

**PEOPLE'S DEMOCRATIC REPUBLIC OF ALGERIA
MINISTRY OF HIGHER EDUCATION AND
SCIENTIFIC RESEARCH**

PROFESSIONAL BACHELOR'S TRAINING OFFER

Field: Earth and Universe Sciences (EUS)

Branch: Geography and Territorial Planning

Specialty: Smart Cities

2025/2026

**Semester Sheets for the Organization of Courses of a
Professional Bachelor in Smart Cities, Divided into
Teaching Units**

Field: EARTH AND UNIVERSE SCIENCES (E.U.S)

Branch: GEOGRAPHY AND TERRITORIAL PLANNING (G.T.P)

Specialty: Smart Cities

Order No of
**Defining the curriculum of the training programme leading to the award of the Professional Bachelor's Degree
in the field of "Earth and Universe Sciences", Branch "Geography and Territorial Planning (GTP)",
Specialty "Smart Cities".**

Semester 01

Teaching Unit	Modules	Credits	Coefficient	Weekly Teaching Hours			WTH (15 weeks)	Other	Evaluation Method	
	Title			Course	DW	PW			CA	Exam
Fundamental TU Code: FTU 1.1 Credits: 17 Coefficient: 9	Territorial Planning	6	4	1h30		03h00	67h30	45h00	40%	60%
	Urban Dynamics and Centrality Systems	6	3	1h30	1h30		45h00	45h00	40%	60%
	Smart Urban Ecosystems	5	2	1h30	1h30		45h00	45h00	40%	60%
Methodological TU Code: MTU 1.1 Credits: 9 Coefficient: 6	Mathematical Thinking in Smart Cities (1)	3	2	1h30	1h30		45h00	45h00	40%	60%
	Physical Systems for Smart Cities (1)	3	2	1h30	1h30		45h00	45h00	40%	60%
	Computer science	3	2	1h30	1h30		45h00	45h00	40%	60%
Discovery TU Code: DTU 1.1 Credits: 2 Coefficient: 1	Urban historical studies	2	1	1h30			22h30	22h30	100%	X
Transversal FU Code: TTU 1.1 Credits: 2 Coefficient: 1	Scientific English 1	2	1	1h30			22h30	22h30	X	100%
Totals Semester 1		30	17	12h00	9h000	01h00	337h30	337h30		

CA: Continuous assessment

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Semester 02

Teaching Unit	Modules	Credits	Coefficient	Weekly Teaching Hours			WTH (15 weeks)	Other	Evaluation Method	
	Title			Course	DW	PW			CA	Exam
Fundamental TU Code : FTU 2.1 Credits: 12 Coefficient: 7	Urban smart strategies	6	4	1h30	1h30		45h00	45h00	40%	60%
	Population data science	6	3	1h30	1h30		45h00	45h00	40%	60%
Methodological TU Code : MTU 2.1 Credits: 6 Coefficient: 4	Mathematical Thinking (2)	3	2	1h30	1h30		45h00	45h00	40%	60%
	Physical Systems (2)	3	2	1h30	1h30		45h00	45h00	40%	60%
Methodological TU Code : MTU 2.2 Credits: 8 Coefficient: 4	Introduction to Geomatic	4	2	1h30	/	3h00	67h30	45h00	40%	60%
	Internship	4	2	/	/	/	45h00	45h00	100%	X
Discovery TU Code : DTU 2.1 Credits: 2 Coefficient: 1	Algorithm and Programming	2	1	1h30	1h30		45h00	45h00	40%	60%
Transversal FU Code : TTU 2.1 Credits: 2 Coefficient: 1	Scientific English 2	2	1	1h30			22h30	22h30	X	100%
Totals Semester 2		30	17	10h30	07h30	03h00	360h00	360h00		

CA: Continuous assessment

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Semester 03

Teaching Unit	Modules	Credits	Coefficient	Weekly Teaching Hours			WTH (15 weeks)	Other	Evaluation Method	
	Title			Course	DW	PW			CA	Exam
Fundamental TU Code : FTU 3.1 Credits: 14 Coefficient: 7	Urban planning and land use in smart cities	8	4	1h30		3h00	67h30	45h00	40%	60%
	Urban design (1)	6	3	1h30		3h00	67h30	45h00	40%	60%
Methodological TU Code : MTU 3.1 Credits: 8 Coefficient: 4	Remote sensing	4	2	1h30	1h30		45h00	45h00	40%	60%
	Geographic information systems	4	2	1h30	1h30		45h00	45h00	40%	60%
Methodological TU Code : MTU 3.2 Credits : 6 Coefficient : 4	Topography and surveying	3	2	1h30		3h00	67h30	45h00	40%	60%
	Internet of things (IoT) + ICT	3	2	1h30	1h30		45h00	45h00	40%	60%
Discovery TU Code : DTU 3.1 Credits: 1 Coefficient: 1	Artificial intelligence (1) (AI)	1	1	1h30	1h30		45h00	45h00	40%	60%
Transversal TU Code : TTU 3.1 Credits: 1 Coefficient: 1	Scientific English 3	1	1	1h30			22h30	22h30	X	100%
Totals Semester 3		30	17	12h00	04h30	10H30	405h00	405h00		

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Semester 04

Teaching Unit	Modules	Credits	Coefficient	Weekly Teaching Hours			WTH (15 weeks)	Other	Evaluation Method	
	Title			Course	DW	PW			CA	Exam
Fundamental TU Code : FTU 4.1 Credits: 14 Coefficient: 9	Urban design (2)	5	3	1h30		3h00	67h30	45h00	40%	60%
	Smart infrastructure systems	5	3	1h30		3h00	67h30	45h00	40%	60%
	Geotechnics and project cycle	4	3	1h30	1h30		45h00	45h00	40%	60%
Methodological TU Code : MTU 4.1 Credits: 6 Coefficient: 4	Risk and Climate Change	3	2	1h30	1h30		45h00	45h00	40%	60%
	Urban sociology	3	2	1h30	1h30		45h00	45h00	40%	60%
Methodological TU Code : MTU 4.2 Credits: 6 Coefficient: 2	Urban law and regulations	3	1	1h30	1h30		45h00	45h00	40%	60%
	Mini project - Internship	3	1				45h00	45h00	100%	
Discovery TU Code : DTU 4.1 Credits: 4 Coefficient: 2	Open source	2	1	1h30	1h30		45h00	45h00	40%	60%
	Artificial intelligence (2) (AI)	2	1	1h30	1h30		45h00	45h00	40%	60%
Totals Semester 4		30	17	12h00	09h00	6h00	450h00	405h00		

CA: Continuous assessment

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Semester 05

Teaching Unit	Modules	Credits	Coefficient	Weekly Teaching Hours			WTH (15 weeks)	Other	Evaluation Method	
	Title			Course	DW	PW			CA	Exam
Fundamental TU Code: FTU 5.1 Credits: 15 Coefficient: 09	Smart decision making	5	3	1h30		1h30	45h00	45h00	40%	60%
	Sustainable and smart mobility	5	3	1h30		1h30	45h00	45h00	40%	60%
	Smart building and BIM (building information modeling)	5	3	1h30		3h00	67h30	45h00	40%	60%
Methodological TU Code: MTU 5.1 Credits: 8 Coefficient: 4	Resilience cities and adaptation	4	2	1h30	1h30		45h00	45h00	40%	60%
	Urban cybersecurity	4	2	1h30		1h30	45h00	45h00	40%	60%
Methodological TU Code: MTU 5.2 Credits: 05 Coefficient: 03	Geospasial WEB service	3	2	1h30	1h30		45h00	45h00	40%	60%
	Entrepreneurship	2	1	1h30		1h30	45h00	45h00	40%	60%
Discovery TU Code: DTU 5.1 Credits: 2 Coefficient: 1	Artificial intelligence (3) (AI)	2	1	1h30	1h30		45h00	45h00	40%	60%
Totals Semester 5		30	17	12h00	04h30	09h00	382h30	360h00		

CA: Continuous assessment

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Semester 06

Teaching Unit	Modules	Credits	Coefficient	Weekly Teaching Hours			WTH (15 weeks)	Other	Evaluation Method	
	Title			Course	DW	PW			CA	Exam
Fundamental TU Code : FTU 6.1 Credits: 30 Coefficient: 17	Final Studies Project (FSP) Professional Internship	30	17				360h00		100%	
Totals Semester 6		30	17				360h00			

CA: Continuous assessment

Detailed program by semester and subject spread

Over 15 weeks

Semester: 1
Fundamental Teaching Unit: FTU 1.1
Title of subject: Territorial Planning
Annual hourly volume: 67h30
Credits: 6
Coefficients: 4

Objectives of teaching:

This course introduces the fundamental concepts of territorial planning and equips students with practical skills to read, analyze, and create basic urban plans. Students will explore the purpose and significance of territorial planning, interpret urban plans and maps, and identify the main components of a city, including zones, networks, and infrastructure. The course also provides an understanding of the Algerian planning system and regulations, and engages students in conducting simple field surveys and observations, as well as creating basic urban sketches and diagrams by hand. Emphasis is placed on connecting planning principles to everyday urban life and decision-making.

Course Content

Chapter 1: Introduction to Territorial Planning

- What is territorial planning? Definition in simple terms
- Why do we plan cities? Benefits and goals
- Brief history of cities and urban development in Algeria
- Main actors in planning: government, municipalities, planners, citizens
- Scales of planning: national, regional, local (wilaya, commune)
- Components of territory: Natural components population, land, activities, infrastructure
- Urban vs rural areas: differences and connections
- Basic planning concepts: zoning, land use, density
- Introduction to Algerian planning system (simple overview)

Chapter 3: Analyzing Urban Plans

- Types of maps (topographic, cadastral, urban plans)
- Map elements.
- Understanding symbols and colors on urban plans
- Land use zones: residential, commercial, industrial, green spaces
- Urban equipment: schools, hospitals, markets, mosques
- Transportation networks: roads, public transport, pedestrian paths
- Utility networks: water, electricity, sanitation (basic concepts)
- Algerian planning documents: PDAU (Master Plan) basics
- How to read a PDAU map .

