Dep. of Industrial Engineering & Management

INTERNATIONAL HELLENIC UNIVERSITY

UNDERGRADUATE COURSE HANDBOOK

2021 – 2022

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General Information about the Erasmus+ Programme

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Course Selection Procedure

The Learning Agreement is signed before the mobility approval.
The final course selection must be included in the Learning Agreement.
Changes in course selection are considered strictly until 1 month before the semester start date.
Course selection and association is based on syllabi and ECTS correspondence.

Courses

The Erasmus+ courses offered by the Department of Industrial Engineering and Management are listed in the following table, including embedded links to the course descriptions and the e-mail addresses of the course instructors.

No	Course Name	Course Code	Semester	ECTS	Instructor Name
1	Electrotechnical Materials	26.2	2	4	Michail Kiziroglou
2	Electronic Systems	32	3	6	Michail Kiziroglou
3	Probability Theory and Statistics	34	3	5	Fotini Papadopoulou
4	Industrial Safety And Health	36.1	3	4	Stelios Xanthos
5	Transform Theory and Systems	42	4	4	Fotini Papadopoulou
6	Micro-Electro-Mechanical Systems (MEMS)	46.1	4	4	Michail Kiziroglou
7	Operational Research	64	6	5	Vassilis Kostoglou
8	Electric Machines and Electric Motor Drives II	65.3	6	4	Fotis Stergiopoulos
9	Signals, Information and Communication	65.8	6	4	Fotini Papadopoulou
10	Thermal Engines	73	7	5	Dimitrios Tziourtzioumis
11	Project Management	75	7	4	Christos Bialas
12	Nanotechnology	76.1	7	4	Michail Kiziroglou
13	Electronic Energy Systems and Energy Saving	76.3	7	4	Fotis Stergiopoulos
14	Automotive Electronics	76.6	7	4	Theodoros Kosmanis
15	Control Systems Design techniques	76.7	7	4	Christos Yfoulis
16	Modeling and simulation	81	8	4	Christos Yfoulis
17	Finite Element Method	86.3	8	4	Pavlos Aisopoulos
18	Renewable Energy Sources	86.6	8	4	Fotis Stergiopoulos
19	Vehicle Dynamics	86.7	8	4	Pavlos Aisopoulos
20	Digital Control Systems	86.9	8	4	Christos Yfoulis
21	Environmental Engineering	93	9	4	Stelios Xanthos
22	Vehicle Electrification	95.6	9	4	Theodoros Kosmanis
23	Stochastic Processes	95.7	9	4	Fotini Papadopoulou

26.2 Electrotechnical Materials
Delivery Method: Assignments
1. Objectives, Significance and Interest
2. Atomic forces and bonds
3. Crystal Structures 1 (Basics)
4. Crystal Structures 1 (Structure types)
5. Metals
5. Semiconductors
6. Polymers
7. Thermal properties of materials
8. Dielectric properties of materials
9. Thermoelectricity, Piezoelectricity, Ferroelectricity
10. Magnetic properties of materials
11. Artificial structures
12. Application example: Materials in a Smartphones
13. Summary

32 Electronic Systems
Delivery Method: Assignments
1. Introduction to Electronic Systems
2. Basic concepts (circuits and systems)
3. Diode
4. Bipolar Junction Transistor
5. Field Effect Transistor
6. Basic Circuits: Switches and amplifiers
7. DC and small signal models
8. Operational amplifiers
9. Digital Gates and CMOS
10. Analog to Digital Converters and Digital to Analog Converters
11. Oscillators
12. Applications
13. Summary

34 Probability Theory and Statistics

Delivery Method: Lectures and Assignments

Probability Theory as a framework for describing and analyzing uncertainty. An overview of Set Theory. Basic Probability Models and Axioms.

Independent events. Basic Listing Principle. Combinatorial Principles, Discrete Probability Calculation Applications.

Conditional Probability, Total Probability Theorem, Multiplication Rule, Bayes Theorem. Statistical Independence.

