introduction, Discrete time system representation, Mathematical modeling of sampling process, Data reconstruction
Modeling discrete-time systems by pulse transfer function
Revisiting Z-transform, Mapping of s-plane to z-plane, Pulse transfer function, and Pulse transfer function of closed loop system, sampled signal flow graph
Stability analysis of discrete time systems
Jury stability test, Stability analysis using bi-linear transformation, Time response of discrete systems, Transient and steady state responses, Time response parameters of a prototype second order system

Design of sampled data control systems
Root locus method, Controller design using root locus, Root locus based controller design using MATLAB, Nyquist stability criteria, Bode plot, Lead compensator design using Bode plot, Lag compensator design using Bode plot, Lag-lead compensator design in frequency domain

4. Design in Discrete Domain:
Sample and Hold-Digital equivalents-Impulse and step invariant transformations Methods of discretization-Effect of sampling- Direct discrete design – discrete root locus, Design examples

5. Discrete State Variable Design:
Discrete pole placement- state and output feedback-estimated state feedback-discrete optimal control- dynamic programming-Design examples

Discrete state space model
Introduction to state variable model, various canonical forms, Characteristic equation, state transition matrix, Solution to discrete state equation

Controllability, observability and stability of discrete state space models
Controllability and observability, Stability, Lyapunov stability theorem

State feedback design
Pole placement by state feedback, Set point tracking controller, Full order observer, reduced order observer

Subject: Operating Systems **Theoretical: 3 hrs/wk**
Code: CC404 **Practical: ---**
Class: 4th Year **Tutorial: ---**
Pre-requisite: CC303, CC304 **Units: 3**

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1- **History and overview:** Introduction, Hardware: CPU, memories, Memory hierarchy, I/O devices, I/O interrupts, DMA, Firmware: BOIS, Software, Operating systems review and its roles, Types of operating systems, Time sharing, Concurrency, System programs, Operating system structures, Operating system components, Microkernel, System calls and APIs, Interrupts, General definitions: Buffering, resources, device management, device driver, caching, crash…etc.
2- **Process Management:** Processes, Process state diagram, Process control block (PCB), Context switch, Process scheduling, Queuing diagram, Schedulers, Types and operation of processes., Bounded-buffer problem.
3- **Threads:** Definition, Benefits, Types of threads, Multithreading models, Java threads, Java thread management, Java thread states, Producer-consumer problem.
4- **Scheduling and dispatch :** CPU-I/O burst cycle, Preemptive and non-preemptive scheduling, Dispatcher, Scheduling criteria, Multi-processor and multiple core scheduling.

5- **Process Synchronization:** Define the problem, Race condition, Critical section problem, Mutual exclusion, Semaphore, Starvation, Producer-consumer problem, Monitors.
6- **Deadlock:** Definition, Deadlock characterization, Necessary conditions, Resource allocation graph, Deadlock prevention, avoidance, and recovery. Process termination.
7- **Memory Management:** Address binding, Logical vs. physical address space, Static and dynamic loading and linking, Overlaying and swapping, paging, segmentation, fragmentation, Memory hierarchy.
8- **File systems:** Definition, attribute, types, access methods, Directory, Allocation methods, Consistency checking, Backup and restore, Disk management.
9- **Protection and Security:** Goals of protection, Domain of protection, Access matrix, Access control and rights, Cryptography, User authentication, Firewall.

Subject: Computer Networks I **Theoretical: 3 hrs/wk**
Code: CC406 **Practical: ---**
Class: 4th Year **Tutorial: ---**
Pre-requisite: **Units: 3**

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

Subject: Advanced Computer Architecture **Theoretical: 2 hrs/wk**
Code: CC408 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC303 **Units: 2**

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Introduction to Computer Architecture;
- Single-Instruction Single- Data Stream (SISD)
- Single-Instruction Multiple- Data Stream (SIMD)
- Multiple-Instruction Single- Data Stream (MISD)
- Multiple-Instruction Multiple- Data Stream (MIMD)

System Buses
- Bus design issues; Bus width, Bus type, Bus operations
- Synchronous bus; Bus operation, Wait states, Block transfer
- Asynchronous bus
- Bus arbitration; Dynamic bus arbitration, Implementation, Centralized, Distributed
- Example buses; ISA, PCI, AGP, PCI-X, PCMCIA