Chapter 3: Basic Planning Practice

- How planning projects are done: steps from idea to implementation
- Data collection: what information planners need
- Simple analysis methods: counting, calculating, comparing
- Planning for population needs: housing, services, infrastructure
- Basic design principles: accessibility, connectivity, mix of uses
- Participation: how citizens are involved in planning
- Planning regulations in Algeria (very basic introduction)
- Examples of good and bad planning (case studies)

Practical Works (PW): Cartographic production, graphical representation, diagram construction, and analytical interpretation

1. Cartographic Analysis of the Natural Components of the City: The main objective of this practical work is to identify, represent, and analyze the natural components within an urban area.

2. Population Density Mapping
3. Urban Growth and Stages of Spatial Expansion in city
4. Urban Zoning, Land Use Organization, and Spatial Structure
5. Spatial Distribution and Accessibility of Urban Facilities
6. Urban Mobility and Flow Dynamics in city

Final Group Project

Title: Neighborhood Analysis and Simple Improvement Plan

Students work in groups of 4-5 to analyze a neighborhood in Batna and propose simple improvements. This project integrates all skills learned during the semester.

Project Steps:

- Select neighborhood and conduct field survey
- Collect data - count equipment, measure distances, take photos
- Draw existing situation map (by hand)
- Identify problems and needs
- Develop simple improvement proposals
- Draw proposal sketch showing improvements
- Prepare presentation poster
- Present to class

Deliverables:

- Existing situation map (hand-drawn, clean)
- Analysis document (problems identified)
- Proposal sketch with improvements
- Photo documentation (before)
- Presentation poster (A1 size)
- Oral presentation (group)

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Hall, P., & Tewdwr-Jones, M. (2019). *Urban and Regional Planning (6th ed.)*. Routledge. [Selected simple chapters]
- Levy, J. M. (2016). *Contemporary Urban Planning (11th ed.)*. Routledge. [Introductory chapters]

Algerian Context

- *Algerian Law 90-29 on Territorial Planning and Urbanism (simplified excerpts)*
- *Guide to reading PDAU documents*
- *Examples of Algerian urban planning projects (case studies)*

Semester: 1
Fundamental Teaching Unit: FTU 1.1
Title of subject: urban dynamics and centrality systems
Annual hourly volume: 45h00
Credits: 6
Coefficients: 3

Objectives of teaching:

This course examines the dynamics of cities and explores the systems of centrality that structure urban space. Students will analyze both external and internal urban dynamics, including functional relationships between cities, city–countryside interactions, urban regions and networks, as well as internal systems of centrality, road networks, and areas of influence. The course also addresses the structural components of the city, focusing on site, situation, and the elements that shape urban form.

The course integrates urban geography, spatial analysis, and planning theory with practical interpretation of urban systems, applied to real territorial contexts and contemporary urban challenges.

Course Content

Chapter 1: External Urban Dynamics

- The city and its functional relationships
- City–countryside relations
- Urban regions and sub-regions
- Urban networks

Chapter 2: Internal Urban Dynamics

- Concepts of the urban system
- Centrality
- Road networks
- Areas of influence and service areas

Chapter 3: Urban Structure

- Site and situation
- Components of the urban structure

Directed Works (DW):

- 1- Introduction to Urban Dynamics
- 2- Functional Relationships Between Cities
- 3- City–Countryside Relations (Part 1)
- 4- City–Countryside Relations (Part 2)
- 5- Urban Regions
- 6- Urban Networks
- 7- Introduction to Internal Urban Dynamics
- 8- Centrality in Urban Space: Types of centrality (commercial, administrative, cultural)
- 9- Road Networks and Urban Form
- 10- Areas of Influence and Service Areas
- 11- Urban Structure

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Rahmani, C. (1982). *La croissance urbaine en Algérie*. OPU, Algiers.
- Braudel, F. (1985). *La dynamique du capitalisme*. Flammarion, Paris.
- Beaujeu-Garnier, J. & Dezert, B. (1999). *La Grande Ville, Enjeu du XIXe siècle*. PUF, Paris.
- Moriconi-Ebrard, F. (2000). *De Babylone à Tokyo: Les grandes agglomérations du monde*. Géophrys.
- Powell, K. (2000). *La Ville de Demain*. Seuil, Paris.
- Pranlas-Descours, P. (Ed.). (2002). *L'Archipel Métropolitain*. Picard, Paris.
- Mangin, D. (2004). *La ville franchisée: Formes et structures de la ville contemporaine*. La Villette, Paris.

Semester: 1

Fundamental Teaching Unit: FTU 1.1

Title of subject: Smart Urban Ecosystems

Annual hourly volume: 45h00

Credits: 5

Coefficients: 2

Objectives of teaching:

This course examines the role of smart technologies in protecting urban ecosystems and explores the principles of smart environmental management in cities. Students will analyze urban ecological systems, digital monitoring mechanisms, and sustainable resource strategies, as well as decision-making processes for smart and resilient urban environments.

Course Content

Chapter 1: Air Quality and Pollution Sensors

- Types of sensors (PM2.5, NO₂, CO, O₃)
- Urban sensor networks
- Connecting sensors to digital platforms
- Real-time data analysis

Chapter 2: Wastewater Treatment and Reuse

- Smart wastewater treatment systems
- Real-time water quality monitoring
- Reuse for irrigation and industry
- Circular water management models

Chapter 3: Decentralized Solid Waste Management Models

- Smart source separation
- Smart waste bins
- Digital waste tracking
- Circular economy models

Chapter 4: Smart Urban Green Spaces

- Smart ecological planning
- Vegetation monitoring sensors
- Smart irrigation systems
- Role of green spaces in pollution reduction

Chapter 5: Smart Environmental Monitoring

- Environmental dashboards
- Early warning systems
- Environmental forecasting models
- Urban decision support

Directed Works (DW):

- 1- Air Quality and Sensor Networks
- 2- Assessment of the Zero-Waste City Performance Index
- 3- Smart Water and Wastewater Management
- 4- Solid Waste and Circular Economy
- 5- Smart Green Spaces
- 6- Dashboards and Decision Support Systems
- 7- Greywater Recycling and Reuse Systems
- 8- Smart Landfill (Technical Landfill) Management Smart Technical Landfills: Classical vs Automated Assessment
- 9- Monitoring and Managing Urban Noise Pollution
- 10- Smart Digital Solutions for Pandemic-Resilient Cities

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Kumar, P., Skouloudis, A. N., Bell, M., Viana, M., Carotta, M. C., Biskos, G., & Morawska, L. (2015). *Real-time sensors for indoor and outdoor air quality monitoring*
- Gikas, P., & Tchobanoglous, G. (2009). *The role of water reuse in urban sustainability*.

Semester: 1**Methodological Teaching Unit: MTU 1.1****Title of subject: Mathematical Thinking I****Annual hourly volume: 45h00****Credits: 3****Coefficients: 2****Objectives of teaching:**

Develop mathematical thinking and analytical skills to model and solve real urban planning problems using mathematical methods.

By the end of this course, students will be able to:

- Apply geometric principles to calculate urban spatial parameters
- Use algebraic methods to model urban networks and systems
- Formulate and solve optimization problems for urban planning
- Analyze and interpret mathematical results in urban context
- Communicate mathematical solutions to planning problems

Course Content**Chapter 1: Urban Geometry and Spatial Mathematics****Topics Covered:**

- Coordinate systems: Cartesian, polar, and geographic coordinates
- Distance calculations: Euclidean, Manhattan, and network distances
- Areas and perimeters: parcels, blocks, neighborhoods, urban zones
- Volumes: water reservoirs, retention basins, urban structures
- Density calculations: population density, building density
- Geometric transformations: translation, rotation, scaling

Mathematical Methods:

- Pythagorean theorem and distance formulas
- Area formulas for polygons and irregular shapes
- Volume formulas for 3D urban structures
- Ratio and proportion calculations

Practical Application: Calculate population density and required public facilities for a new neighborhood in Batna

Chapter 2: Linear Algebra for Urban Networks**Topics Covered:**

- Vectors in urban space: direction, magnitude, operations
- Matrices: representation of urban networks (roads, water, electricity)
- Matrix operations: addition, multiplication, transposition
- Systems of linear equations: urban flow problems
- Matrix solutions: Gaussian elimination, Cramer's rule
- Graph theory basics: nodes, edges, adjacency matrices
- Shortest path problems: Dijkstra's algorithm (conceptual)

Mathematical Methods:

- Vector algebra and geometric interpretation
- Matrix arithmetic and determinants
- Solving systems using elimination methods
- Graph representation using matrices

Practical Application: Model water distribution network and calculate optimal flow rates in a district

Chapter 3: Optimization Mathematics for Urban Planning**Topics Covered:**

- Functions in urban context: cost, distance, efficiency
- Extrema: finding minimum and maximum values
- Optimization without constraints: facility location problems
- Optimization with constraints: budget and space limitations
- Linear programming: graphical method for 2 variables
- Feasible regions and optimal solutions
- Multi-objective optimization: balancing competing goals

Mathematical Methods:

- Function analysis and critical points
- Derivative concepts for optimization (introduction)
- Linear programming setup and graphical solution
- Constraint formulation and feasibility analysis

Directed Works (DW):

- 1- Calculate population density and required public facilities for a new neighborhood in Batna
- 2- Model water distribution network and calculate optimal flow rates in a district
- 3- Optimize placement of public fountains to minimize average distance while respecting budget constraints
- 4- Integrated Final Project

Title: Mathematical Planning of a New Urban District

Students work in groups (3-4 people) to solve a comprehensive urban planning problem:

- Calculate available land area and geometric constraints
- Use ratios to determine required public facilities (schools, health centers)
- Model street network using graph theory
- Optimize facility placement using mathematical methods

- Formulate constraints (budget, distances, regulations)
- Present mathematical solution with diagrams and calculations

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- *Stewart, J., Redlin, L., & Watson, S. (2015). Precalculus: Mathematics for Calculus. Cengage Learning.*
- *Anton, H., & Rorres, C. (2013). Elementary Linear Algebra: Applications Version. Wiley.*
- *Winston, W. L. (2003). Operations Research: Applications and Algorithms. Thomson Learning.*
- *Batty, M. (2013). The New Science of Cities. MIT Press.*
- *Wilson, A. G. (2000). Complex Spatial Systems: The Modelling Foundations of Urban and Regional Analysis. Pearson.*

Semester: 1

Methodological Teaching Unit: MTU 1.1

Title of subject: Physical Systems for Smart Cities (1)

Annual hourly volume: 45h00

Credits: 3

Coefficients: 2

Objectives of teaching:

To provide students with fundamental electrical knowledge required to understand, operate, and design electrical systems in smart and sustainable cities.

