



ENGINEERING PROGRAM
CENTRALESUPÉLEC

SECOND YEAR COURSES CATALOG

Academic year 2022-2023



CentraleSupélec

Edition du 22 septembre 2022



TABLE OF CONTENTS

CORE CURRICULUM COURSES.....	11
2CC1000 – Control theory	12
2CC1005 – Control theory - DUAL	19
2CC2000 – System modeling	25
2CC3000 – Optimization	27
2CC3005 – Optimisation - DUAL.....	29
 SEMESTER LONG COURSES	 32
2SL1000 – Economics	33
2SL1100 – Climate science and climate change issues.....	36
2SL2000 – Law	39
2SL3000 – Philosophy	41
2SL4000 – Sociology of organizations	43
2SL5000 – "Engineering Skills" Workshops	46
2SL7000 – Professional Practice Workshops.....	49
2SL8000 – Project S7	51
2SL8100 – Project S8	54
2SL9000 – Sport.....	57
 SCIENCE COURSES FOR ENGINEERS.....	 59
2EL0010 – Teaching assistant	60
2EL1110 – Dynamical systems in neuroscience	63
2EL1120 – Interactive Robotic Systems.....	67
2EL1130 – Dynamical Multi-Agent Systems. Application to drones formation control	71
2EL1210 – Exposure of people to electromagnetism and electromagnetic compatibility	76
2EL1230 – Embedded space systems	79
2EL1310 – Renewable energies.....	82



2EL1315 – Electrical Energy Conversion for renewable energy sources and electromobility	85
2EL1320 – Energy conversion	87
2EL1410 – Heat Transfer	90
2EL1420 – Fluid Mechanics	95
2EL1430 – Nuclear engineering	99
2EL1440 – Modeling and numerical simulation of reactive media	101
2EL1520 – Object oriented software Engineering.....	105
2EL1540 – Theoretical computing	108
2EL1550 – High Performance Computing.....	111
2EL1560 – Models and Systems for Big Data management	115
2EL1580 – Artificial Intelligence	117
2EL1590 – Cloud computing and distributed computing	120
2EL1710 – Advanced probabilities	124
2EL1720 – Distributions and operators	126
2EL1730 – Machine Learning.....	128
2EL1740 – Algebra and cryptology	131
2EL1750 – Advanced statistics.....	134
2EL1760 – Scientific calculation.....	137
2EL1810 – Structural Dynamics & Acoustics	140
2EL1820 – Biomechanics and life materials	142
2EL1830 – Non-linear behavior of materials	144
2EL1840 – Advanced Mechanics for Civil Engineering: "Building tomorrow"	147
2EL1850 – Simulation of multiphysic couplings with FEM	149
2EL1860 – Building the city - Town planning, architecture and engineering.....	151
2EL1910 – Fundamental laws of the Universe: particle and gravitation physics	153
2EL1920 – Advanced Quantum and Statistical Physics	155
2EL2010 – Understanding, optimization and simulation of biotechnological processes	158
2EL2020 – Physics of divided matter	161
2EL2030 – Genomics and synthetic biology in health and industrial biotechnology	166
2EL2040 – Chemical Engineering: application to environment and sustainable production	169
2EL2120 – Design Science.....	174