Processor Organization and Performance
- Number of addresses; 3-address machines, 2-address machines, 1-address machines, 0-address machines, Load/store architecture
- Flow control, Branching, Procedure calls, Delayed versions, Parameter passing
- Instruction set design issues; Operand types, Addressing modes, Instruction types, Instruction formats
- Microprogrammed control; Implementation issues
- Performance; Performance metrics, Execution time calculation, Means of performance, The SPEC benchmarks

The Pentium Processor
- Pentium family history
- Pentium processor details
- Pentium registers; Data, Pointer and index, Control, Segment
- Real mode memory architecture
- Protected mode memory architecture; Segment registers, Segment descriptors, Segment descriptor tables, Segmentation models
- Mixed-mode operation
- Default segment registers used

Pipelining and Vector Processing
- Basic concepts
- Handling resource conflicts
- Data hazards
- Handling branches
- Performance enhancements
- Example implementations; Pentium, PowerPC, SPARC, MIPS
- Vector processors; Architecture, Advantages, Cray X-MP, Vector length, Vector stride, Chaining
- Performance; Pipeline, Vector processing

Subject: Laboratories-7 **Theoretical: ---**
Code: CC410 **Practical: 6 hrs/wk**
Class: 4th Year **Tutorial: ---**
Pre-requisite: None **Units: 2**

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This course contains:

Computer Networks & Control Engineering Lab.	6 hrs/wk

4th Year/2nd Semester

Subject: Engineering Project II **Theoretical: 1 hr/wk**
Code: E402 **Practical: 3**
Class: 4th Year **Tutorial: ---**
Pre-requisite: Continuation of E401 **Units: 2**

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This is the continuation of engineering project I.

Subject: Industrial Engineering **Theoretical: 2 hr/wk**
Code: E403 **Practical: ---**
Class: 4th Year **Tutorial: ---**
Pre-requisite: **Units: 2**

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Introduction
Economic Study
Plant Location and Plant Layout
Production and Productivity
Work Study
The Assembly Line Balancing Problem
Scheduling
Inventory Control
Quality Control
Maintenance, Replacement and Reliability Theory
Workplace Health and Safety

Subject: Control Theory III **Theoretical: 3 hrs/wk**
Code: CC403 **Practical: ---**
Class: 4th Year **Tutorial: ----**
Pre-requisite: CC305, CC306 **Units: 3**

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1. Analysis of Control Systems in State Space: Mathematical modeling of dynamic systems in state space (Mechanical and Electric systems), transfer functions, Diagonalization, Eigen values and Eigenvector, determination of State Transition Matrix, solution of state equations, Carley -Hamilton Theorem, Controllability and Observability.
2. Design of Control Systems in State Space: Pole-placement, State observers (Full, reduced and minimum types), design of servo systems.
3. Liapunov Stability Analysis and Quadratic Optimal Control: Liapunov Stability analysis, Liapunov Stability analysis of LTI systems, Model reference control systems, quadratic optimal control
4. Non- linear systems:
Common physical nonlinearities, the phase plane methods, Singular points, stability of nonlinear systems, Construction of phase trajectories.
5. The describing function methods:
Basic concepts, derivation of describing functions for common non linearity's, stability analysis by Describing function approach, Jump resonance, Lyapunov stability criterion.

Subject: Principles of Robotics **Theoretical: 3 hrs/wk**
Code: CC405 **Practical: ---**
Class: 4th Year **Tutorial: ----**
Pre-requisite: CC305, CC306 **Units: 3**

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1. Introduction And Terminologies:
Definition-Classification-History- Robots components-Degrees of freedom-Robot joints coordinates- Reference frames-workspace-Robot languages-actuators-sensors Position, velocity and acceleration sensors-Torque sensors-tactile and touch sensors proximity and range sensors-social issues.
2. Kinematics:
Mechanism-matrix representation-homogenous transformation-DH representation Inverse kinematics-solution and programming-degeneracy and dexterity.
3. Differential Motion & Velocities:
Jacobian-differential motion of frames-Interpretation-calculation of Jacobian-Inverse Jacobian-Design-Lagrangian mechanics-dynamic equations-static force analysis.
4. Robot Control System:
Sensor characteristics- Hydraulic, Pneumatic and electric actuators-trajectory planning decentralized PID control- non-linear decoupling control.
5. Image Processing & Vision Systems:
Two and three dimensional images-spatial and frequency domain representation-noise and edges- convolution masks-Processing techniques-thresholding-noise reduction edge detection-segmentation-Image analysis and object recognition