Random Variables: Definition of discrete and continuous random variables, Cumulative Distribution Function, Probability Mass Function, Probability Density Function.

Discrete Random Variables: Moments, Basic Distributions.

Continuous random variables: Moments, Basic Distributions.

Normal Random Variables: Properties, Standard Normal Distribution.

Multiple Random Variables: Joint and Marginal Distributions, Statistical Independence, Derived Distributions: Sum of Independent Random Variables. Joint Moments.

Boundary Theorems: Markov and Chebyshev Inequalities, Laws of Large Numbers, Central Limit Theorem.

Descriptive Statistics: Frequency Tables, Barcharts, Histograms, Stemplots, Dot Diagrams, Location Measures, Variability Measures.

Statistical Inference, Parameter Estimation, Point Estimation (Moments Method, Maximum Likelihood Estimation), Confidence Intervals. Linear Regression

36.1 Industrial Safety And Health

Delivery Method: Lectures and Assignments

Introduction to Industrial Management and Safety

Occupational accident

Personal Protective Equipment

Hazardous Materials

Fire Protection

Radioactivity

Electromagnetic Radiation

Noise

Lighting

Ergonomics

Estimate occupational risks

42 Transform Theory and Systems

Delivery Method: Lectures and Assignments

Signals and Systems: definitions, classification, types of representation. The complex Fourier Series and the Fourier Transform. The Discrete Time and the Discrete Fourier Transform. Basic system properties: linearity, time invariance, causality, stability. Impulse and step response of a system, convolution. Difference equations and differential equations. Analysis of signals and systems in frequency domain. Spectral representation: magnitude and phase diagrams. Frequency response. Frequency selection filters. Laplace Transform and z-Transform. Transfer function. Pole-zero diagrams. Connecting LTI systems: parallel, cascade and feedback connection. The Nyquist–Shannon sampling theorem. Pulse Width Modulation. Design and implementation of discrete time systems with block diagrams. Parameter accuracy. Applications and examples.

46.1 Micro-Electro-Mechanical Systems (MEMS)

Delivery Method: Assignments

1. Introduction to MEMS
2. Importance and capabilities
3. Scaling
4. MEMS materials
5. Micromachining techniques
6. Lithography
7. Process flows
8. MEMS Electronics
9. MEMS Mechanics
10. MEMS Application 1 (MicroEnergy)
11. MEMS Application 2 (Micro-robots)
12. MEMS Foundries
13. Summary

64 Operational Research

Delivery Method: Lectures

Introduction to Operational Research (the nature of OR – Mathematical models and algorithms)

Linear Programming (mathematical model, problems formulation, the Simplex method, graphical solution, sensitivity analysis)

Transportation and Transhipment Problem (mathematical model, initial feasible solution, optimal solution algorithm, special cases, solution of given problems and case studies)

Stock Control (interpretation, costs analysis, main variables and terminology, main stock control systems, systems graphical representation, calculation of main variables)

Production Systems Planning (assignment problems – task scheduling in one, two or three media – production line balancing)

65.3 Electric Machines and Electric Motor Drives II

Delivery Method: Lectures and Assignments

1. Introduction to synchronous machines: principles of operation, construction, applications
2. Synchronous generators: equivalent circuit, power and torque calculations
3. Voltage and frequency control and parallel operation of synchronous generators
4. Transient phenomena in synchronous generators
5. Synchronous motor: equivalent circuit and steady state operation
6. Start up of a synchronous generator, application in reactive power compensation
7. Single phase motors: creation of a magnetic field and start up
8. Single phase motors: equivalent circuit, speed control
9. Introduction to switched reluctance motors
10. Other types of motors: step and hysteresis motors
11. Permanent Magnet (synchronous and brushless DC) motors & drives: construction & operation
12. Permanent Magnet motors: equivalent circuits and applications
13. Power electronic drive systems for permanent magnet machines

65.8 Signals, Information and Communication

Delivery Method: Lectures and Assignments

Basic concepts: definitions and brief review of Fourier transform theory. Sampling in time. Representation of digital signals in both time and frequency domains. Signal bandwidth. Modulation techniques. Communication system design: constraints, legislation and market. Introduction to information theory. Entropy. Basic principles of data transmission. Channel capacity and noise. Natural channel modeling: sources and examples of channel degradation. Data transmission. Digital modulation ASK, FSK, PSK. Source encoding. Sampling Theorem. Quantization Noise. Compression and error protection techniques. Channel encoding and block encoding. Multiple access with frequency/time/code division. Communication networks and signaling protocols. Applications and examples.

