Ninevah University
جامعة نينوى

First Cycle – Bachelor's Degree (B.Sc.) – Systems and Control Engineering

بكالوريوس - هندسة النظم والسيطرة

Table of Contents

1. Overview

This catalogue is about the courses (modules) given by the program of Systems and Control Engineering to gain the Bachelor of Science degree. The program delivers (47) Modules with (6000) total student workload hours and 240 total ECTS. The module delivery is based on the Bologna Process.

نظره عامه

يتناول هذا الدليل المواد الدراسية التي يقدمها برنامج هندسة النظم والسيطرة للحصول على درجة بكالوريوس العلوم. يقدم البرنامج (47) مادة دراسية، على سبيل المثال، مع (٦٠٠٠) إجمالي ساعات حمل الطالب و ٢٤٠ إجمالي وحدات أوروبية. يعتمد تقديم المواد الدراسية على عملية بولونيا.

2. Undergraduate Courses 2023-2024

Module 1

Code	Course/Module Title	ECTS	Semester
NVEE206	Mathematics I	6	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	1	63	87
Description			
This calculus course for first-year control engineering students provides a comprehensive foundation in calculus concepts and their practical applications. The course covers topics such as vectors, complex numbers, matrices, determinants, and differentiation techniques including the chain rule and implicit differentiation. Students will develop proficiency in differentiating trigonometric, exponential, logarithmic, and inverse trigonometric functions. The course also delves into definite integration and its applications in finding areas, volumes, and lengths. Emphasis is placed on problem-solving, critical thinking, and the ability to apply calculus principles to engineering scenarios. Through interactive classes, tutorials, and hands-on experiments, students will engage actively, refine their critical thinking skills, and gain a deeper understanding of calculus concepts relevant to control engineering.			

Module 2

Code	Course/Module Title	ECTS	Semester
NVEE215	DC Circuits Analysis	7	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	3	92	83
Description			
The analysis of electrical circuits is summarized by the ability to use the basic laws, namely Ohm's law and Kirchhoff's law for current and voltage, and applying them to circuits in order to find the current of any branch or the voltage difference for any element in the circuit, including calculating the supplied and consumed power for all circuit elements, in addition to understanding the theories derived from the two basic laws above To analyze circuits such as Theven and Norton theory and other theories and to understand the difference between DC circuits and alternating current circuits in analysis and the close relationship between frequency, impedance calculation and phase difference on the one hand and the power factor and real power on the other hand and how to improve the power factor. In addition to understanding the transient state and the time constant of circuits of the first degree. Finally, a bility to use the best methods for any problem in the live.			

Module 3

Code	Course/Module Title	ECTS	Semester
NVEESC301	Physics of Semiconductors	6	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	77	73
Description			
The Solid-State Physics Module offers dedicated features for the analysis of III-V semiconductor device basic operation at the fundamental physics level for modern microelectronics. The following topics are covered in this module: charge carrier statistics and carrier transport mechanism, electron-hole electrical properties, and a variety of common electronic/optoelectronic device types, including PN-Junction, Zener diodes, Light-Emitting Diodes (LEDs), their structure and characteristics, Solar cell, and more. This course also covers Bipolar Junction Transistors (BJTs) and Field-Effect Transistors (FETs) with their structure, modes and characteristics. These provide students with great opportunities to develop a strong foundation in electronic/optoelectronic devices and integration technology and link this knowledge with upcoming courses in the ensuing study years.			

Module 4

Code	Course/Module Title	ECTS	Semester
NVU10	Computer I	3	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	62	13
Description			
The Computer Fundamentals and Programming module provides a comprehensive introduction to the fundamental concepts and principles of computer systems. Students will explore the basic components of a computer system, including hardware, software, input/output devices, and storage systems. They will gain an understanding of the underlying architecture and functionality of a computer, as well as the role of operating systems in managing resources and facilitating user interaction. Throughout the module, students will gain knowledge of common software applications such as word processors, presentation, and spreadsheets software. In this module, students will be introduced to the basics of computer security, including common threats, vulnerabilities, and best practices for securing computer systems. Students will explore the basics of using the Internet and Web Browsers. By the end of this module, students will have a solid grasp of programming principles such as Programming languages history, program development steps, and classification of Programming languages.			

Module 5

Code	Course/Module Title	ECTS	Semester
NVEESC302	Engineering Mechanics (Statics)	6	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	1	63	87
Description			
Engineering mechanics, with its two branches, static and dynamic, is a very extensive topic that engineers need in all engineering specialties. Statics is branch of engineering mechanics that study the states of bodies under the effect of forces at rest. The study of statics leads to Understanding the laws, theories, and basic concepts related to forces and moments applied on bodies. As well as give detailed knowledge of equilibrium, its conditions, mathematical laws and applications, how to model the effect of forces and construction of free-body diagrams. Also learn in detail how to analyze engineering structures in all its branches and learn how to analyze them, and learn in detail about the principles of friction between contacting surfaces, and also learn how to find the centers of bodies, and learn how to find the moment of inertia of areas and masses in detail.			