Subject: Computer Networks II **Theoretical: 3 hrs/wk**
Code: CC407 **Practical: ---**
Class: 4th Year **Tutorial: ---**
Pre-requisite: CC406 **Units: 3**

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

Subject: Embedded Computing Systems **Theoretical: 2 hrs/wk**
Code: CC409 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC304 **Units: 2**

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1- **Embedded ARM microcontrollers:** ARM processor architecture, Software model, Addressing modes, programming instructions, Fundamental concepts of assembly language and linking: labels, address management.
2- **Microcontroller Hardware:** Microcontroller I/O pins, I/O programming and the direction register, Phased-lock loop, SysTick timer, Measurement of dynamic efficiency, Power management.
3- **Real-time operating systems:** Fundamental concepts.

4- **Interfacing and Communication:** Introduction to interfacing, Synchronous serial interface SSI, LCD interface, Scanned keyboard, I^2C interface, USB interface, High speed interfacing: Hardware FIFO, Dual-port memory, DMA controllers.
5- **Interrupt programming and real-time systems:** I/O synchronization, Interrupt concepts, Polled I/O vs. interrupt-driven I/O, Timer periodic interrupt, Ballast code timing, Multithreading.
6- **Analog I/O Interfacing:** Real-time data acquisition, 4~20mA signal standards.
7- **Networked embedded systems:** Networked embedded systems, Network topologies: ring, bus, multi-hop. Wireless communication, Internet-enabled embedded systems.
8- **High speed networks:** Fundamentals, CAN, Ethernet, Internet of Things.

Subject: Laboratories-8 **Theoretical: ---**
Code: CS408 **Practical: 6 hrs/wk**
Class: 4th Year **Tutorial: ---**
Pre-requisite: None **Units: 2**

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This course contains two laboratories:

Real time, Computer Networks & Control Engineering Lab. 6 hrs/wk

Electives: 2 Subjects from 10 Subject titles

Subject Code	*Subject Title*	*Units*	*Weekly hours*		
			Th.	*Prac.*	*Tut.*
CC412	*Adaptive Control*	*2*	*2*	*-*	*1*
CC413	*Nonlinear Control*	*2*	*2*	*-*	*1*
CC414	*Optimal Control & Filtering*	*2*	*2*	*-*	*1*
CC415	*Biomedical Engineering*	*2*	*2*	*-*	*1*
CC416	*Introduction to Nanotechnology*	*2*	*2*	*-*	*1*
CC417	*Mechatronics*	*2*	*2*	*-*	*1*
CC418	*Electrical Transportation Systems*	*2*	*2*	*-*	*1*
CC419	*Electrical Design & Sustainability*	*2*	*2*	*-*	*1*
CC420	*Industrial Automation*	*2*	*2*	*-*	*1*
CC421	*Process Control*	*2*	*2*	*-*	*1*

Subject: Adaptive Control **Theoretical: 2 hrs/wk**
Code: CS412 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC305, CC306 **Units: 2**

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Introduction.

Adaptive Control and Adaptation Techniques:

Introduction – Uses – Auto tuning – Self Tuning Regulators (STR) – Model Reference Adaptive Control (MRAC) – Types of STR and MRAC – Different approaches to self-tuning regulators – Stochastic Adaptive control – Gain Scheduling.

Case Studies:

Inverted Pendulum, Robot arm, process control application: heat exchanger, Distillation column, application to power system, Ship steering control.

Subject: Nonlinear Control **Theoretical: 2 hrs/wk**
Code: CC413 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC305, CC306 **Units: 2**

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Phase Plane Analysis:

Concepts of phase plane analysis- Phase portraits- singular points- Symmetry in phase plane portraits-Constructing Phase Portraits- Phase plane Analysis of Linear and Nonlinear Systems- Existence of Limit Cycles.