Course Content

Chapter 1: Fundamentals of Electricity

- Electric charge and electric current
- Voltage, resistance, power, electrical energy
- Ohm's Law
- Series and parallel circuits
- Kirchhoff's laws (current and voltage laws)
- Direct Current (DC) vs Alternating Current (AC)
- Applications to Smart Cities
- Public lighting systems
- Power supply of urban sensors
- Basic electrical installations in buildings

Chapter 2: Electrical Components and Circuits

- Resistors, capacitors, inductors
- Energy storage principles
- RC and RL circuits (introductory level)
- Electrical safety principles
- Applications
- Energy efficiency in smart buildings
- Electrical stability in connected devices

Chapter 3: Urban Electrical Power Systems

- Structure of electrical power systems
- Generation
- Transmission
- Distribution
- Low-voltage and medium-voltage networks
- Electrical losses and efficiency
- Power quality basics (frequency, voltage stability)
- Applications
- City-scale electrical infrastructure
- Urban distribution networks

Chapter 4: Smart Grids and Intelligent Electrical Networks

- Definition and principles of Smart Grids
- Bidirectional energy flow
- Smart meters (e.g. intelligent electricity meters)
- Real-time monitoring and control
- Demand-side management
- Applications
- Energy optimization
- Integration of renewable energy
- Reduction of peak demand

Chapter 5: Electricity and Renewable Energy Sources

- Photovoltaic energy (basic physical principles)
- Wind power (electrical conversion basics)
- Distributed energy generation
- Grid connection of renewable systems
- Applications
- Solar-powered buildings
- Urban micro-generation systems

Chapter 6: Electrical Measurement and Instrumentation

- Measurement of voltage, current, power
- Sensors and transducers
- Data acquisition basics
- Introduction to IoT electrical sensors
- Applications
- Monitoring urban energy consumption
- Smart meters and sensor networks

Directed Works (DW):

- 1- Public lighting systems
- 2- Power supply of urban sensors
- 3- Basic electrical installations in buildings
- 4- Energy efficiency in smart buildings
- 5- Electrical stability in connected devices
- 6- City-scale electrical infrastructure

- 7- Urban distribution networks
- 8- Integration of renewable energy
- 9- Reduction of peak demand
- 10- Solar-powered buildings
- 11- Urban micro-generation systems
- 12- Monitoring urban energy consumption
- 13- Smart meters and sensor networks

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Halliday, D., Resnick, R., & Walker, J. (2018). *Fundamentals of Physics (11th ed.)*. Wiley.
- Boylestad, R. L., & Nashelsky, L. (2016). *Electronic Devices and Circuit Theory (11th ed.)*. Pearson.
- Grainger, J. J., & Stevenson, W. D. (1994). *Power System Analysis*. McGraw-Hill.
- Fang, X., Misra, S., Xue, G., & Yang, D. (2012). Smart grid—The new and improved power grid: A survey. *IEEE Communications Surveys & Tutorials*, 14(4), 944–980.
<https://doi.org/10.1109/SURV.2011.101911.00087>
- Boyle, G. (2012). *Renewable Energy: Power for a Sustainable Future (3rd ed.)*. Oxford University Press.

Semester: 1

Methodological Teaching Unit: MTU 1.1

Title of subject: Computer science

Annual hourly volume: 45h00

Credits: 3

Coefficients: 2

Objectives of teaching:

Understand fundamental computer science concepts, computer architecture, operating systems, networks, and practical digital skills needed for smart city applications.

By the end of this course, students will be able to:

- Understand computer architecture and how computers work
- Use operating systems efficiently (Windows and Linux basics)
- Manage files, folders, and data organization
- Understand networking and Internet fundamentals
- Apply basic cybersecurity practices
- Use productivity software (word processors, spreadsheets)
- Understand open-source software and licenses
- Work with digital data formats relevant to urban planning

Course Content

Chapter 1: Computer Architecture and Hardware

Topics Covered:

- Computer components: CPU, RAM, storage devices, motherboard
- Input devices: keyboard, mouse, scanner, sensors
- Output devices: monitor, printer, speakers

- Data representation: bits, bytes, binary system basics
- Storage hierarchy: cache, RAM, hard drive, cloud
- Computer performance factors: speed, memory, storage
- Types of computers: desktop, laptop, server, mobile devices

Chapter 2: Operating Systems and File Management

Topics Covered:

- What is an operating system? Functions and roles
- Popular operating systems: Windows, Linux, macOS
- File systems: organizing data on disk
- File types and extensions: .txt, .docx, .pdf, .jpg, .csv, .shp
- Directory structure and paths
- File operations: create, copy, move, delete, rename
- File permissions and access control
- Command line basics: terminal/command prompt introduction

Chapter 3: Networks and Internet

Topics Covered:

- Network fundamentals: LAN, WAN, Internet
- Network devices: router, switch, modem, access point
- IP addresses and DNS: how computers find each other
- Internet protocols: HTTP, HTTPS, FTP, SSH
- Web browsers and search engines
- Cloud computing basics: storage, services, applications
- Email systems and communication tools

Chapter 4: Cybersecurity and Data Privacy

Topics Covered:

- Cybersecurity threats: viruses, malware, phishing, ransomware
- Password security: creating strong passwords, password managers
- Two-factor authentication (2FA)
- Safe browsing practices
- Data backup and recovery
- Privacy concerns: personal data protection
- Social engineering awareness

Chapter 5: Productivity Software and Digital Tools

Topics Covered:

- Word processors: creating professional documents
- Spreadsheets: organizing and analyzing data
- Presentation software: creating effective presentations
- PDF documents: creating, editing, converting
- Digital collaboration tools: shared documents, version control
- Open source alternatives: LibreOffice, GIMP, Inkscape
- Data formats for urban planning: CSV, GeoJSON, KML, Shapefile

Directed Works (DW):

- 1- Identify computer parts - open a computer case, label components
- 2- Compare specifications - evaluate different computers for tasks
- 3- Binary exercises - convert decimal to binary and vice versa
- 4- Storage calculations - bytes, KB, MB, GB, TB conversions
- 5- Hardware troubleshooting scenarios - diagnose common problems
- 6- Final Project

Title: Digital Portfolio: Computer Skills for Smart Cities

Description:

Students create a comprehensive digital portfolio demonstrating all skills learned.

Portfolio Components:

- Part 1: Computer System Report - document your computer specifications, explain components
- Part 2: File Organization System - create logical folder structure for urban planning files
- Part 3: Network Diagram - draw and explain a simple network setup
- Part 4: Security Checklist - cybersecurity best practices document
- Part 5: Data Analysis Exercise - use spreadsheet to analyze urban dataset
- Part 6: Presentation - present one smart city technology topic

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- *Parsons, J. J., & Oja, D. (2018). New Perspectives on Computer Concepts. Cengage Learning.*
- *Vermaat, M. E., et al. (2017). Discovering Computers. Cengage Learning.*
- *Evans, A., Martin, K., & Poatsy, M. A. (2019). Technology in Action. Pearson.*

Semester: 1

Discovery Teaching Unit: DTU 1.1

Title of subject: Urban Historical Studies

Annual hourly volume: 22h30

Credits: 1

Coefficients: 1

Objectives of teaching:

This course aims to explore the historical evolution of cities and to analyze how social, economic, political, and cultural factors have shaped urban development across different periods.

It also seeks to link past urban forms to present challenges and future trends, particularly within the frameworks of smart cities and sustainable urban planning.

Course Content**Chapter: Introduction to Urban Historical Studies**

- Definition and scope of urban studies.
- The historical concept of the city and its evolution.

Chapter 2: Ancient Cities

- Urban planning in ancient civilizations: Egyptian, Babylonian, Greek, and Roman cities.
- Architectural and urban forms of ancient cities.

Chapter 3: Medieval Urban Development

- The influence of religion, wars, and feudalism on city planning.
- The role of markets, trade, and transport in medieval cities.

Chapter 4: Modern Cities in the 19th and 20th Centuries

- Urban expansion during the Industrial Revolution.
- Social and economic transformations and their impact on urban planning.

Chapter 5: Cities in the Digital Age

- Smart cities and technological innovations in urban development.

- Environmental and economic challenges in modern urban planning.

Assessment Methods

- Exam (100%)

Bibliography and References

Books:

- "The City in History" by Lewis Mumford
- "A History of the City of New York" by George H. Smith
- "Urban Forms and Historical Processes" by David J. Harvey

Semester: 1

Transversal Teaching Unit: TTU 1.1

Title of subject: Scientific English 1

Annual hourly volume: 22h30

Credits: 1

Coefficients: 1

Objectives of teaching:

The aim is to develop the following four skills in this subject: listening comprehension, reading comprehension, speaking and writing through reading and studying texts.

Course Content

We suggest below the themes that deal with the sciences of territorial planning and smart cities. The teacher can choose from these subject texts to develop them during the course and advance the scientific language.

- Territorial Planning
- Artificial intelligence
- Climate change
- Natural resources and renewable energies
- Pollution
- Sustainable development
- Risk management
- Smart cities

Assessment Methods

- Exam (100%)

Bibliography and References

- *English Profile Introducing the CEFR for English (UCLES/CUP 2011)*
- *Common European Framework of Reference for Languages: Learning, Teaching, Assessment - Companion volume (2020)*
- *CEFR-informed Learning, Teaching and Assessment: A Practical Guide (2020)*
-

Semester: 2
Fundamental Teaching Unit: FTU 2.1
Title of subject: urban smart strategies
Annual hourly volume: 45h00
Credits: 6
Coefficients: 4

Objectives of teaching:

This course examines the principles of sustainable and smart urban development and explores the strategic approaches adopted by cities to respond to environmental, social, and climate challenges. Students will analyze the evolution of the concept of sustainable development through international agendas, the foundations of sustainable urbanism, and the use of performance indicators to assess urban sustainability.