73 Thermal Engines

Delivery Method: Assignments

1. Basic Principles and historic evolution of Internal Combustion Engines. Reciprocating engine cycles.
2. Design, construction, materials of engine components–subsystems. Main categories of reciprocating engines. Vehicle engines. Naval engines. Static engines. Airplane engines.
3. Engine design and operation parameters.
4. Thermochemistry of flammable air-fuel mixtures. Air to Fuel ratio calculation based on exhaust gas composition.
5. Diesel and gasoline fuel injection systems. Fuel jet behavior, droplet distribution. Droplet vaporization–ignition. Gasoline Direct Injection Engines (GDI).
6. Combustion in diesel engines. IDI and DI combustion chambers. Combustion in Spark Ignited engines.
7. Engine friction and lubrication. Introduction to tribology.
8. Pollutant formation and control in Spark Ignited and Diesel engines.
9. Basic Principles and definition of a turbomachine. Coordinate system. Relative velocities.
10. Main categories of turbines, compressors, steam turbines, gas turbines.
11. Velocity diagrams for an axial flow compressor stage. The fundamental laws.
12. Dimensional analysis and performance laws. Incompressible fluid analysis. Performance characteristics for low-speed machines.
13. Compressible flow analysis. Flow coefficient and stage loading. Performance characteristics for high-speed machines. Specific speed and specific diameter.

75 Project Management

Delivery Method: Assignments

1. Feasibility Study
2. Project Initiation, Planning, Execution, Monitoring & Control, Closure
3. Integration management
4. Scope management
5. Cost management
6. Time management
7. Quality management
8. Human resources management
9. Communications management
10. Risk management

76.1 Nanotechnology

Delivery Method: Assignments

1. Introduction, significance, examples
2. Parallel fabrication techniques
3. Serial fabrication techniques
4. Self-assembly and exotic methods
5. Bottom-up and molecular nanotechnology / Metamaterials
6. Single-electron nanoelectronics
7. Quantum computers
8. Spintronics
9. Carbon nanotubes
10. Two-dimensional materials: Graphene and MoS2
11. Applications of Nanotechnology
12. Microscopy techniques
13. Accessibility, real technologies and roadmap"

76.3 Electronic Energy Systems and Energy Saving

Delivery Method: Lectures and Assignments

1. Introduction: electronic energy management and systems – applications
2. Electronic power conversion systems in electric vehicles
3. Current source power converters – applications
4. Switching mode power supplies
5. Principles and technologies of UPS systems
6. Multilevel power converters: technologies and industrial applications
7. Power quality in industry: voltage and frequency transients, harmonics
8. Harmonic filters design: passive and active filters in industrial applications
9. Electronic control of reactive power: Thyristor switched capacitors, static var compensations
10. Induction heating: principles and operation
11. Energy saving technologies: cogeneration of heat and power
12. Energy saving technologies: building management systems applications
13. Energy saving technologies: Optimal management of electrical energy storage systems

76.6 Automotive Electronics

Delivery Method: Assignments

1. Automotive electronic drawing elements.
2. Elementary Electronics and Control theory: Analogue and digital electronics, Microcontrollers, Microprocessors.
3. Electronic control unit
4. Engine control systems (direct and indirect injection)
5. Automotive Sensors: speed, temperature, throttle valve,
6. Automotive Sensors: load measurement (VAF, MAF, MAP)
7. Automotive Sensors: oxygen, knock etc
8. Automotive Actuators: relays, electromagnetic valves (analogue, ON/OFF)
9. Automotive Actuators: injectors, fuel pump, idle motor, EGR
10. Automotive passive Safety Systems
11. Anti-block braking system (ABS)
12. Transmission system, Transmission control systems (steering, differential)
13. Laboratory experiments: Engine Control Systems"