Module 6

Code	Course/Module Title	ECTS	Semester
NVU12	Democracy and Human Rights	2	1
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	0	33	17
Description			

Module 7

Code	Course/Module Title	ECTS	Semester
NVEE207	Mathematics II	6	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	1	63	87
Description			
This second-semester course in System and Control Engineering focuses on advanced topics in calculus. Students will delve into methods of integration, including trigonometric substitutions, partial fractions, and integration by parts. They will also explore vector calculus principles, such as the del operator, gradient, divergence, and curl, and their application in system and control engineering. The course covers polar and cylindrical coordinate systems, enabling students to graph functions in these coordinates. Additionally, the study of sequences and series includes convergence tests and the analysis of alternating series. Power series and Taylor series expansions are introduced for function approximation. Through problem-solving exercises and real-world applications, students will develop critical thinking and problem-solving skills, preparing them to apply calculus concepts to complex engineering problems in system and control engineering.			

Module 8

Code	Course/Module Title	ECTS	Semester
NVEE216	AC Circuits Analysis	7	2

Class (hr/w)	Lect/Lab./Prac./Tutor	SSWL (hr/sem)	USWL (hr/w)
3	3	92	83

Description

The analysis of electrical circuits is summarized by the ability to use the basic laws, namely Ohm's law and Kirchhoff's law for current and voltage, and applying them to circuits in order to find the current of any branch or the voltage difference for any element in the circuit, including calculating the supplied and consumed power for all circuit elements, in addition to understanding the theories derived from the two basic laws above To analyze circuits such as Theven and Norton theory and other theories and to understand the difference between DC circuits and alternating current circuits in analysis and the close relationship between frequency, impedance calculation and phase difference on the one hand and the power factor and real power on the other hand and how to improve the power factor.
In addition to understanding the transient state and the time constant of circuits of the first degree.
Finally, a bility to use the best methods for any problem in the live.

Module 9

Code	Course/Module Title	ECTS	Semester
NVEESC303	Engineering Mechanics (Dynamics)	4	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	1	63	37

Description

Engineering mechanics, with its two branches, static and dynamic, is a very extensive topic that engineers need in all engineering specialties.
Dynamics is branch of engineering mechanics that study the states of bodies under the effect of forces at irregular motion. It is divided into two branches, kinematics which study the motion without reference to the forces that cause it, and kinetics which study the action of forces on bodies to their resulting motions. The study of dynamics leads to understanding the laws and theories related to the motion of bodies by the action of the forces that applied to them. As well as knowing the types, forms and characteristics of the motions generated on bodies and classifying their vocabulary (location, displacement, distance, velocity, speed, acceleration, time). Also knowing the relationship between the vocabulary of motion and the possibility of representing it graphically. And knowing the relationship between (force, mass, displacement, and velocity) and how to derive (work, energy, power, efficiency, momentum, impulse, and impact).

Module 10

Code	Course/Module Title	ECTS	Semester

NVEESC304	Computer Programming	5	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	77	48
Description			
The C++ Programming module provides a comprehensive introduction to the C++ programming language, emphasizing its key features, syntax, and best practices. This module serves as a foundation for students pursuing careers in system programming, or other fields that require knowledge of C++. Students will start by learning the basics of C++, including variables, data types, control structures, functions, and arrays. students will gain a comprehensive understanding of programming languages and specifically the features and advantages of C++. They will learn to write and execute simple C++ programs, understand the syntax and structure of C++ programs, differentiate between data types, and effectively use variables, constants, and data types in their programs. By the end of this module, students will have a strong foundation in C++ programming, including understanding programming concepts, designing algorithms, working with variables and data types, making decisions using selection statements, implementing loops, manipulating arrays, and using functions effectively.			

Module 11

Code	Course/Module Title	ECTS	Semester
NVEESC331	Digital Design	4	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	77	23
Description			
The Digital Techniques module is designed to provide students with a comprehensive understanding of digital technologies and their applications. The module covers a wide range of topics related to digital techniques, including logic gates, digital circuits, Boolean algebra, digital systems, and data transmission. Throughout the module, students will learn digital techniques' fundamental principles and concepts. They will explore the building blocks of digital systems, such as logic gates, flip-flops, and registers, and understand how these components are interconnected to create complex digital circuits. The module also introduces students to Boolean algebra, which is essential for designing and analyzing digital systems. In addition to theoretical concepts, the module emphasizes practical skills and applications. Students will have the opportunity to work with digital design software and hardware tools to implement and simulate digital circuits. They will learn about various digital technologies, such as multiplexers, decoders, and encoders, and understand their functions and applications.			