2EL2140 – Strategy, Marketing and Organization	180
2EL2150 – Corporate finance and Law	183
2EL2160 – Environmental economics, energy and sustainable development	186
2EL2170 – Economics of growth and innovation	188
2EL2190 – Innovation management and business creation.....	192
2EL2210 – Operations and supply chain management	195
2EL2220 – Organizational and market theories	198
2EL2230 – Maintenance and Industry 4.0.....	200
2EL2240 – Mobility issues	203
2EL2410 – Signal compression and denoising.....	207
2EL2420 – Digital image processing	210
2EL2510 – Architecture and design of digital systems.....	213
2EL2520 – Electronics for biomedical and communication applications	216
2EL2530 – Integrated MEMS sensors	219
2EL2610 – Communications Theory	222
2EL2620 – Mobile communication networks and services	226
2EL2630 – Applications of statistical and quantum physics to information science	229
2EL2710 – Design your way.....	233
2EL2720 – Tutoring of young people with disabilities.....	236
2EL2730 – Associative Elective	240
2EL5010 – Introduction to mobile applications engineering	242
2EL5020 – Introduction to multi-tier application development and web services	245
2EL5030 – Programming efficiently in C++.....	249
2EL5040 – Big Data: data gathering, storage and analysis on clusters and Clouds	252
2EL5050 – Estimation methods and introduction to the modern coding theory	256
2EL5060 – Analysis and processing of audio data (speech and music)	259
2EL5070 – Image processing	262
2EL5080 – Robust electronic and embedded systems.....	265
2EL5090 – Design of complex electronic systems: from component to heterogeneous system	268
2EL5110 – Light to understand matter.....	271
2EL5120 – Smart Photonics Systems.....	273



2EL5130 – Chaos, Fractals and complexity.....	276
2EL5140 – Modeling for Systems Engineering	280
2EL5150 – Transitions and socio-economic symbiosis.....	283
2EL5170 – Innovation management tools at the service of responsible innovation.....	284
2EL6010 – Model based design of critical embedded control systems	285
2EL6020 – Computer Architecture	288
2EL6030 – Operating systems	292
2EL6040 – System programming under linux and windows	295
2EL6050 – Modelica and bond graph: multi-domain modeling, analysis and simulation	297
2EL6060 – Serious Game	302
2EL6090 – Artificial Intelligence and Deep Learning	306
2EL6100 – Communication Systems Engineering.....	310
2EL6110 – Advanced computer networks.....	314
2EL6120 – Intelligent Wireless Access & Experimentation	317
2EL6130 – Embedded systems and internet of things	321
2EL6140 – Electric machinery, power electronics and grids.	324
2EL6150 – Model-based predictive control.....	328
2EL6170 – Production and flow management	332
2EL6180 – Digital marketing.....	335
2EL6190 – Bayesian methods for machine learning.....	337
2EL6200 – Advanced corporate finance.....	341
2EL6210 – Geopolitics of resources and objects.....	344
SCIENCE AND ENGINEERING CHALLENGE N°5 COURSES	349
ST5 – 51 – PILOTING AND FLIGHT CONTROL IN AERONAUTICS AND SPACE TRANSPORTATION	350
2SC5110 – Performance and flight paths	353
2SC5191 – Control strategy of a nanosatellite	358
2SC5192 – Definition and design of a launcher mission	360
2SC5193 – Aircraft design.....	363
ST5 – 52 – CONTROL OF BIOPROCESSES FOR ENVIRONMENT AND BIOMANUFACTURING	365
2SC5210 – Chemical Engineering: application to environment and biomanufacturing	370
2SC5291 – Optimized biological treatment of urban wastewater	374