Recommended Prerequisites:

Environmental studies, and introductory sustainability concepts

Course Content

Chapter 1: Introduction to Sustainable Development

- Evolution of the concept and objectives

Chapter 2: Sustainable Urban Development: definition, evolution of the concept, and objectives

- Evolution of the concept according to international agendas (Agenda 21, Habitat I, II, III)
- Measurement indicators

Chapter 3: Urban Sustainability Strategies

- Smart City
- Green City
- Short-Distance City (15-minute / proximity-based city)
- Participatory City
- Resilient City
- Regenerative city
- Zero-Carbon and Zero Waste Strategy Strategies
- Net Zero Energy Urban Strategy

Chapter 4: Sustainable Urban Transport

Chapter 5: Climate and Sustainable Urban Form (Urban Heat Island formation)

Chapter 6: Planning of Public Spaces (Green Spaces and Sustainability)

Practical Work

- Measuring Sustainable Development Indicators (SDI, HDI)
- Measuring Sustainable Urban Development (NZE, KPI)
- Measuring Energy Flows in Urban Ecosystems
- Measuring Indicators of Urban Form: Integration and Compactness
- Analysis of Urban Sustainability Indicators Related to the Use of Renewable Energy in Urban Planning
- Sustainable Urban Mobility: Principles of Implementation and Models
- Architectural and Urban Treatments and Their Relationship to Climate Change
- Measuring Green Space Indicators (Siemens Index)
- Field or Applied Studies on Sustainable Urban Development (in the form of research projects)

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- De Herde, A., & Liébard, A. (2005). *Traité d'architecture et d'urbanisme bioclimatiques*.
- Ministry of Ecological Transition. (2012). *Guide to Sustainable Urban Planning*. French Government.
- UN-Habitat. (2012). *Urban Planning for City Leaders*. United Nations Human Settlements Programme.
- ICLEI. (2020). *Local Renewables Guidebook*. ICLEI – Local Governments for Sustainability.
- Hall, P. (2002). *Cities of Tomorrow: An Intellectual History of Urban Planning and Design in the Twentieth Century*. Wiley-Blackwell.
- Girardet, H. (2008). *Cities, People, Planet: Urban Development and Climate Change*. Wiley.
- United Nations. (1993). *Agenda 21: Earth Summit – The United Nations Programme of Action from Rio*. United Nations Publications.

Semester: 2

Fundamental Teaching Unit: FTU 2.1

Title of subject: Population Data Science

Annual hourly volume: 45h00

Credits: 6

Coefficients: 4

Objectives of teaching:

This course examines the fundamental principles of demography and explores the main mechanisms that shape population change over time and space. Students will analyze demographic data sources, natural population movement, fertility and mortality patterns, demographic transition, and population structures using quantitative and analytical tools.

The course integrates statistical methods, demographic models, and population theories with the study of migration processes, both internal and international, and their social, economic, and territorial impacts.

Recommended Prerequisites:

Basic statistics, human geography, and introductory social sciences

Course Content

Chapter 1: Introduction, definition of demography

Chapter 2: Sources of Demographic Data

- Census data
- Vital statistics
- Surveys (national, regional, global)
- Big data

Chapter 3: Natural Population Movement

- Types of population growth worldwide (Malthusian perspective)
- Various demographic rates:
 - ✓ Birth rate/Death rate/Infant mortality/
 - ✓ Fertility rate/Average and final offspring per woman
- Demographic transition theory
- Life table (abridged)
- Nuptiality table (Average age at first marriage)
- Reproduction table
- Age and time evolution (Lexis diagram)
- Generations and cohorts

- Multipliers or Sprague coefficients

Chapter 4: Migrations

- Definitions, types, rates, and indices
- Migration flows
- International migration:
 - ✓ Evolution and characteristics
 - ✓ Historical overview
 - ✓ New trends (including irregular migration)
- Internal migration:
 - ✓ Rural exodus

Directed Works (DW):

- 1- Sources of Demographic Data Focus: Data collection methods in demography and Big Data in population analysis
- 2- Delimitation of Statistical Districts
- 3- Calculating Population Growth Rates (PGR) Using Different Methods
 - ✓ Traditional (Classical) Method
 - ✓ Digital / Automated Method Using Software Tools
- 4- Measuring Crude Birth Rate and Comparative Analysis
- 5- Reproduction Table (Comparative Analysis)
- 6- Mortality Rates – Analysis and Interpretation
- 7- Standardization of the Crude Death Rate (CDR)
- 8- Life Table (Abridged)
- 9- Age-Time Analysis (Lexis Diagram)
- 10- Demographic Transition Theory and Identification of Its Stages
- 11- Measuring Natural Population Growth Rates
- 12- Calculation of Migration Rates (Immigration, Emigration, and Net Migration)
 - ✓ Population Estimation and Projection: Traditional Methods Vs Computer-Base Demographic Modelling (Spectrum MortPak)

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- George, P. (1972). *Population et peuplement*. Collection SUP. Paris: PUF.
- George, P. (1951). *Introduction à l'étude de la population du monde*. Paris: PUF.
- Brahimi, R. (1998). *Démographie algérienne*. Collections statistiques No. 17. Algiers.
- Henri, L. (1984). *La démographie: analyse et type* (Translated by Djilali Sari). Algiers: OPU.
- Pressa, R. (1985). *Analyse démographique* (Translated by M. R. Rabia). Algiers: OPU.
- Kouaouci, A. (1994). *Elements of demographic analysis*. Algiers: OPU.
- Dekkar, N., Khaldoun, H., Lamri, L., & Boumghar, L. (1999). *La démographie algérienne face aux grandes questions de société*. CENEAP.
- Noin, D. (1998). *Geography of population*. Paris: Armand Colin.

Semester: 2
Methodological Teaching Unit: MTU 2.1
Title of subject: Mathematical Thinking (2)
Annual hourly volume: 45h00
Credits: 3
Coefficients: 2

Objectives of teaching:

Learn practical mathematical methods to analyze urban data, calculate statistics, and make simple predictions for planning purposes.

By the end of this course, students will be able to:

- Calculate basic statistics from urban datasets (average, percentage, growth)
- Understand probability basics for urban risk assessment
- Analyze trends in urban data over time
- Make simple forecasts for population and urban services
- Present statistical results with clear graphs and tables

Course Content

Chapter 1: Basic Statistics for Urban Data

- Collecting and organizing urban data in tables
- Calculating averages (mean, median, mode)
- Understanding data spread: range and standard deviation
- Percentages and proportions in urban context
- Growth rates: calculating population or infrastructure growth
- Simple correlation: do two variables move together?
- Creating frequency tables and histograms
- Reading and interpreting statistical graphs

Practical Application: Calculate average household size, water consumption per capita, and growth rates for Batna districts

Chapter 2: Simple Probability and Urban Risks

- What is probability? Basic concepts and notation
- Calculating simple probabilities: events and outcomes
- AND and OR rules for combining probabilities
- Expected value: what to expect on average
- Introduction to risk: high probability vs low probability events
- Urban applications: accident risk, flood risk, service failure
- Using probability to make planning decisions

Practical Application: Assess probability of traffic accidents at intersections; calculate risk of water supply interruption

Chapter 3: Trends and Simple Forecasting

- Understanding trends: is data going up, down, or staying stable?
- Plotting data over time: line graphs
- Calculating simple growth rates: year-to-year changes
- Average growth method for prediction
- Linear trend forecasting: drawing the best-fit line
- Percentage increase method: compound growth
- Understanding forecast limitations and uncertainty
- Comparing actual vs predicted values

Directed Works (DW):

- 1- Calculate average household size, water consumption per capita, and growth rates for Batna districts.
- 2- Assess probability of traffic accidents at intersections; calculate risk of water supply interruption
- 3- Forecast Batna population for 2030 and 2035; predict future water demand based on historical consumption
- 4- **Integrated Final Project**
 - Collect real data for a district (population, services, infrastructure)
 - Calculate basic statistics: averages, growth rates, percentages
 - Create clear tables and graphs showing the data
 - Identify trends in the data over recent years
 - Make simple forecasts for 5-10 years ahead
 - Calculate needed infrastructure based on projections
 - Present findings with visual aids (posters, charts)

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Bluman, A. G. (2017). *Elementary Statistics: A Step by Step Approach*. McGraw-Hill.
- Donnelly, R. A. (2019). *Business Statistics for Dummies*. Wiley.
- Levine, D., Stephan, D., & Szabat, K. (2017). *Statistics for Managers Using Microsoft Excel*. Pearson.
- Rumsey, D. (2016). *Statistics For Dummies*. Wiley.
- Wheelan, C. (2013). *Naked Statistics: Stripping the Dread from the Data*. W. W. Norton.

Semester: 2
Methodological Teaching Unit: MTU 2.1
Title of subject: Physical Systems (2)
Annual hourly volume: 45h00
Credits: 3
Coefficients: 2

Objectives of teaching:

By the end of this course, students will be able to:

- Understand basic fluid physics
- Analyze simple fluid flows
- Apply fluid mechanics principles to urban infrastructure
- Link fluid behavior to energy, environmental considerations, and smart city systems

Course Content

Chapter 1: Introduction to Fluid Mechanics

- Key concepts
- Definition of a fluid (liquids & gases)
- Continuum hypothesis
- Fluid properties:
- Density
- Viscosity
- Pressure
- Temperature

Chapter 2: Fluid Statics (Fluids at Rest)

- Content
- Pressure in fluids
- Hydrostatic pressure
- Pascal's law
- Forces on submerged surfaces
- Buoyancy and Archimedes' principle

Chapter 3: Fluid Kinematics (Description of Flow)

- Content
- Flow types:
- Steady / unsteady
- Uniform / non-uniform
- Laminar / turbulent
- Velocity field
- Streamlines and flow visualization
- Flow rate and continuity equation

Chapter 4: Fluid Dynamics (Forces and Energy in Flow)

- Content
- Conservation of mass
- Conservation of energy
- Bernoulli's equation
- Head losses and friction
- Basic introduction to pressure losses in pipes

Chapter 5: Flow in Pipes and Urban Networks

- Content
- Internal flows
- Reynolds number
- Laminar vs turbulent flow
- Darcy–Weisbach equation (introductory level)
- Simple pipe network analysis

Chapter 6: Air Flow and Urban Ventilation

- Content
- Basics of gas flow
- Natural and forced convection
- Urban wind effects
- Introduction to ventilation principles

Chapter 7: Fluid Mechanics & Environment

- Content
- Pollution transport in air and water
- Dispersion principles (qualitative)
- Urban runoff and stormwater flow

Chapter 8: Introduction to Smart Monitoring & Sensors

- Content
- Flow measurement methods:
- Flow meters
- Pressure sensors
- Data acquisition basics
- Role of IoT in fluid systems

Directed Works (DW):

- 1- Pressure Measurement Experiments: Calculate pressure at various depths and compare experimental data against theoretical predictions to evaluate measurement error.
- 2- Flow Rate Measurement in Pipes: Understanding flow rate is critical for industrial piping and hydraulic systems. This experiment focuses on the application of the Continuity Equation and Bernoulli's Principle.
 - Key Concept: Bernoulli's Principle, which relates pressure, velocity, and elevation. Flow rate $Q=S.V$ is measured by calculating the pressure drop across a restriction.
 - Equipment: Venturi Meter: A smooth, tapered constriction.
Orifice Plate: A thin plate with a hole, causing a sudden pressure drop.
- 3- Numerical or Software-Based Simulations: Bridge the gap between physical experiments and virtual models using Computational Fluid Dynamics (CFD).
- 4- Mini-Project: Smart Water Network Case Study: This project applies fluid principles to modern infrastructure challenges like leak detection and efficiency.