Describing Function:

Describing Function Fundamentals-Definitions-Assumptions-Computing Describing

Functions-Common Nonlinearities and its Describing Functions-Nyquist Criterion and its Extension-Existence of Limit Cycles-Stability of limit Cycles.

Lyapunov Theory:

Nonlinear Systems and Equilibrium Points-Concepts of Stability-Linearization and Local Stability-Lyapunov's Direct Method-Positive definite Functions and Lyapunov Functions Equilibrium Point Theorems-Invariant Set Theorems-LTI System Analysis based on Lyapunov's Direct Method-Krasovski's Method-Variable Gradient Method-Physically – Control Design based on Lyapunov's Direct Method.

Feedback Linearization:

Feedback Linearization and the Canonical Form-Mathematical Tools-Input-State Linearization of SISO Systems- input-Output Linearization of SISO Systems-Generating a Linear Input-Output Relation-Normal Forms-The Zero-Dynamics-Stabilization and Tracking-Inverse Dynamics and Non-Minimum-Phase Systems-Feedback Linearization of MIMO Systems Zero-Dynamics and Control Design.

Sliding Mode Control:

Sliding Surfaces- Continuous approximations of Switching Control laws-The Modeling/Performance Trade-Offs-MIMO Systems.

Subject: Optimal Control & Filtering **Theoretical: 2 hrs/wk**
Code: CC414 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CS305, CS306 **Units: 2**

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1. Introduction:

Statement of optimal control problem – Problem formulation and forms of optimal Control – Selection of performance measures. Necessary conditions for optimal control – Pontryagin's minimum principle – State inequality constraints – Minimum time problem.

2. LQ Control Problems and Dynamic Programming:

Linear optimal regulator problem – Matrix Riccatti equation and solution method – Choice of weighting matrices – Steady state properties of optimal regulator – Linear tracking problem – LQG problem – Computational procedure for solving optimal control problems – Characteristics of dynamic programming solution – Dynamic programming application to discrete and continuous systems – Hamilton Jacobi Bellman equation.

3. Numerical Techniques for Optimal Control:

Numerical solution of 2-point boundary value problem by steepest descent and Fletcher Powell method solution of Ricatti equation by negative exponential and interactive Methods

4. Filtering and Estimation:

Filtering – Linear system and estimation – System noise smoothing and prediction – Gauss Markov discrete time model – Estimation criteria – Minimum variance estimation – Least square estimation – Recursive estimation.

5. Kalman Filter and Properties:

Filter problem and properties – Linear estimator property of Kalman Filter – Time invariance and asymptotic stability of filters – Time filtered estimates and signal to noise ratio improvement – Extended Kalman filter.

Subject: Biomedical Engineering **Theoretical: 2 hrs/wk**
Code: CC415 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC305, CC306 **Units: 2**

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Cell and its structure – Action and resting potential - Propagation of action potential – Sodium pump –Nerve cell – Synapse –Different systems of human body- Cardio pulmonary system – Physiology of heart and lungs – Circulation and respiration – Man instrument system. Electrodes Different types, Safety instrumentation-Radiation safety instrumentation-Physiological effects due to 50 Hz, current passage- Microshock and macroshock-Electrical accidents in hospitals-Devices to protect against electrical hazards-hospital architecture
Bio potential Recorders - Characteristics of recording system – Electrocardiography – Conducting system of heart - ECG lead configuration - Analysis of ECG signals - Heart sounds - Phonocardiography - Electroencephalography (EEG) - Placement of electrodes in EEG - Analysis of EEG – Electromyography - Electroretinography and Electrooculography Physiological Assist Devices- Pacemakers-Different modes of operation- Pacemaker batteries Artificial heart valves- Defibrillators –Different types- Heart Lung machine - Oxygenators Blood pumps- Kidney machine-Dialysis-Hemodialysis- Peritonial dialysis Blood pressure measurement (invasive and noninvasive)
Operation Theatre Equipment- Surgical Diathermy- Short wave diathermy-Microwave diathermy- Ultrasonic diathermy-Therapeutic effects of heat-Range and area of irritation of different diathermy techniques-Ventilators- Anesthesia machine- Blood flow meter-Pulmonary function analyzers-Lung volumes and capacities- Gas analyzer- Oximeters-Elements of intensive care monitoring
Advances in Biomedical Instrumentation-X-ray tube-X-ray machine - Radio graphic and fluoroscopic techniques – Computer tomography – Block diagram of CT machine-Applications of CT- Ultrasonic imaging-Modes of display-US imaging instrumentation-Applications of US Magnetic Resonance Imaging- MRI instrumentation- Thermography-Block diagram of the thermographic equipment- Medical applications of thermography-LASER in Medicine–LASER instrumentation-Photo thermal and photochemical applications of LASERS