2SC5292 – Life support system for space missions	378
2SC5293 – Advanced supervision of biogas production from waste	381
ST5 – 53 – AUTONOMOUS AND CONNECTED VEHICLE.....	384
2SC5310 – Architecture and technology of the autonomous vehicle	388
2SC5390 – Design of a "last mile" urban delivery system using autonomous and connected vehicles	391
ST5 – 54 – THE ECO-NEIGHBORHOOD, A COMPLEX SYSTEM. SUSTAINABLE DEVELOPMENT & COMPLEX PROJECT MANAGEMENT	394
2SC5410 – Sustainable urban planning and development.....	397
2SC5490 – Design project for an eco-neighborhood.....	400
ST5 – 55 – LIGHT AND MATTER : DEVELOPMENT OF HIGH TECHNOLOGY INSTRUMENTS	402
2SC5510 – Physics of matter	404
2SC5591 – Synchrotron Beamline design.....	407
2SC5592 – Quantum cascade lasers.....	410
ST5 – 56 – MULTI-ENERGY SYSTEMS	413
2SC5610 – Introduction to energy production.....	416
2SC5691 – Regulation and control of energy production and conversion systems	419
2SC5692 – Hybrid power train.....	423
2SC5693 – Hybrid aeronautical propulsion	425
ST5 – 57 – CONTROL OF ACOUSTIC AND ELECTROMAGNETIC POLLUTION	428
2SC5710 – Theory and algorithmics for wave control.....	432
2SC5791 – Design of a cladding : Control of external acoustic pollution.....	437
2SC5792 – Design of a cladding : Indoor noise pollution control.....	440
2SC5793 – Design of a coating : Control of electromagnetic pollution.....	443
ST5 – 58 – COMPLEX INDUSTRIAL AND CRITICAL SYSTEMS WITH DOMINANT SOFTWARE.....	445
2SC5810 – Design and verification of critical systems	448
2SC5891 – Design of a safe signaling system for the railways	451
2SC5893 – Intelligent system for automated control of air traffic.....	453
2SC5894 – Design and analysis of production systems for smart factories .	455
ST5 – 59 – ASSISTANCE AND AUTONOMY OF THE PERSON	457
2SC5910 – Control of a motorization chain.....	459
2SC5990 – Design of a motorised wheelchair for people with reduced mobility.....	461
ST5 – 60 – SEMI-AUTONOMOUS NAVIGATION OF DRONES	463



2SC6010 – Autonomous Robotics	465
2SC6090 – Building inspection by a semi-autonomous drone (quadricopter)	468
ST5 – 61 – SMART PHOTONICS SYSTEMS FOR CONTROL AND MEASURE.....	470
2SC6110 – Photonics for the control of physical systems.....	472
2SC6190 – Laser remote sensing (LIDAR) for optronic surveillance and target detection.....	474
ST5 – 62 – ENERGY INTELLIGENCE.....	476
AND SMART BUILDING	476
2SC6210 – High energy performance communications	479
2SC6291 – Hierarchical management of thermal comfort.....	483
2SC6292 – Remote control of thermal comfort	486
ST5 – 63 – SMART AND EMBEDDED SYSTEMS FOR HEALTH	488
2SC6310 – System Architecture and Modeling	490
2SC6390 – Smart system for personalized blood glucose control	492
ST5 – 64 – MODELLING AND DEVELOPMENT OF SUPERVISION SOFTWARE ...	494
2SC6410 – Data models and design schemas.....	496
2SC6490 – Development of a sensor monitoring system	499
SCIENCE AND ENGINEERING CHALLENGE N°7 COURSES	501
ST7 – 71 – STOCHASTIC FINANCE AND RISK MODELLING	502
2SC7110 – Stochastic Finance and risk modelling.....	504
2SC7190 – Risk Management on financial markets	505
ST7 – 72 – OPTIMIZATION OF NETWORK INFRASTRUCTURE FOR SMART CITIES	506
2SC7210 – Game Theory for Smart Cities.....	508
2SC7290 – Smart cities: connected cities	511
ST7 – 73 – CIRCULAR ECONOMY AND INDUSTRIAL SYSTEMS	514
2SC7310 – Circular economy and industrial ecology methods	518
2SC7390 – Circular economy industrial project	522
ST7- 74 – OPTIMIZATION OF PASSENGER TRANSPORT SYSTEMS	523
2SC7410 – Decision Support : Models, algorithms and implementation.....	525
2SC7490 – Passenger transport systems optimization	528
ST7 – 75 – OPTIMIZATION AND MANAGEMENT OF COMPLEX SYSTEMS FLOWS	529
2SC7510 – Managing and optimising industrial flows.....	531
2SC7591 – Flow management in industrial gas delivery	533