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Munson, B. R., Young, D. F., Okiishi, T. H., & Huebsch, W. W. (2013). *Fundamentals of Fluid Mechanics* (7th ed.).
- Streeter, V. L., & Wylie, E. B. (1998). *Fluid Mechanics* (9th ed.). McGraw-Hill.
- Kundu, P. K., Cohen, I. M., & Dowling, D. R. (2015). *Fluid Mechanics, Chapters 2–5*.

- Çengel, Y. A., & Cimbala, J. M. (2014). *Fluid Mechanics: Fundamentals and Applications (3rd ed.)*. McGraw-Hill.
-

Semester: 2
Methodological Teaching Unit: MTU 2.1
Title of subject: Introduction to Geomatic
Annual hourly volume: 67h30
Credits: 4
Coefficients: 2

Objectives of teaching:

The objective of this course is to provide students with a solid theoretical and practical foundation in geomatics, Geographic Information Systems (GIS), and remote sensing. It aims to develop the ability to understand, analyze, manage, and visualize spatial data for decision-making in various applied fields.

Chapter1: Geomatics

- ❖ Definition of fundamental concepts
- ❖ Disciplines of geomatics:
 (Cartography, Geographic Information Systems (GIS), Computer Science, Aerial and Satellite Imaging, Geodesy, Topometry, Remote Sensing, Photogrammetry, Mathematics)
- ❖ Applications of geomatics

Chapter 2: Geographic Information Systems (GIS)

- ❖ Components of a GIS (hardware, software, data, users, etc.)
- ❖ Geographic databases
- ❖ Main GIS functions (geoprocessing, geovisualization, geodatabases)
- ❖ Fields of GIS application
- ❖ Advantages of using GIS

Chapter 3: Remote Sensing

- ❖ Principles of operation
- ❖ Electromagnetic radiation
- ❖ Satellite systems
- ❖ Multispectral signatures
- ❖ Spatial, spectral, temporal, and radiometric resolution
- ❖ Fields of application of remote sensing

- ❖ Advantages of using remote sensing

Directed Works (DW):

- ❖ Getting started with GIS software
- ❖ Loading raster and vector data
- ❖ Identifying data types (raster / vector)
- ❖ Displaying coordinates
- ❖ Changing the projection system
- ❖ Using basic tools (zoom, selection, navigation)
- ❖ Geographic databases
- ❖ Geoprocessing
- ❖ Geovisualization
- Loading satellite images (e.g., Landsat)
- Displaying bands (RGB)
- Supervised classification
- Producing a land use/land cover (LULC) map
- Classification validation

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

References

- Burrough, P. A., McDonnell, R. A., & Lloyd, C. D. (2015). Principles of Geographical Information Systems (3rd ed.). Oxford University Press.
- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). Geographic Information Science and Systems (4th ed.). Wiley.
- DeMers, M. N. (2018). Fundamentals of Geographic Information Systems (6th ed.). Wiley.
- Introductory Digital Image Processing: A Remote Sensing Perspective (4th ed.). Pearson.
- Lillesand, T. M., Kiefer, R. W., & Chipman, J. W. (2015). Remote Sensing and Image Interpretation (7th ed.). Wiley.

Semester: 2
Methodological Teaching Unit: MTU 2.1
Title of subject: Internship
Annual hourly volume: 45h00
Credits: 4
Coefficients: 2

Objectives of teaching:

The internship module aims to enable students to apply theoretical knowledge acquired during their academic training in a real professional environment. It seeks to develop practical skills, professional responsibility, and autonomy while familiarizing students with workplace practices, tools, and organizational structures. The module also aims to strengthen students' employability and facilitate their integration into the labor market.

Semester: 2
Discovery Teaching Unit: DTU 2.1
Title of subject: Algorithms and Programming
Annual hourly volume: 45h00
Credits: 2
Coefficients: 1

Objectives of teaching:

The course emphasizes practical skills including creating interactive maps and dashboards, automating spatial workflows for site suitability and accessibility analysis, and integrating diverse urban datasets from APIs, sensors, and open data portals

Recommended Prerequisites:

Basic computer literacy, introductory statistics, and familiarity with digital tools

Course Content

Chapter 1: Introduction to Programming

- Introduction
- Oriented Object Programming
- Scripting & General programming (Javascript; HTML for Web)
- Data Structures
- Graph structures
- Setting up development environments

Chapter 2: Python Programming Language

- Inputs & outputs
- Syntax
- Keywords
- Operators and expressions
- Control flow
- Functions
- Modules
- Exceptions
- Data structures
- Debugging and error handling

Chapter 3: Into the GIS World

- Prepare python for GIS environment
- Handle vector data visualization
- Handle vector data algorithm
- Handle raster data
- Surface Data Algorithm
- Mapping

Chapter 4: Data Manipulation and Automation

- Reading urban datasets (CSV, JSON, XML, Excel)
- Connecting to urban databases (PostgreSQL/PostGIS, SQLite)
- Libraries (Pygis)
- RESTful APIs for urban data retrieval (OpenWeatherMap, Transit APIs)
- Building simple web-based urban dashboards Mini project.

Directed Works (DW) :

- 1- From Problem to Algorithmic Solution
 - ✓ Declaration
 - ✓ Assignment
 - ✓ Input/Output

- ✓ Sum
- ✓ Parity
- ✓ Conversion
- ✓ Permutation
- ✓ Order of Precedence
- ✓ Flowchart
- ✓ Procedure

2- Series: 02

- ✓ Maximum
- ✓ Minimum
- ✓ Mean
- ✓ Median
- ✓ Flowchart
- ✓ Procedure

3- Series: 03

- ✓ Arrays
- ✓ Sorting
- ✓ Factorial
- ✓ Flowchart
- ✓ Procedure

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- *The Quick Python Book, 4th Edition*
- *Mastering Geospatial Analysis with Python* Paul Crickard, Eric van Rees, Silas Toms

Semester: 2

Transversal Teaching Unit: TTU 2.1

Title of subject: Scientific English 2

Annual hourly volume: 22h30

Credits: 2

Coefficients: 1

Objectives of teaching:

The chosen texts must be used to study scientific and technical English and Grammar acquisition.

The texts must be selected according to the vocabulary built up, familiarization with both scientific and technical matters.

Recommended Prerequisites:

Academic english

Course Content

The teacher can choose from these subject texts to develop them during the course and advance the scientific language.

- Strategic planning
- The sustainable city
- The geographical information system
- The remote detection
- Policy decision and planning

Assessment Methods

- Exam (100%)

Bibliography and References

- *English Profile Introducing the CEFR for English (UCLES/CUP 2011)*
- *Common European Framework of Reference for Languages: Learning, Teaching, Assessment - Companion volume (2020)*
- *CEFR-informed Learning, Teaching and Assessment: A Practical Guide (2020)*

Semester: 3
Fundamental Teaching Unit: FTU 3.1
Title of subject: Urban planning and land use in smart cities
Annual hourly volume: 67h30
Credits: 8
Coefficients: 4

Objectives of teaching:

This course examines the principles of smart urban form, density, and transit-oriented development, exploring their impacts on energy consumption, mobility, and quality of life. Students will analyze advanced zoning and land-use strategies, integrating digital tools and data-driven planning to design sustainable, resilient, and multifunctional urban neighborhoods. The course also emphasizes the planning and rehabilitation of existing urban areas, with a focus on smart infrastructure, environmental integration, and social and economic vibrancy.

Recommended Prerequisites:

Basic urban planning, GIS, environmental studies, and introductory concepts of sustainable development.

Course Content

Chapter 1: Smart Urban Form & Density

- Concepts of smart urban morphology and compact cities
- Density indicators: floor area ratio, population density, land coverage
- Impacts on energy, mobility, public services, and quality of life
- Digital modeling of urban form using GIS and simulation tools

Chapter 2: Zoning and Land-Use Strategies

- Traditional approaches vs flexible and dynamic zoning
- Mixed-use zoning to encourage multifunctional neighborhoods
- Integration of environmental constraints and green infrastructure
- Smart monitoring of land use via IoT and satellite imagery
- Policy frameworks for sustainable urban growth

Chapter 3: Transit-Oriented Development (TOD)

- TOD principles: walkability, transport accessibility, multimodal integration
- Planning tools: GIS-based accessibility analysis, mobility simulations
- Impact assessment on traffic, emissions, and land values

Chapter 4: Mixed-Use Development

- Vertical and horizontal integration of residential, commercial, and recreational functions
- Designing vibrant neighborhoods: social, economic, and environmental dimensions
- Integration of smart infrastructure: energy, water, and waste management

Chapter 5: Urban Rehabilitation and Retrofitting

- Adaptive reuse of existing buildings and infrastructure
- Sustainable renovation strategies
- Integration of smart technologies (sensors, IoT, Digital Twin)
- Assessment of energy efficiency, social impact, and resilience

Practical Works (PW):

- 1- Introduction to Smart Urban Planning: Evolution of urban planning paradigms.
- 2- Smart Urban Form and Compact City Theory.