Module 12

Code	Course/Module Title	ECTS	Semester
NVU11	English I	2	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	0	33	17
Description			

Module 13

Code	Course/Module Title	ECTS	Semester
NVU16	Arabic I	2	2
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	0	33	17
Description			

Module 14

Code	Course/Module Title	ECTS	Semester
NVEE208	Engineering Analysis I	5	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	48	77
Description			
The Engineering Analysis I module provides students with a solid foundation in fundamental mathematical concepts and techniques essential for engineering applications. This module aims to develop students' analytical and problem-solving skills through the study of topics such as calculus, and ordinary differential equations.			

Module 15

Code	Course/Module Title	ECTS	Semester
NVEE210	Signals & Systems	5	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	77	48
Description			
This module introduces the characteristics and properties of signals and systems and provide fundamental tools for their analysis and representation. The module will elaborate on signal representations: continuous and discrete signals; Elementary signals: unit impulse, unit step, real exponential, sinusoids, complex exponential signals; Transformations of the independent variable: time-reversal, time-shift, time-scaling; Periodicity of signals: periods and fundamental period, frequency; Harmonically related signals in CT and DT; Fourier series representation of periodic signals in CT and DT: definitions and properties; Fourier Transform of CT signals: definitions and properties; Time and Frequency domain representations of signals: duality; Systems properties: linearity, causality, time-invariance, memory, stability; LTI systems: impulse response and frequency response; Introduction to filtering and modulation.			

Module 16

Code	Course/Module Title	ECTS	Semester
NVEESC305	Control I	6	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	77	73
Description			
The Control I module provides students with a comprehensive introduction to the field of control engineering, covering essential topics and techniques. The module begins with an overview of control engineering principles, introducing students to the fundamental concepts and terminology used in the field. Students then delve into the basics of control systems, studying the various components and their interconnections. The module explores block diagram reduction, a crucial technique for simplifying complex control system representations. Additionally, students learn about signal flow graphs, an alternative method for analyzing and designing control systems. The module also covers the time response of control systems, focusing on understanding how systems behave over time when subjected to different inputs. Students gain insights into system stability, studying			

the factors that affect the stability of control systems and the methods for analyzing and ensuring stability. Furthermore, the module introduces students to the concept of root locus, a graphical method for analyzing the behavior of control systems in the frequency domain. Students learn how to construct root locus plots and interpret them to gain insights into system dynamics and stability.
Overall, the Control Engineering Analysis module equips students with a solid foundation in control engineering, enabling them to analyze and design control systems effectively.

Module 17

Code	Course/Module Title	ECTS	Semester
NVEESC306	Matlab Programming	3	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	62	13
Description			
MATLAB (short for Matrix Laboratory) is a programming environment and language widely used for numerical computation, data analysis, and algorithm development. It provides a comprehensive set of tools and functions for solving a wide range of mathematical problems, including linear algebra, optimization, signal processing, image processing, and more. The course provides a gentle introduction to the MATLAB computing environment, and is intended for beginning users and those looking for a review. It is designed to give students a basic understanding of MATLAB. The course consists of interactive lectures and sample MATLAB problems discussed in class. No prior programming experience or knowledge of MATLAB is assumed. Concepts covered include basic use, graphical representations and tips for designing and implementing MATLAB code.			

Module 18

Code	Course/Module Title	ECTS	Semester
NVEE212	Analog Electronics I	6	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	77	73
Description			
The study of analog electronics aims to understand the composition of the bipolar transistor, its working areas, and the types of circuits by which we get the best working point in the active area, in addition to how to analyze the circuits after drawing the continuous and alternating equivalent to determine the type of amplifier, the value of the voltage and current gain of the amplifier, calculate the input and output impedance, and determine the general characteristics of each They are common emitter amplifiers, common base amplifiers, and finally common collector amplifiers. In addition to understanding the impact of the load on the efficiency of each type of amplifiers and the desired benefit from using the multiple stages of the amplifiers. Finally, the effect of frequency on circuit gain and how to calculate the bandwidth.			

Module 19

Code	Course/Module Title	ECTS	Semester
NVU13	Crimes of the Baath regime in Iraq	2	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	0	33	17
Description			

Module 20

Code	Course/Module Title	ECTS	Semester
NVU18	Computer II	3	3
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	0	62	13
Description			

Module 21

Code	Course/Module Title	ECTS	Semester
NVEE209	Engineering Analysis II	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	47	78
Description			

The Engineering Analysis II module builds upon the foundation established in Engineering Analysis I and focuses on advanced mathematical concepts and techniques applicable to engineering problems. This module aims to deepen students' understanding of mathematical analysis and equip them with additional tools for modeling, analyzing, and solving complex engineering systems.