ST7 – 76 – HIGH PERFORMANCE SIMULATION FOR FOOTPRINT REDUCTION	535
2SC7610 – Parallel Computing Methods and Algorithms, and Optimization Methods	541
2SC7691 – Optimization of a seismic exploration campaign for infrastructure protection	544
2SC7692 – Shape optimization and drag reduction in aeronautics	549
2SC7693 – Optimization of infrasonic wave detection for verification of the Comprehensive Nuclear-Test-Ban Treaty.....	554
2SC7694 – Energy optimization and acceleration of a cloud financial calculation graph	559
2SC7695 – Low cost optimization of acoustic wave propagation code performance	565
ST7 – 77 – EFFICIENCY OF ON-BOARD ENERGY SYSTEMS	571
2SC7710 – Numerical methods and problem solving for optimizing embedded energy systems	574
2SC7790 – Efficiency of on-board energy systems.....	576
ST7 – 78 – ENERGY TRANSITION IN ISOLATED SITES	577
2SC7810 – Renewable energies and micro grids.....	580
2SC7890 – Insular carbon-free micro grid	583
ST7 – 79 – DIGITAL TECHNOLOGY AT THE SERVICE OF THE HUMAN FACTOR	585
2SC7910 – 2D-3D image and sound analysis.....	587
2SC7990 – What you unwittingly say: decryption and automatic analysis of nonverbal behaviors	590
ST7 – 80 – SOURCE SEPARATION FOR OPTIMAL SIGNAL PROCESSING	594
2SC8010 – Sparse representations of signals	597
2SC8092 – Tracking a speaker by a robot.....	600
2SC8093 – Separation of sound sources from recordings of several microphones	603
2SC8094 – Non-invasive extraction of the fetal electrocardiogram	606
ST7 – 81 – ADDITIVE MANUFACTURING DESIGN	609
2SC8110 – Multiphysical couplings for additive manufacturing	612
2SC8191 – Optimization of aeronautical parts in metal additive manufacturing	614
2SC8192 – Optimization of parts for biomedical applications in polymer additive manufacturing	616
2SC8193 – Optimization of civil engineering structures in additive concrete manufacturing	618
ST7 – 82 – PHYSICAL NEURO-INSPIRATORY SYSTEMS FOR INFORMATION PROCESSING	620



2SC8210 – Optimization for neuro-inspired computing with physical architectures.....	622
2SC8290 – Classification of image and videos signals with power-efficient photonic systems.....	626

INTENSIVE COURSES629

2IN1510 – Understanding blockchain	630
2IN1520 – Risk analysis - INFOSEC.....	633
2IN1570 – Web and mobile application development.....	635
2IN1580 – Artificial intelligence and global health.....	637
2IN2100 – Communicate on sustainable research projects.....	640
2IN2180 – Procurement management.....	643
2IN2310 – Individuals, Work, Organizations	645
2IN2320 – Perspective on Key Social Issues	646
2IN2330 – Science, Technology, Society	648
2IN2340 – Innovation, Arts and Creativity	650
2IN4000 – Business Games.....	652
2IN5010 – Bridge Building challenge	654
2IN5020 – Semiconductor innovation.....	657
2IN5030 – Experimental physics work	659
2IN5050 – Discovery of software defined radio	661
2IN5060 – Audio Signal Processing.....	663
2IN5106 – Marketing and its tools: towards responsible marketing ?	665
2IN5110 – Ethics and Responsibility.....	667
2IN5120 – Public Finances.....	670

LANGUAGE AND CULTURE COURSES.....673

LC0100 – English	674
LC0200 – French as a Foreign Language.....	676
LC0300 – German	678
LC0400 – Spanish.....	680
LC0500 – Italian	681
LC0600 – Portuguese	682
LC0700 – Chinese 2A	683
LC0800 – Japanese.....	684
LC0900 – Russian	685



LC1000 – Arabic	686
LC1100 – French Sign Language	687
LC1200 – Hebrew.....	688
LC1400 – Ukrainian.....	689



CORE CURRICULUM COURSES