- 3- Urban Density Indicators.
- 4- Impacts of Urban Form.
- 5- Introduction to Zoning Systems.
- 6- Flexible and Dynamic Zoning.
- 7- Mixed-Use Zoning and Urban Vitality.
- 8- Environmental Integration in Land Use.
- 9- Smart Monitoring of Land Use.
- 10- Transit-Oriented Development (TOD).
- 11- Mixed-Use Urban Development and Infrastructure.
- 12- Urban Rehabilitation and Smart Retrofitting (Synthesis PW)

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Giffinger, R., et al. *Smart Cities: Ranking of European Medium-Sized Cities*.
- Calthorpe, P. *The Next American Metropolis: Ecology, Community, and the American Dream*.
- Neirotti, P., et al. *Current Trends in Smart City Initiatives: Technologies, Policies, and*

Semester: 3

Fundamental Teaching Unit: FTU 3.1

Title of subject: Urban Design (1)

Annual hourly volume: 67h30

Credits: 6

Coefficients: 4

Objectives of teaching:

This course introduces students to the fundamental skills of urban site analysis and design, emphasizing both material and non-material components of the urban environment. Students will learn to apply urban design principles to produce preliminary design solutions that respond to contemporary urban challenges. The course combines theoretical knowledge with practical application, equipping students with tools to analyze the morphological, functional, visual, and social dimensions of urban spaces, and to translate their analysis into informed design decisions.

Recommended Prerequisites:

Basic urban studies, GIS.

Course Content

Chapter 1: Introduction to Urban Design and Field Analysis

- Definition, objectives, and areas of intervention of urban design
- Importance of urban design
- Tools and methods for fieldwork

Chapter 1: Morphological and Functional Analysis of the City

- Theories of urban fabric formation: street networks, plot patterns, building forms
- Functional analysis: land use, diversity, density, and impact on urban vitality

Chapter 2: Visual and Sensory Analysis of Urban Space

- Kevin Lynch's *The Image of the City*: paths, edges, nodes, landmarks, districts
- Gordon Cullen's *Townscape*: serial visual analysis and movement experience
- Formulation of design vision
- Social and environmental analysis: human activity and public space behavior (Jan Gehl)
- Transition from analysis to diagnosis using SWOT and strategic vision formulation

Chapter 3: Principles and Tools of Urban Design

- Basic principles: containment, continuity, orientation, human scale, diversity
- Design of public spaces: squares, parks, and their role in the social fabric

Chapter 4: Details of Urban Design

- Street design: hierarchy, cross-section, streets as public spaces
- Elements of detailed design: materials, urban furniture, lighting, planting, signage

Chapter 5: Techniques of Presentation and Display

- Importance of presentation in communicating design ideas
- Drawing techniques, maquette building, 3D modeling
- Structuring project presentations and arguments

Workshop Activities (Practical works)

- 1- Formation of work teams and project site selection
- 2- Exploratory field visit: photography, sketches, initial observations
- 3- Preparation of base maps and analytical maps (land use, building heights, movement networks, open spaces) using CAD/GIS
- 4- Field application of Lynch analysis: identification of key visual elements
- 5- Preparation of visual and mental maps of the site
- 6- SWOT analysis and presentation of diagnostic findings
- 7- Brainstorming for project vision and objectives
- 8- Development of preliminary design scenarios
- 9- Drawing master plans: movement structure, mass distribution, green spaces
- 10- Maquette and 3D render production
- 11- Preparation of final project poster

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Bentley, I., Alcock, A., Murrain, P., McGlynn, S., & Smith, G. (1985). *Responsive Environments: A Manual for Designers*. Architectural Press.
- Cullen, G. (1961). *The Concise Townscape*. Architectural Press.
- Gehl, J. (2011). *Life Between Buildings: Using Public Space*. Island Press.
- Lynch, K. (1960). *The Image of the City*. MIT Press.
- Carmona, M., Heath, T., Oc, T., & Tiesdell, S. (2012). *Public Places, Urban Spaces: The Dimensions of Urban Design*. Architectural Press.
- Jacobs, J. (1961). *The Death and Life of Great American Cities*. Random House.
- Moughtin, C. (2003). *Urban Design: Street and Square*. Architectural Press.

Semester: 3
Methodological Teaching Unit: MTU 3.1
Title of subject: Remote Sensing
Annual hourly volume: 45h00
Credits: 4
Coefficients: 2

Objectives of teaching:

Learn how to extract, process, and analyze satellite and airborne (drone) data to optimize urban infrastructure management and improve city resilience.

Recommended Prerequisites:

GIS, environmental science, and introductory statistics.

Course Content

Chapter 1: Introduction

- Definition and scope of remote sensing

Chapter 2: Fundamentals and Physics of Measurement

- Physical principles
- Spectral signatures
- Spatial, spectral, temporal, and radiometric resolutions

Chapter 3: Data Sources and Modern Sensors

- Optical satellite imagery
- Radar (SAR)
- Urban LiDAR
- Drone-based imagery

Chapter 4: Image Processing and Spatial Analysis

- Preprocessing: atmospheric and geometric corrections
- Vegetation and urban indices: NDVI, NDWI, NDBI, and machine learning approaches
- Change detection: multi-temporal analysis to track urban sprawl

Chapter 4: Principles of Digital Photogrammetry

- Digital 3D reconstruction and modeling of urban environments

Directed Works (DW):

Software ENVI

- 1- Interface, Band Composites
- 2- Radiometric, Atmospheric Correction
- 3- Spectral Indices, Urban Mapping
- 4- Supervised Classification and Accuracy
- 5- Multi-Temporal Change Detection

Software ERDAS

- 1- Interface and Image Enhancement
- 2- Geometric Correction and Mosaicking
- 3- Classification, Accuracy Assessment
- 4- DEM Analysis, 3D Visualization

5- SAR Image Processing

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Kraus, K., & Waldhäusl, P. (1998). *Manuel de photogrammétrie – principes et procédés fondamentaux*. Paris: Editions HERMES. (Translated by P. Grussenmeyer & O. Reis)
- Ducher, G., Paul, S., Jobard, I., Latarche, C.H., & Lenco, M. (1997). *Manuel terminologique didactique de télédétection et photogrammétrie*
- Wolf, P. R., Dewitt, B. A., & Wilkinson, B. E. (Fourth Edition). *Elements of Photogrammetry with Applications in GIS*.

Semester: 3

Methodological Teaching Unit: MTU 3.1

Title of subject: Geographic information systems GIS

Annual hourly volume: 45h00

Credits: 4

Coefficients: 2

Objectives of teaching:

This course introduces students to the concepts, tools, and applications of Geographic Information Systems (GIS) and geomatics for urban planning and spatial management.

The course emphasizes spatial modeling, geoprocessing, and GIS-based decision-making for smart cities and urban development projects, enabling students to translate spatial data into actionable urban maps and plans.

Recommended Prerequisites:

Basic computer skills, Algorithms and Programming.

Course Content

Chapter 1: Definition of Concepts

- Geomatics, GIS, and components of a GIS
- Geographic data: vectors, rasters, and attribute tables
- Topology: basic concepts and rules

Chapter 2: Database and Geodatabase Structure

- Database concepts, object classes, geodatabases, feature datasets, and attribute tables
- Raster data and spatial reference
- Binary relationships, topological relationships, cardinality, primary and foreign keys

Chapter 3: Spatial Modeling and GIS Projects

- Systemic approach in spatial planning
- Spatial modeling techniques
- GIS applications for smart cities
- Digitalization of land-use plans and master plans

Chapter 4: Analysis and Geoprocessing

- Statistical analysis and spatial statistics
- Network analysis and multi-criteria analysis
- Geocoding and model builder tools

Directed Works (DW):

- 1- Creating a geodatabase
- 2- Importing a structured database into an object-relational model
- 3- Integrating data into a GIS
- 4- Raster Data
- 5- Vector Data
- 6- Importing and processing data from spreadsheets
- 7- GIS export
- 8- Processing a DEM raster
- 9- Spatial Analysis
- 10- Raster analysis

Assessment Methods:

- Continuous Assessment: 40%
- Final Exam: 60%

Bibliography and References:

- Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). *Geographic Information Systems and Science* (4th ed.). Wiley.
- Worboys, M., & Duckham, M. (2004). *GIS: A Computing Perspective* (2nd ed.). CRC Press.
- Malczewski, J. (2006). *GIS-based Multi-Criteria Decision Analysis: A Survey of the Literature*. *International Journal of Geographical Information Science*, 20(7), 703–726.
<https://doi.org/10.1080/13658810600661508>

Semester: 3**Methodological Teaching Unit: MTU 3.2****Title of subject: Topography and Surveying****Annual hourly volume: 67h30****Credits: 3****Coefficients: 2****Objectives of Teaching:**

This course enables students to acquire the foundational knowledge of topography, allowing them to later perform and verify the layout of construction projects, leveling, angle and coordinate measurements, and the drafting of topographic plans.