Module 22

Code	Course/Module Title	ECTS	Semester
NVEESC309	Control II	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	77	48

Description

The Control II module provides students with a comprehensive understanding of frequency response analysis in control engineering. The module begins with an introduction to frequency response, highlighting its significance in analyzing the behavior of control systems in the frequency domain.
To ensure a strong foundation, the module also includes a review of some basic skills essential for control engineering analysis. This review covers important concepts such as transfer functions, poles and zeros, and the Laplace transform.
Students then dive into the Bode plot, a graphical representation of the frequency response of a system. The module explores Bode analysis, teaching students how to interpret Bode plots and extract crucial information about system characteristics, such as gain, phase shift, and resonance.
The module also covers the rules and steps involved in sketching a Bode plot, providing students with practical skills to analyze and design control systems using this method. Students learn about frequency domain specifications, which define the desired performance criteria for a control system in terms of its frequency response.
Moreover, the module addresses frequency response stability, examining the criteria for ensuring stability based on the system's frequency response. Students gain insights into finding the gain margin and phase margin from a system's transfer function, which are important indicators of stability and robustness.
By the end of the module, students will have a solid understanding of frequency response analysis, equipped with the skills necessary to design and evaluate control systems in the frequency domain.

Module 23

Code	Course/Module Title	ECTS	Semester

NVEE213	Analog Electronics II	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	77	48
Description			
The study of analog electronics aims to understand the structure of the three types of field effect transistors and how to design circuits through which we get a working point within the linear region for the transistor to work as an amplifier. In addition to analyzing the circuits after drawing the continuous and alternating equivalent to find the gain value, calculating the input and output impedance of the circuit, understanding the basic specifications for each type of amplifiers of their three types, the common drain, the common source, and the common gate, and finally calculating the amplifier's bandwidth and calculating the cut-off frequencies.			

Module 24

Code	**Course/Module Title**	**ECTS**	**Semester**
NVEESC311	Measurement and Sensors	4	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	48	52
Description			
The aim of the module is to provide a thorough grounding in the principles, technology and practices of measurement, with an emphasis on the specification, installation and operation of the common types of instrumentation (including sensors and actuators) used in the process industries. The intent is to develop an awareness of the principles of measurement and instrument characteristics. Also, it is important for the student to become familiar with the operation and use of a variety of filters. Furthermore, to realize the operation principle of several sensors and recognize the key issues in selecting the right instrument. Finally, this course helps students to understand modern signal transmission techniques and relevant standards and become aware of the sampling theorem, ADC and DAC.			

Module 25

Code	**Course/Module Title**	**ECTS**	**Semester**
NVEESC312	Machines	5	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	77	48
Description			

The machines module is a comprehensive and fundamental component of many engineering and technical courses. It provides students with essential knowledge of atypical types of machines and their applications. This module covers a wide range of topics related to machines, including principles of operation, construction, performance characteristics, and control techniques.

Students learn about various machine types such as motors, generators, and transformers in the machines module. They delve into the working principles, design considerations, and practical applications of these machines. Additionally, the module explores topics like efficiency, power factor, and torque.

Through theoretical lectures, practical experiments, and hands-on activities, students gain the knowledge and skills required to analyze and troubleshoot different types of machines. They become proficient in interpreting machine performance curves, calculating losses, selecting appropriate machine types for specific applications, and optimizing their operation.

Module 26

Code	Course/Module Title	ECTS	Semester
NVEE201	Engineering Drawing	2	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	3	33	17

Description

AutoCAD is a computer-aided design (CAD) software developed by Autodesk. It is widely used in various industries such as architecture, engineering, and manufacturing to create precise 2D and 3D designs and technical drawings.
AutoCAD provides a comprehensive set of tools and features that allow users to create, modify, and document their designs with great accuracy and efficiency. The software offers a user-friendly interface and supports both command-line and graphical interaction, making it accessible to users with different levels of expertise.
With AutoCAD, designers can create geometric shapes, lines, and curves using basic drawing tools or by inputting precise dimensions. The software also enables the creation of complex 3D models by extruding, revolving, or lofting 2D profiles.
AutoCAD facilitates the creation of detailed technical drawings by providing tools for dimensioning, annotation, and hatching. Users can add text, symbols, and labels to communicate important information about the design. The software supports the creation of multi-sheet drawings and the organization of design data through layers, which allow for efficient management and control over different elements of the drawing.

Module 27

Code	Course/Module Title	ECTS	Semester
NVU15	English II	2	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**

1	0	33	17
Description			

Module 28

Code	**Course/Module Title**	**ECTS**	**Semester**
NVU17	Arabic II	2	4
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
1	0	32	18
Description			

Module 25

Code	Course/Module Title	ECTS	Semester
NVEESC313	System Modeling	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	44	81
Description			
The system modeling course is a comprehensive and practical program designed to equip students with the knowledge and skills necessary to analyze and simulate complex systems. This course introduces students to various modeling techniques and tools used to represent real-world systems, such as mechanical, electrical, electromagnetic, and fluid systems. Throughout the course, students learn how to identify system components, define their interactions, and capture their behavior using mathematical equations. By the end of the module, students will have a solid understanding of system modeling methodologies and be proficient in developing accurate and efficient models to address complex real-world problems.			