76.7 Control Systems Design techniques

Delivery Method: Lectures and Assignments

1 – Introduction to controller design
- 1.1 Basic specifications in time domain
- 1.2 Types of controllers-compensators
- 1.3 Categories of control problems
- 1.4 Closed-loop block diagrams with various inputs
- 1.5 Impact of disturbances, noise and sensitivity functions

2 - Basic design tools
- 2.1 Root Locus
- 2.2. Bode diagrams

3 - Root locus design
- 3.1 Lead-lag controllers
- 3.2 Two-term controllers (PI, PD)
- 3.3 Three-term controllers (PID)

4 - Frequency domain design
- 4.1 Basic specification in the frequency domain
- 4.2 Lead-lag controllers
- 4.3 Two-term controllers (PI, PD)
- 4.4 Three-term controllers (PID)

5– Empirical and semi-empirical design
- 5.1 Three-term controller (PID) tuning rules (Ziegler Nichols, Cohen-Coon, CHR)
- 5.2 Relay feedback tuning

6 – Special design techniques
- 6.1 Notch filter
- 6.2 Combination of Notch with PI / PID (integral action)
- 6.3 Alternative forms of PID algorithm implementation (parallel, serial, practical)
- 6.4 Practical limitations and other techniques (windup integrator, derivative filter, bumpless transfer)

7- Controllers with additional degrees of freedom
- 7.1 Design of controllers with two degrees of freedom (prefilter, cascade)
- 7.2 Design of modified controllers with additional features

8 - Simulation and implementation of control systems
- 8.1 Implementation with active and passive circuits
- 8.2 Applications in MATLAB / SIMULINK environment with special emphasis on servo systems

81 Modelling and simulation

Delivery Method: Lectures and Assignments

1 - System Modelling
  1.1 Description of dynamic systems (inputs, outputs, disturbances)
  1.2 Extraction of a mathematical model from basic principles (electrical, mechanical, electromechanical, thermal, hydraulic)
  1.3 Frequency response models
  1.4 Linear and non-linear state space models
  1.5 Linearization techniques of nonlinear systems
2 - System identification
  2.1 Introduction to least squares methods
  2.2 Model fitting to Input-Output Data
  2.3 Parameter estimation of parametric models
  2.4 Selection of input signals (steps, PRBS, white noise)
  2.5 Representative Examples and Solutions with MATLAB
3 - Simulation
3.1 Simulation models
3.2 Types of simulation
3.3 Continuous-time modeling
3.4 Simulation through equations and block diagrams
3.5 Development of discrete-time models
3.6 Development of simulation programs
3.7 MATLAB / SIMULINK simulation models
3.8 Sampling methods
3.9 Random Number Generators
3.10 Monte Carlo method
3.11 Analysis of results
3.12 Simulation of specialized systems (inventory, production and queues)

86.3 Finite Element Method

Delivery Method: Lectures and Assignments

86.6 Renewable Energy Sources

Delivery Method: Lectures and Assignments

1. Introduction: RES types, the importance of RES for the economy and the environment, current status in the International, European and National (Greek) context
2. Distributed generation systems, development and use in the current framework of production, transmission and distribution of electrical energy.
3. Solar Energy: basic principles of solar energy production, solar cell, PV panels (I-V, P-V curves), basic equations
4. Wind energy: overall system description, estimation of energy produced, types and parts of a wind generator.
5. Hydroelectric power: systems description, types of hydro turbines and operational characteristics
6. Biomass energy: types of biomass and energy content
7. Electrical energy storage: basic battery technologies and their characteristics, other storage systems (supercapacitors, flywheels, fuel cells)
8. PV systems energy production: PV panels connection, mounting systems, balance-of-system (BOS), design, application examples
9. Wind energy systems: mounting, BOS, design application examples
10. Hydroelectric stations: description of a plant, grid interconnection
11. Biomass energy production systems: description of a plant, thermodynamic cycles, examples
12. Geothermal energy systems: basic parts – examples
13. RES systems combination: autonomous energy systems, design, application examples