Subject: Introduction to Nanotechnology **Theoretical: 2 hrs/wk**
Code: CC416 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: **Units: 2**

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Introduction: Background and definition of Nanotechnology, Top-down & Bottom -up approaches to nanotechnology, Major Fields of nanotechnology.
Properties of Nanoscale structure: Brief idea about Crystal structure and defects, Solid disorder Nanostructure (Failure mechanism of conventional grain sized materials, Its different properties, Metal Nanocluster composite, poros Silicon), Effect of size dependence on electrical properties, Magnetic properties, Mechanical properties (Hall-Petch relation), Chemical properties.

Quantum Well, Wires, Dots : Preparation of Quantum nanostructure, quantum size effect, Conduction Electrons And Dimensionality, Femi gas and Density of states, Potential well, Partial confinement, Properties Dependent on Density of states, Excitons Single electron tunneling, Applications (Infra-red detectors, Quantum dot laser), Spintronic.
Carbon Nanotubes: Introduction, fabrications Structure, Electrical properties, Mechanical properties, Vibrational properties, Applications of CNT.
Technique of Nanomaterials Fabrication & Methods of measuring properties: Mechanical & Chemical approaches, (Inort gas Condensation, high energy ball miling, Sol-gel, Pulse Laser deposition, Chemical vapor deposition), Brief discussion of Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-ray Diffraction (XRD).
Nano machines: Microelectromechanical System (MEMSs): Introduction to Micro/Nano sensor and actuator, Materials and Fabrication (Oxidation on Si, Lithography, Photoresist, and Etching) surface micro/nanomachining.
Introduction to Nanomedicine: (Medical Applications of Nanomaterials: drug delivery, Cancer, Surgery, Nano robots, Cell repair etc.)

Subject: Mechatronics **Theoretical: 2 hrs/wk**
Code: CC417 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: **Units: 2**

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Introduction to Mechatronics System: Key elements – Mechatronics Design process – Design Parameters – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.
System Modelling: Introduction-model categories-fields of application-model development-model verification-model validation-model simulation-design of mixed systems-electro mechanics design-model transformation- domain-independent description forms-simulator coupling.
Real Time Interfacing: Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Lab view Environment and its applications, Vim-Sim Environment & its applications -Man machine interface.
Case Studies On Mechatronic System: Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C. Motor & Solenoids – Engine management systems.– Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing
Micro Mechatronic System: Introduction- System principle - Component design – System design – Scaling laws – Micro actuation – Micro robot – Micro pump – Applications of micro mechatronic components.

Almaaqal University
College of Engineering
Department of Control & Computer Engineering

Subject: Electrical Transportation Systems **Theoretical: 2 hrs/wk**
Code: CC418 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: **Units: 2**

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General Review of Transportation:
Need and importance of mobility, various modes of transportation, evolution of transportation system, Horse carriages to steam engines to internal combustion engines to electric vehicles, advantages and disadvantages of electric mobility, various application of electric mobility such as electrical traction, hybrid electric and electric vehicles, elevators, personal mobility and special applications such as wheel chairs, future concepts.

EV- Basic Building Blocks:
Various sources of energy used in transportation and their characteristics, Conventional vehicle power transmission systems. Energy conversions module integrations and their operation. Different types of Batteries & their operation. Types of batteries, their characteristics, charging and discharging of batteries, round trip efficiency, ability to deliver instantaneous power, load cycle and its effect on battery performance, environmental impact of batteries, power quality issues related to charging of batteries. Different load characteristics (Specifically road characteristics)

Power module & Energy converters:
Need for power converters, basic power electronic blocks, AC/DC, DC/DC, DC/AC modules. Types of mechanical drives, conversion of electrical energy into mechanical energy, characteristics of various types of drives, BLDC machines, AC machines, DC machines, mechanical drive / power train

Control system and instrumentation:
Function of instrumentation and control system, speed control, acceleration characteristics, mechanical steering versus electric steering, motion control, driverless vehicles, road safety and traffic control and monitoring, emerging trends

Electric cars:
Emerging trend, typical power train architecture, hybrid cars, acceleration and speed characteristics.