Module 26

Code	Course/Module Title	ECTS	Semester
NVEE214	Digital Control	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	51
Description			
Automatic control is the science that develops techniques to steer, guide, control dynamic systems. These systems are built by humans and must perform a specific task. Examples of such dynamic systems are found in biology, physics, robotics, finance, etc. Digital Control means that the control laws are implemented in a digital device, such as a microcontroller or a microprocessor. Such devices are light, fast and economical. The use of digital computers in the control systems yields the following advantages over analog control systems: - Reduced cost. - Flexibility in response to design changes. - Noise immunity. - Digital control systems are more suitable for Modern control systems. The digital computer (or micro-Controller, microprocessor) receives the error or only the reference signal and performs calculations (program) in order to improve the tracking performance for complex systems. The points that will be examined in these lecture notes are the following: - Transformation of an already designed continuous-time controller into a discrete-time controller. - Discretization of continuous systems. - Direct synthesis of discrete-time control systems. - Practical considerations and precautions when implementing a digital controller.			

Module 27

Code	Course/Module Title	ECTS	Semester
NVEE204	Digital Signal Processing I	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	74	51
Description			
The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Topics include sampling, impulse response, frequency response, finite and infinite impulse response systems, linear phase systems, digital filter design and implementation, discrete-time Fourier transforms, discrete Fourier transform, and the fast Fourier transform algorithms.			

Module 28

Code	Course/Module Title	ECTS	Semester
NVEESC314	PLC I	5	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	74	51
Description			
The aim of studying Programmable Logic Controllers (PLCs) for undergraduate control engineers is to develop a strong foundation in industrial automation and control systems. PLCs are widely used in various industries to automate processes, control machinery, and monitor systems. By studying PLCs, control engineers gain essential skills and knowledge that are crucial for their professional development. In other words, provides a solid foundation in industrial automation, programming, system integration, troubleshooting, and safety. These skills are essential for successfully working with control systems in various industries and contribute to the efficient and reliable operation of automated processes. Thus Understanding Automation Principles and programming skills are the main key elements for the market needs for control engineers to integrate PLC with the manufacturing processes and systems.			

Module 29

Code	Course/Module Title	ECTS	Semester

NVEESC315	Control Systems Design	6	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	3	88	62
Description			
The objective of control system design is to construct a system that has a desirable response to standard inputs. A desirable transient response is sufficiently fast without excessive oscillations. A desirable steady-state response follows the desired output with sufficient accuracy. The closed-loop poles are the roots of the characteristic equation. Finding the roots of the characteristic equation of a degree higher than 3 is laborious and will need a computer solution and MATLAB provides a simple solution to this problem. By using the root-locus method the designer can predict the effects on the location of the closed-loop poles by varying the gain value or adding open-loop poles and/or open-loop zeros. Therefore, it is desired that the designer has a good understanding of the method for generating the root loci of the closed-loop system, both by hand and by use of a computer software program like MATLAB. By the term frequency response, we mean the steady-state response of a system to a sinusoidal input. In frequency-response methods, we vary the frequency of the input signal over a certain range and study the resulting response. Although the frequency response of a control system presents a qualitative picture of the transient response, the correlation between frequency and transient responses is indirect, except for the case of second-order systems. In designing a closed-loop system, we adjust the frequency-response characteristic of the open-loop transfer function by using several design criteria in order to obtain acceptable transient-response characteristics for the system. It is interesting to note that more than half of the industrial controllers in use today are PID controllers or modified PID controllers. Also, automatic tuning methods have been developed and some of the PID controllers may possess on-line automatic tuning capabilities.			

Module 30

Code	Course/Module Title	ECTS	Semester
NVEE202	Industrial Management and Ethics	4	5
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	0	30	70
Description			
The module "Ethics and Industrial Management" explores the intersection of ethics and the field of industrial management. It delves into the ethical considerations and challenges that arise in the industrial sector, focusing on topics such as responsible business practices, corporate social responsibility, and ethical decision-making in managerial roles. The module aims to equip students with the knowledge and skills to navigate ethical dilemmas commonly encountered in industrial settings. Through case studies, discussions, and practical exercises, students gain a deeper understanding of the ethical implications of managerial decisions, organizational behavior, and the impact of industrial practices on various stakeholders, including employees, customers, communities, and the environment. Emphasis is placed on promoting ethical leadership, fostering a culture of integrity, and aligning business objectives with ethical standards. By the end of the module, students are expected to develop a strong ethical framework that informs their approach to industrial management, enabling them to make morally responsible decisions and contribute to sustainable and socially conscious business practices.			