Recommended Prerequisites:

Mathematics ; Physics

Course Content:**Chapter 1: General Concepts**

- Definition of topography
- Topographic survey: planimetry, altimetry, topographic plan, point altitude, point elevation, level differences
- Scales
- Topographic measurement instruments, field equipment, terrain instruments

Chapter 2: Calculation of Coordinates and Areas

- Plane representation of the Earth's surface: longitude, latitude (ϕ)
- Axes: Geographic North (NG), Map North or Lambert North (NL or Y), Magnetic North (MN)
- Orientations: Azimuth (AZ), Bearing (G), Bearing calculation, Coordinate calculation from a bearing
- Topographic survey systems: Alignment survey, Radiating survey, Survey by rectangular coordinates

- Area calculation: Using polar coordinates, Using rectangular coordinates

Chapter 3: Distance and Angle Measurements

- Introduction
- Direct distance measurements: chain measurement, measurement instruments
- Indirect distance measurements: stadia measurement (constant-angle stadia, variable-angle stadia)
- Angle measurements: instrument classification, theodolite operation principles (axes, circles), horizontal angles (measurement principle, direction orientation θ , bearing of a direction G , reverse orientation), vertical angles (determination of slope i)

Chapter 4: Direct and Indirect Leveling (Altimetry)

- General principles
- Direct/geometric leveling: principle, staff readings, leveling methods
- Observations and calculations
- Closure error compensation rules
- Practical applications
- Indirect leveling or planimetry
- Auto-reducing tachymeter: definition, stadia measurement with slope variation, curved-line reduction, practical implementation

Chapter 5: Grid and Detail Surveying

- Definition of a survey grid
- Polygonal network: principle, types of traverses (closed, framed, antenna, nodal points), classifications and characteristics, practical execution, calculation of a framed traverse (bearing transmission, angular closure compensation, coordinate calculation)

Practical Works (PW):

- 1- Instrument identification and scale reading
 - ✓ Instrument recognition
 - ✓ Scale calculations
- 2- Field visit and plan reading
 - ✓ Reading a topographic plan
- 3- Bearings and coordinate calculation
 - ✓ Bearing calculation
 - ✓ Coordinate computation from bearing
- 4- Area calculation
 - ✓ Area by rectangular coordinates (Gauss formula)
- 5- Stadia measurement
 - ✓ Constant-angle stadia (horizontal)
 - ✓ Variable-angle stadia (inclined sighting)
- 6- Theodolite operation
 - ✓ Horizontal angle measurement
- 7- Geometric leveling computation
 - ✓ Rise and fall method
 - ✓ Field leveling (geometric)
- 8- Indirect leveling (tachymeter)
 - ✓ Auto-reducing tachymeter
- 9- Traverse calculation (office)
 - ✓ Framed traverse computation
- 10- Full traverse field session
 - ✓ Campus traverse (field)

Assessment Methods:

- Continuous Assessment: 40%
- Final Exam: 60%

Bibliography and References:

- *Benoit, C. Cours Complet de Topographie et de Géodésie. Forgotten Books, 2013*
- *Brabant, Michel. Maitriser la topographie, des observations au plan. AFT, Groupes Ryrrolles, Paris, 2003*
- *Didier Bouteloup. Topométrie : Mesure des distances*
- *Hollander, R.D. Topographie générale, tome 1: Généralités, mesures des angles et des distances. IGN Scientific Collection*
- *Jean-Baptiste Henry. Cours de Topographie et Topométrie Générale*
- *Pierre Goix. Topographie – La topographie par la pratique. Focus Collection*
- *CRDP de l'académie de Grenoble, 2005*

Semester: 3
Methodological Teaching Unit: MTU 321
Title of subject: Internet of things (IoT) + ICT
Annual hourly volume: 45h00
Credits: 3
Coefficients: 2

Objectives of teaching:

This course introduces students to the principles, components, and applications of the Internet of Things (IoT) in urban contexts. Students will learn how to select appropriate sensors for specific urban challenges, deploy IoT systems, and manage data transmission from devices to cloud platforms.

This course explores the role of Information and Communication Technologies (ICT) in enhancing urban services, improving citizen engagement, and increasing the efficiency, sustainability, and resilience of cities.

Course Content

Chapter 1: IoT Architecture and Modeling

- Perception Layer (Edge): sensors, microcontrollers (Arduino, ESP32, STM32), and signal conditioning
- Network Layer (Transport): gateways, network servers, and secure data transmission
- Application Layer (Cloud/User): data management platforms, visualization interfaces, and storage

Chapter 2: Components of ICT

- Software and hardware
- Cloud computing and data storage
- Internet and communication technologies
- 5G network and connectivity
- Data analytics platforms
- Integrated command centers

Chapter 3: ICT Tools and Platforms

- Mobile applications for urban services
- Online platforms and digital tools for city management
- Web GIS for spatial analysis and planning

Chapter 4: ICT Applications in Smart Cities

- Public safety monitoring
- Citizen interaction with urban services: transport, education, banking
- E-governance and enhanced citizen engagement
- E-commerce and digital service delivery

Chapter 5: Typology of Urban Sensors

- Environmental and weather: temperature sensors (thermistors), humidity sensors (hygrometers), atmospheric pressure
- Air quality: laser-based PM2.5/PM10 sensors, electrochemical CO₂ and NO₂ sensors
- Urban space management: PIR presence sensors for lighting, ultrasonic sensors for waste level detection
- Acoustic monitoring: MEMS microphones for noise mapping and incident detection

Chapter 6: Communication Protocols

- Long-range / Low-power (LPWAN): LoRaWAN, Sigfox, NB-IoT
- Short-range / Local networks: BLE, Zigbee (mesh), Wi-Fi 6

Chapter 7: Practical Work: From Sensor to Gateway

- Node programming: reading sensor data (e.g., DHT22 for humidity)
- Gateway configuration: installation and setup of multi-channel LoRaWAN gateways
- Data transmission and payload encoding (text to binary/hexadecimal)
- Integration: sending data to a network server (e.g., The Things Network) and retrieval via MQTT

Directed Works (DW) :

- 1- Introduction to IoT and ICT in Smart Cities
- 2- IoT System Architecture
- 3- Edge Devices and Microcontrollers
- 4- Sensors in Smart Cities
- 5- Data Acquisition and Signal Processing
- 6- IoT Network Layer and Communication Flow
- 7- Cloud Computing in IoT
- 8- ICT Infrastructure in Smart Cities
- 9- ICT Platforms and Tools
- 10- Web GIS and Spatial ICT Tools
- 11- Smart City Applications of IoT
- 12- Communication Protocols in IoT

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Komninos, N. (2013). *Intelligent Cities: Innovation, Knowledge Systems and Digital Spaces*. Routledge.
- Anthopoulos, L. (2017). *Understanding Smart Cities: A Tool for Smart Government or an Industrial Trick?* Springer.
- Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). *Smart Cities in Europe*. *Journal of Urban Technology*.

Semester: 3
Discovery Teaching Unit: DTU 3.1
Title of subject: Artificial intelligence (1)
Annual hourly volume: 45h00
Credits: 1
Coefficients: 1

Objectives of teaching:

This course introduces students to the fundamental concepts, techniques, and applications of Artificial Intelligence (AI). Students will learn problem-solving strategies, search algorithms, reasoning under uncertainty, and the basics of logic as applied to AI systems. The course prepares students to implement AI algorithms and integrate them into practical projects.

Recommended Prior Knowledge

Basic programming knowledge, introductory data structures

Content of the subject: Foundations of Artificial Intelligence

- Introduction to AI
- Problem Solving
- Advanced Search
- Constraint Satisfaction Problems
- Introduction to Logic
- Uncertainty and Probability
- Neural Networks
- Review and Integration Project

Practical work:

PW1: Introduction to the Python environment and exploration of geospatial data

PW2: Descriptive statistical analysis of data

PW3: Visualization and correlation of variables

PW4: Linear regression modeling for prediction

PW5: Introduction to classification methods applied to geographic data

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Russell, S., & Norvig, P. (2021). *Artificial Intelligence: A Modern Approach (4th ed.)*. Pearson.
-

Semester: 3
Transversal Teaching Unit: TTU 3.1
Title of subject: Scientific English 3
Annual hourly volume: 22h30
Credits: 1
Coefficients: 1

Objectives of teaching:

At this stage of the teaching of the English language, the student can pass through this subject to the technical language related to basic training using an adequate vocabulary in oral and written

Recommended Prerequisites:

To be able to follow this course the student must know the basics of the English language taught during semester 1 and 2.

Course Content

The teacher can choose from these subject texts to develop them during the course and advance the scientific language.

- Writing's skills: initiation to how to write a report
- Speaking Skills: Situational dialogues
- Reading Skills: Read a scientific paper
- Listening Skills: understanding a technical language or video
- Synthesize a professional document

Assessment Methods

- Exam (100%)

Semester: 4
Fundamental Teaching Unit: FTU 4.1
Title of subject: Urban Design (2)
Annual hourly volume: 67h30
Credits: 5
Coefficients: 3

Objectives of teaching:

This workshop explores the integration of smart technologies into the urban design process to create public spaces and urban systems that are more efficient, responsive, and interactive.

The course combines urban design theory, smart city technologies, digital participation tools, and advanced visualization techniques, enabling students to design adaptive environments that enhance mobility, public space quality, infrastructure efficiency, and citizen interaction

Recommended Prerequisites:

Basic urban planning, and introductory knowledge of digital tools and smart city concepts.

Content of the subject:

Chapter 1: Introduction to Smart Urban Design

- The shift from traditional urban design to responsive and interactive design.
- Key concepts: Internet of Things (IoT), Big Data, Artificial Intelligence (AI) in the urban context.
- Critical case studies of global smart cities (e.g., Songdo, Sidewalk Labs project in Toronto, Masdar City).

Chapter 2: Theories and Technologies of Smart Mobility

- The concept of "Complete Streets" and the humanization of streets in the digital age.
- Mobility management technologies: parking sensors, adaptive traffic signals, shared mobility applications, and the integration of public transport.

Chapter 3: Smart and Sustainable Public Space

- Principles of designing interactive public places: adaptive lighting, smart urban furniture, and smart irrigation systems.
- Biophilic design , how to integrate nature and technology to create healthy and sustainable environments.

Chapter 4: Smart Infrastructure and Resource Management

- Components of smart infrastructure: Microgrids, smart waste management (connected containers), and smart water networks.
- Introduction to IoT networks: sensors, actuators, gateways, and cloud platforms.

Chapter 5: Digital Community Participation and Interactive Design

- Tools and platforms for engaging residents remotely (e-participation) in the design process.
- The role of art and Interactive Installations in enriching the experience of public space.
- Advanced Visualization Techniques and Project Evaluation
- Using Virtual Reality (VR) and Augmented Reality (AR) technologies in presenting urban projects.
- Criteria for evaluating smart projects: technological feasibility, economic sustainability, social acceptance, and environmental impact.

Workshop Activities (Practical Works)

- 1- Identifying the Project Problem:
- 2- Selection of the project site (neighborhood, industrial area, waterfront).