Traction:
Introduction to Modern AC traction for high speed rail application, their control and performance under different operating conditions. Comparison of AC/DC traction.

Elevators:
Load characteristics of elevator systems, Introduction to control schemes in elevators with new power-electronics controlled drives, considerations for energy efficient systems. Special vehicles, basic concepts and emerging trend.

Subject: Electrical Design & sustainability **Theoretical: 2 hrs/wk**
Code: CC419 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: None **Units: 2**

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Definitions, Regulations and Standards: Basic design concepts, IEE wiring regulations, National Electrical Code (NEC), national & international standards, Iraqi wiring Installation Code, Iraqi Specification of Electrical Equipment, graphical electrical symbols for architectural plans.

Interior Lighting Design: Definition of terms, lamp types, light fittings, mounting methods, fitting layout, photometric data, lighting calculations, economic considerations. Computer aided lighting design.

Wiring Methods & Regulations: Light and power circuit wiring, circuit loading, conduit types, switches, socket outlets, telephone outlets, junction boxes, low-voltage circuit protection, fuses and miniature circuit breakers, cable routes, cable trays.

Main Sub-main and Final Distribution Boards: Selection and sizing of main, sub-main, & final distribution boards, board location.

Specifications and Bill of Quantities: Preparation of electrical specifications and bill s of quantities for contract documents. Sustainability features consideration in electrical design

Subject: Industrial Automation **Theoretical: 2 hrs/wk**
Code: CC420 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC312 **Units: 2**

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Introduction to Industrial Automation 2 hrs

Sensors and Actuators: 9 hrs

HMI Configuration and Programming: 6 hrs

Screen designing, control and monitoring, PLC and HMI networking, interfacing of PLC with HMI.

Electric Drives: 6 hrs

VFD, servo drive, and stepper drive

An Introduction to DCS System: 4 hrs

Introduction and definition of DCS, fundamental principles of modern DCS systems and architectures.

SCADA Systems: **10 hrs**

Introduction, definitions and history of Supervisory Control and Data Acquisition, typical SCADA system Architecture, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, Second generation - Distributed, Third generation – Networked Architecture), SCADA applications.

SCADA Protocols **8 hrs**

Open systems interconnection (OSI) Model, TCP/IP protocol, DNP3 protocol, IEC61850 layered architecture, Control and Information Protocol (CIP), Device Net, Control Net, Ether

Net/IP, Flexible Function Block process (FFB), Process Field bus (Profibus). Interfacing of SCADA with PLC.

Subject: Process Control **Theoretical: 2 hrs/wk**
Code: CC421 **Practical: ---**
Class: 4th Year **Tutorial: 1 hrs/wk**
Pre-requisite: CC305, CC306 **Units: 2**

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Process Control System: Terms and objectives, piping and Instrumentation diagram, instrument terms and symbols. Regulator and servo control, classification of variables. Process characteristics: Process equation, degrees of freedom, modeling of simple systems – thermal, gas, liquid systems. Process lag, load disturbance and their effect on processes. Self-regulating processes, interacting and non-interacting processes.
Controller modes: Basic control action, two position, multi-position, floating control modes. Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, PD, P-I-D, Integral wind-up and prevention. Auto/Manual transfer, Bumpless transfer. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature and flow.
Controller tuning Methods: Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method, continuous oscillation method, damped oscillation method. Auto tuning. Closed loop response of I & II order systems, with and without valve, measuring element dynamics.
Final control elements: Pneumatic control valves, construction details, types, various plug characteristics. Valve sizing. Selection of control valves. Inherent and installed valve characteristics. Cavitation and flashing in control valves. Valve actuators and positioners. Instrument air supply specifications.
Advanced control system: Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, interaction of control loops.
Case Studies: Distillation column, boiler drum level control and chemical reactor control.