Module 31

Code	Course/Module Title	ECTS	Semester
NVEE205	Digital Signal Processing II	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	51
Description			
The course covers theory and methods for digital signal processing including basic principles governing the analysis and design of discrete-time systems as signal processing devices. Review of discrete-time linear, time-invariant systems, Fourier transforms and z-transforms. Topics include sampling, impulse response, frequency response, finite and infinite impulse response systems, linear phase systems, digital filter design and implementation, discrete-time Fourier transforms, discrete Fourier transform, and the fast Fourier transform algorithms.			

Module 32

Code	Course/Module Title	ECTS	Semester
NVEESC316	Industrial Networks	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	51
Description			
The Industrial Networks module provides an in-depth understanding of networking principles and technologies specifically tailored for industrial applications. This module covers the essential concepts, protocols, and architectures used in industrial networks to enable efficient and reliable communication between devices and systems within industrial environments. Students will learn about the different types of industrial networks, such as Ethernet/IP, Profinet, Modbus, and DeviceNet, and gain insights into their strengths, limitations, and applications. The module explores topics such as network topologies, network layers, network devices, and communication protocols commonly employed in networks. By the end of this module, students will be equipped with the necessary skills and knowledge to design, implement, and maintain robust and efficient industrial networks, enabling them to contribute effectively to the optimization and automation of industrial processes.			

Module 33

Code	Course/Module Title	ECTS	Semester
NVEESC317	PLC II	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	65
Description			
The aim of studying Programmable Logic Controllers (PLCs) for undergraduate control engineers is to develop a strong foundation in industrial automation and control systems. PLCs are widely used in various industries to automate processes, control machinery, and monitor systems. By studying PLCs, control engineers gain essential skills and knowledge that are crucial for their professional development. In other words, provides a solid foundation in industrial automation, programming, system integration, troubleshooting, and safety. These skills are essential for successfully working with control systems in various industries and contribute to the efficient and reliable operation of automated processes. Thus Understanding Automation Principles and programming skills are the main key elements for the market needs for control engineers to integrate PLC with the manufacturing processes and systems.			

Module 34

Code	Course/Module Title	ECTS	Semester
NVEESC318	Power Electronics	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	74	51
Description			
The Power Electronics module is designed to provide students with a solid foundation in the principles and applications of power electronics. Power electronics is a technology that deals with the efficient conversion, control, and regulation of electrical power. It plays a crucial role in various industries such as energy systems, electric vehicles, aerospace, and manufacturing. This module begins with an introduction to power electronics, highlighting its importance and applications in modern society. Students will learn about the basic concepts and terminology used in power electronics and gain an understanding of the different types of power semiconductor devices. Students will also learn about different types of power converters such as AC-DC, DC-DC, and DC-AC converters. They will explore the analysis and design of rectifiers, inverters, and various converter topologies. The module covers topics like commutation techniques, pulse width modulation (PWM), and control strategies for efficient power conversion. Throughout the module, practical applications of power electronics will be highlighted, emphasizing their use in renewable energy systems, electric vehicle technologies, motor drives, and industrial power systems. Case studies and real-world examples will be used to enhance the understanding of how power			

electronics impacts these domains.
By the end of the module, students will have developed a solid grasp of power electronics principles, enabling them to analyze, design, and control power electronic systems effectively. They will be prepared to apply their knowledge in various industries, contribute to research and development efforts, and address emerging challenges in the field of power electronics.

Module 35

Code	Course/Module Title	ECTS	Semester
NVEESC319	AC Machines	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	65
Description			
The machines module is a comprehensive and fundamental component of many engineering and technical courses. It provides students with essential knowledge of atypical types of machines and their applications. This module covers a wide range of topics related to machines, including principles of operation, construction, performance characteristics, and control techniques. Students learn about various machine types such as motors, generators, and transformers in the machines module. They delve into the working principles, design considerations, and practical applications of these machines. Additionally, the module explores topics like efficiency, power factor, and torque. Through theoretical lectures, practical experiments, and hands-on activities, students gain the knowledge and skills required to analyze and troubleshoot different types of machines. They become proficient in interpreting machine performance curves, calculating losses, selecting appropriate machine types for specific applications, and optimizing their operation.			

Module 36

Code	Course/Module Title	ECTS	Semester
NVEESC320	Microprocessors	5	6
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	65
Description			
Review of 8086. 8086 System Connections and Timing. input/output interfacing. Memory Interfacing. Digital to Analog Converter Interfacing. Analog to Digital Converter Interfacing. Memory test. Programmable peripheral Interface 82C55 programming and Interfacing. Implementation of Digital filter. Stepper Motor Interfacing. Microprocessor System Design Applications.			