86.7 Vehicle Dynamics

Delivery Method: Lectures and Assignments

86.9 Digital Control Systems

Requires Proven Background in Control Systems

Delivery Method: Lectures and Assignments

1 – Introduction
  1.1 Introduction to computer-controlled systems
  1.2 The Z-transform and inverse Z-transform
  1.3 Sampling and hold
  1.4 Block diagrams
2 – Analysis of digital control systems
  2.1 Pulse transfer functions for sampled-data systems
  2.2 Digital Root locus and pole locations
  2.3 Steady-state errors of sampled-data systems
  2.4 Frequency response of sampled-data systems
  2.5 Sampling frequency calculation rules
  2.6 Antialiasing filter design
  2.7 Stability criteria for discrete-time systems (modified Routh, Jury)
3 – Digital controller realization
  3.1 Difference equations
  3.2 Discrete-time computer code
4 – Design by emulation (analog design discretization)
  4.1 Discrete-time performance specifications
  4.2 Methods of Discretization of analog controllers
5– Direct digital design
  5.1 Digital PID design techniques
5.2 Pole placement digital design
5.3 The method of Ragazzini
6–State-space design
  6.1 State-space discretization
  6.2 Controllablity and observability in discrete-time
  6.3 Pole placement design in discrete-time
  6.4 Observers in discrete-time
7– Optimal control of digital controllers
  7.1 Deadbeat control design
  7.2 Ripple-free deadbeat control design
8 – Simulation of digital control systems
  8.1 Digital and hybrid simulation diagrams
  8.2 MATLAB/SIMULINK examples and case studies

93 Environmental Engineering

Delivery Method: Lectures and Assignments

1. Introduction to environmental Engineering
2. Natural resources and sustainability
3. Air pollution –Air quality
4. Water pollution –Water quality
5. Soil pollution
6. Wastes – solid, liquid, gas
7. Radioactivity
8. Ionizing - non ionizing radiation
9. Energy and environment
10. Environmental management

95.6 Vehicle Electrification

Delivery Method: Assignments

1. Electric motion and environment. Well-to-Wheel analysis.
2. Electric Vehicle architectures.
3. Electric vehicle powertrain systems general description
4. Energy storage systems (Batteries – design, characteristics)
5. Energy storage systems (Batteries – Battery Management System, Energy management)
6. Energy storage systems (ultracapacitors, fuel cells, flywheels)
7. Charging systems
8. Propulsion system (DC/DC and DC/AC converters, Power converters, motor drives)
9. Propulsion system (Electric motors for traction: DC, AC inductive)
10. Propulsion system (Electric motors for traction: BLDC, PMSM, in-wheel, electric differential)
11. Hybrid electric vehicles: series, parallel, compound
12. Hybrid electric vehicles: transmission systems
13. Human powered vehicles (electrically and non-electrically assisted).
14. Regenerative braking description and strategies"

95.7 Stochastic Processes

Delivery Method: Lectures and Assignments

A brief review of key elements of probability theory and distributions. Basic concepts of Random Processes. Discrete- /continuous-time and discrete /continuous state space models of processes. Arrivals in discrete time: Bernoulli process. Arrivals in continuous time: Poisson process. Markov chains: Definition of Markov models. Transition probability tables. Chapman-Kolmogorov equations. Markov Chains: Periodicity. Balance equations. Stochastic signals: definition, classification. Expected values: Mean, autocorrelation. Stationarity. Ergodicity. Autocorrelation and cross-correlation properties. Spectral power density. Linear system response to stochastic input. Gaussian process. White noise. Applications and examples.