Module 37

Code	Course/Module Title	ECTS	Semester

NVEESC321	Robotics I	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	74	51
Description			
The aim of teaching Introduction to Robotics Manipulator for undergraduate students is to provide them with a fundamental understanding of robotics and its applications in manipulating objects. This course aims to lay the groundwork for students to explore and excel in the field of robotics. Through this course, students will: 1- Gain foundational knowledge: Students will be introduced to the basic concepts, principles, and terminology of robotics manipulators. They will learn about the components of a robotic system, including robot arms, grippers, sensors, and actuators. Additionally, they will understand key topics such as kinematics, dynamics, and control as applied to robotic manipulators. 2- Understand robotic systems design: Students will explore the design process of robotic systems, including the considerations for selecting appropriate components, designing effective kinematic structures, and integrating sensors and actuators. They will learn about different types of robotic manipulators and their applications in various industries. 3- Foster problem-solving and critical thinking: Through project-based assignments and problem-solving exercises, students will develop their ability to analyze and solve robotics-related challenges. They will learn to think critically about robotic system design, optimization, and performance evaluation.			

Module 38

Code	Course/Module Title	ECTS	Semester
NVEESC322	Optimal Control	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	3	88	37
Description			
The optimal control module introduces students by basics, principles, concepts and theory of optimal control techniques. The module covers a range of topics related to optimal control technique, including mathematical modeling of dynamic systems, control simulation and performance analysis. The aim of the module is to provide students with detailed knowledge and deep understanding of optimal control theory and its practical applications. Students will learn how to formulate and solve optimal control problems using mathematical tools such as calculus of variations and optimal control theory method. In addition, the students will be able to design and simulate optimal control systems using the Matlab environment. The module will include both theoretical concepts and practical examples, allowing students to apply their knowledge to real-world problems. Finally, students will have the opportunity to work on case studies, simulations, and hands-on projects to gain practical experience in optimal control.			

Module 39

Code	Course/Module Title	ECTS	Semester
NVEESC323	Soft Computing	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	1	58	67
Description			
Soft computing, as opposed to traditional computing, deals with approximate models and gives solutions to complex real-life problems. Unlike hard computing, soft computing is tolerant of imprecision, uncertainty, partial truth, and approximations. In effect, the role model for soft computing is the human mind. Soft computing is based on techniques such as fuzzy logic, genetic algorithms, artificial neural networks, machine learning, and expert systems. Although soft computing theory and techniques were first introduced in 1980s, it has now become a major research and study area in automatic control engineering. The techniques of soft computing are nowadays being used successfully in many domestic, commercial, and industrial applications. With the advent of the low-cost and very high performance digital processors and the reduction of the cost of memory chips it is clear that the techniques and application areas of soft computing will continue to expand.			

Module 40

Code	Course/Module Title	ECTS	Semester
NVEESC324	Process Control	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	3	88	37
Description			
process control module is a component or system used in industrial processes to monitor and regulate various parameters to ensure efficient and safe operation. It plays a critical role in maintaining the desired conditions, optimizing performance, and preventing failures or deviations in the process. 1. To introduce students to the fundamental concepts and principles of process control. 2. To develop students' skills in designing and analyzing control systems. 3. To familiarize students with various control strategies and techniques. 4. To enable students to apply their knowledge to solve real-world process control problems. 5. To promote critical thinking, teamwork, and effective communication skills.			

Module 41

Code	Course/Module Title	ECTS	Semester
NVEESC325	Industrial Automation	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	1	44	81
Description			
The module of Industrial Automation provides students with a comprehensive understanding of the principles and applications of automation in industrial systems. This module aims to equip students with the knowledge and skills necessary to design, implement, and troubleshoot automated control systems used in various industries. The module emphasizes a combination of theoretical concepts and practical hands-on exercises, allowing students to apply their knowledge in real-world scenarios. Students will have opportunities to work with industrial automation software, simulate control systems, and develop solutions for automation challenges. Additionally, the module encourages collaborative teamwork, problem-solving skills, and effective communication to prepare students for successful careers in the field of industrial automation.			

Module 42

Code	Course/Module Title	ECTS	Semester
NVEESC308	Advanced Control Systems	5	7
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	2	60	65
Description			
This course is concerned with the analysis and design of control systems with the state variable point of view. The class of systems studied are assumed linear time-invariant (LTI) systems. Linear time-invariant systems are usually mathematically described in one of two domains: time-domain and frequency-domain. In time-domain, the system's representation is in the form of a differential equation. The frequency domain approach usually results in a system representation in the form of a transfer function. By use of the Laplace transform the transfer function can be derived from the differential equations, and a differential equation model can be derived from the transfer function using the inverse Laplace transform. A transfer function can be written only for the case in which the system model is a linear time-invariant differential equation and the system initial conditions are ignored. It is assumed that the student is familiar with obtaining the mathematical models of various physical systems in the form of differential equations and transfer functions. Knowledge of the laws of physics for mechanical, rotational mechanical, and electrical systems is also assumed to be familiar to the student. Modern Control Methods, instead of changing domains to avoid the complexities of time-domain ODE mathematics, converts the differential equations into a system of lower-order time domain equations called State Equations, which can then be manipulated using techniques from linear algebra.			

Module 43

Code	Course/Module Title	ECTS	Semester
NVEESC326	Robotics II	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	74	76
Description			
The mobile robot module is a focused and hands-on component of the curriculum that aims to provide students with a comprehensive understanding of mobile robotics and its practical applications. This module covers key concepts related to the modeling, control, and understanding of the fundamentals of autonomous mobile robots. Students will delve into the principles of mobile robot locomotion, kinematics, and control. Through practical exercises and projects, students will gain experience in programming and implementing control strategies for mobile robots. Upon completion of the mobile robot module, students will possess the skills to design, program, and operate autonomous mobile robots, making them well-prepared for careers in robotics research, industrial automation, and other related fields.			

Module 44

Code	Course/Module Title	ECTS	Semester
NVEESC327	Adaptive Control	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	3	88	62
Description			
The adaptive control module introduces students by basics, principles, concepts and theory of adaptive control systems. The module gives more details about different types of system plants. The students will learn classifications and categories of adaptive control techniques, in addition, they will also have knowledge about estimation approaches for plant components and controller gain parameters. The module covers a range of topics related to adaptive control systems, including mathematical modeling of unconventional dynamic systems, control simulation, performance criteria and response analysis in time domain. The aim of the module is to provide students with knowledge and deep understanding of adaptive control theory and its practical applications. Furthermore, the students will be also able to design and simulate adaptive control systems using the MATLAB environment. The module will include both theoretical concepts and practical examples, allowing students to apply their knowledge to real-world problems.			

Module 45

Code	Course/Module Title	ECTS	Semester
NVEESC328	Computer Control System	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	1	58	92
Description			

The Computer Control Systems module aims to provide students with a comprehensive understanding of computer-based control systems and their applications in various industries. Through theoretical study, and simulation exercises, the module aims to achieve the following objectives:

- Explore case studies and real-world examples of computer control systems in various industries, such as manufacturing, process control, and robotics.
- Gain hands-on experience through projects involving computer control systems.
- Develop critical thinking and problem-solving skills:
- Apply theoretical knowledge to analyze and solve complex problems related to computer control systems.
- Develop the ability to evaluate the performance and efficiency of computer control systems.
- Enhance troubleshooting skills for diagnosing and resolving issues in computer control systems.

Module 46

Code	Course/Module Title	ECTS	Semester
NVEESC329	Embedded Systems	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
3	2	74	76
Description			

An embedded system is a combination of computer hardware and software designed for a specific function. Embedded systems may also function within a larger system. The systems can be programmable or have a fixed functionality. Industrial machines, consumer electronics, agricultural and processing industry devices, automobiles, medical equipment, cameras, digital watches, household appliances, airplanes, vending machines and toys, as well as mobile devices, are possible locations for an embedded system.

How to learn embedded systems programming

Below are six steps you can use to learn embedded systems programming:

1. Choose a programming language
2. Learn about microprocessor.
3. Acquire equipment and tools.
4. Select components

5. Practice with minor projects 6. Use simulation tools

Module 47

Code	Course/Module Title	ECTS	Semester
NVEESC330	Project	6	8
Class (hr/w)	**Lect/Lab./Prac./Tutor**	**SSWL (hr/sem)**	**USWL (hr/w)**
2	3	72	78
Description			
The BSc Systems and Control Engineer program provides undergraduate students with the chance to select a project from a range of options within the control department. This allows them to engage in research and enhance their skills in line with fundamental engineering principles and design. Students will undertake a substantial project that necessitates the utilization of professional competencies such as project planning, risk assessment, and management. Presenting a final project report and delivering a presentation will enable students to apply critical analysis, thorough research, and enhance their communication abilities. - Prepare for a comprehensive literature review that can plan for an appropriate project for a certain group to add new knowledge - Attempt to find an engineering problem or industry problem and use a blend of theoretical plus practical skills and knowledge to solve it.			

Contact

Program Manager:

Abdullah I. Abdullah | MSc. in Control Engineering | Assistant Prof.

Email: abdullah.abdullah@uoninevah.edu.iq

Mobile no.: +9647740887822

Program Coordinator:

Hussein M. Hussein | Ph.D. in Electronic and Communication Engineering | Lecturer

Email: Hussein.hussein@uoninevah.edu.iq

Mobile no.: +9647703824635