- 3- Conducting a site analysis to identify urban problems (e.g., energy consumption, congestion, lack of security) that can be addressed with smart solutions, and formulating a "Smart Hypothesis" for the project.
- 4- Designing Smart Mobility: Redesigning a main street segment in the site to include bike lanes, smart public transport stations, and solutions for managing parking. Plans and cross-sections are to be submitted.
- 5- Designing Smart Public Space: Designing a park or public square that includes at least three smart solutions (e.g., movement-adaptive lighting, charging benches, smart irrigation system). Detailed plans and illustrative drawings of the technologies used are to be submitted.
- 6- Planning Smart Infrastructure: Preparing a network map at the site level illustrating the distribution of smart infrastructure components (locations of sensors, smart containers, solar streetlights).
- 7- Project Modeling: Practical application of simple spatial data analysis (e.g., creating a Heatmap).
- 8- Starting the construction of an advanced 3D model of the project.
- 9- Integrating Interaction and Participation:
- 10- Final Project Visualization.

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Batty, M. (2018). *Inventing Future Cities*. MIT Press.
- Greenfield, A. (2013). *Against the Smart City. Do Projects*.
- Mitchell, W. J. (2000). *City of Bits: Space, Place, and the Infobahn*. MIT Press.
- Townsend, A. M. (2013). *Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia*. W. W. Norton & Company.
- Mattern, S. (2021). *A City Is Not a Computer: Other Urban Intelligences*. Princeton University Press.
- Ratti, C., & Claudel, M. (2016). *The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life*. Yale University Press.
- Shepard, M. (Ed.). (2011). *Sentient City: Ubiquitous Computing, Architecture, and the Future of Urban Space*. MIT Press.

Semester: 4
Fundamental Teaching Unit: FTU 4.1
Title of subject: Smart Infrastructure Systems
Annual hourly volume: 67h30
Credits: 5
Coefficients: 3

Objectives of teaching:

By the end of this program, students should be able to: Master the technical and regulatory rules for road and network construction. Know how to read and design road and utility network plans using CAD tools (AutoCAD). Coordinate different stakeholders during an urban development project. Integrate environmental constraints from the design phase. Master digital tools for urban infrastructure management.

Content of the subject:

Chapter 1: Work Preparation: Preparatory works, Work preparation.

Chapter 2: Road Design and Dimensioning:

- Road Geometry: Administrative classification of roads, Horizontal alignment, longitudinal profile and cross-section, Design of intersections and roundabouts.
- Pavement Structure: Sub-base, base and wearing course layers. Material selection.
- Accessibility and Safety: PRM standards (Persons with Reduced Mobility), horizontal and vertical signage, encounter zones (20 and 30 km/h zones).

Chapter 3: Sanitation and Water Supply Networks:

- Sanitation: Combined and separate sewer systems. Pipe dimensioning (Manning- Strickler formula), Sanitation network accessories.
- Stormwater Management: Alternative techniques (landscaped swales, retention basins, reservoir pavements) to limit flooding.
- Drinking Water Supply (DWS): Main elements of an urban hydraulic system, Network layout, Network operating conditions, Water demand, Distribution networks, Calculation and dimensioning. Intelligent leak detection systems.

Chapter 4: Dry Networks and Digital Infrastructure:

- Energy and Lighting: Low and high voltage networks. Installation of lighting poles and control cabinets. Smart public lighting: LED, dimming, presence detection. Smart grids and energy management.
- Fiber Optic Deployment (FTTH/FTTO): Conduit installation, pulling chambers, underground space sharing rules.
- Gas Network: Design and safety, Distribution pressures, Strict installation rules, Structures, Materials.
- District Heating Networks: Principles of centralized heat distribution for sustainable neighborhoods.

Chapter 5: Work Coordination and Execution:

- DICT/DTC: Work declaration procedures to avoid damage to existing networks.
- Installation Rules: Frost-free depths, safety distances between different networks (gas, electricity, water).
- BIM Infrastructure: Introduction to 3D network modeling for underground congestion management.

Chapter 6: Integrated and Digital Management of Road and Utility Networks:

- Geographic Information Systems (GIS) for infrastructure
- Digital Twins of urban networks
- Regulation, safety and compliance

Chapter 7: Regulations and Standards:

- Regulatory framework for road and utility networks
- National and international technical standards
- Accessibility and PRM standards
- Administrative procedures

Practical Works (PW):

- 1- Mapping Climate Risks in an Urban Area
- 2- Analysis of Flood Risk
- 3- Urban Heat Island (UHI) Study
- 4- Vulnerability Assessment to Climate Change
- 5- Land Use Change and Climate Risk
- 6- Natural Hazard Zoning
- 7- Case Study of an Extreme Climate Event
- 8- Smart Vulnerability Assessment
- 9- Smart Land Use Planning and Risk Reduction

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Bayon, (R.), (1998), *V.R.D. : voirie – réseaux divers – terrassements – espaces verts : aide-mémoire du concepteur*, éditions Eyrolles.
- BUILDINGSMART FRANCE (2019). *Le BIM Infrastructures : Enjeux et applications*.
- Bureau VERITAS, « *Guide Voirie et réseaux divers : Eau, électricité, assainissement, ANC* », Edition Le Moniteur, 2014.
- CIAUD, F. (2018). *BIM et maquette numérique pour l'architecture, le bâtiment et la construction*. Eyrolles.
- ESRI (2020). *GIS for Smart Communities*.
- Gérard Karsenty, « *Guide pratique des VRD et aménagements extérieurs : Des études à la réalisation des travaux* », Edition Eyrolles, 2004.
- Jean-Pierre Gyéjacquot, « *Conception, Réalisation et Entretien de la voirie : Chaussée, trottoirs, carrefours, signalisation* », Construction et exploitation », Edition Le Moniteur, AFNOR, 1998.
- P. Carillo : *L'aide-mémoire de VRD : Voirie et réseaux divers* (Éditions Dunod).
- Régis Bourrier, « *Les réseaux d'assainissement : Calculs, applications, perspectives* », Edition Lavoisier, 2008.

Semester: 4
Fundamental Teaching Unit: FTU 4.1
Title of subject: Geotechnics and Project Cycle
Annual hourly volume: 45h00
Credits: 4
Coefficients: 3

Objectives of teaching:

The teaching of soil mechanics enables students to understand the nature and strength of different soil types. It promotes the application of this knowledge in the design and construction of safe and durable infrastructures. In this way, it contributes to improved planning and the long-term sustainability of urban developments.

This module equips students with the essential skills required to engage in the planning and development of smart cities. It emphasizes the importance of understanding the various stakeholders involved in the construction cycle and the complementarity of their roles.

Content of the subject:

Chapter 1: Geotechnics and Physical Characteristics of Soils

- Engineering Geology
- Soil Mechanics
- Rock Mechanics
- Physical Properties of Soils
- Soil Classification by Grain Size
- Atterberg Limits

Chapter 2: Stakeholders in the Construction Cycle

- Urban Planner: Plans and organizes urban space, ensuring coherence between buildings, infrastructure, and the environment within the logic of a smart city.
- Surveyor: Conducts land surveys, prepares topographic maps, and provides geometric data necessary for project implementation.
- Architect: Designs buildings and spaces, develops architectural plans, and coordinates the aesthetic and functional dimensions.
- Landscape Architect (optional depending on the project): Integrates green and natural spaces into urban development.
- Civil Engineer: Oversees the technical implementation of infrastructure, ensuring the stability and safety of structures.

Chapter 3: Architectural and Construction Terminology

- Basic vocabulary: column, beam, slab, load-bearing wall.
- Construction terminology: foundations, framework, roofing.
- Advanced terminology: cantilever, brackets, arches, domes, staircases, ramps.
- Application: identification and annotation on real plans.

Chapter 4: Construction Materials and Sustainability

- Concrete, steel, wood: uses and characteristics.
- Durability and environmental impact of materials.
- Responsible choices in the context of smart cities (recycling, circular economy).

Chapter 5: Reading and Interpreting Plans

- Location plans and their relation to the territory.
- Site plans: layout and positioning.
- Elevation plans: reading external volumes.
- Floor plans: spatial and functional organization.
- Section plans: understanding levels and structures.

Chapter 6: Construction Cycle and Smart Cities

- Stages of the construction cycle: design, planning, execution, monitoring.
- Role of the urban planner in coordinating stakeholders (architects, engineers, local authorities).
- Integration of digital technologies (digital models, urban sensors).
- Sustainable and intelligent approaches to urban development.

Chapter 7: Fieldwork and Visits

- Immersion in a design office or local authority.
- Observation of practices in plan reading and project coordination.
- Writing a report linking theory to practice.

Directed Works (DW) :

- 1- Soil classification exercises based on grain size distribution (granulometry).
- 2- Case Studies: The role of each stakeholder in an urban project.
 - ✓ Analysis: Organizational charts of a Smart City.
 - ✓ Project Simulation: Role allocation (Urban Planner, Architect, Engineer).
 - ✓ Production: Creating a mini-coordination plan between stakeholders.
- 3- Vocabulary Exercises: Identifying elements on blueprints/plans.
 - ✓ Mini-quiz: Advanced building and construction terms.
 - ✓ Annotation: Labeling real architectural plans.
- 4- Comparison: Properties of concrete, steel, and wood.
 - ✓ Case Studies: Durability and environmental impact.
 - ✓ Lab Experiments: Material strength and resistance testing.
 - ✓ Project: Proposing material choices for a sustainable building.
- 5- Reading plans (site plans, elevations, sections/cross-sections).
 - ✓ Case Studies: Analyzing plan consistency and technical coherence.
 - ✓ Software Training: Introduction to AutoCAD, Revit, ArcGIS, and other tools.
 - ✓ Drafting: Creating a simple plan (house or small building).
- 6- The stages of an urban project.
 - ✓ Analysis: Integrating digital technologies into construction.
 - ✓ Digital Tools: Utilizing BIM (Building Information Modeling) and urban sensors.
- 7- Preparation of an observation questionnaire.
 - ✓ Site visit to a construction project or an engineering consultancy office.
 - ✓ Theoretical discussion on observed field practices.
 - ✓ Report writing linking theoretical knowledge to practical application.

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- *Lambe, T.W. & Whitman, R.V. – Soil Mechanics (Wiley, 1969).*
- *Das, Braja M. – Principles of Geotechnical Engineering (Cengage, 2018).*
- *Craig, R.F. – Soil Mechanics (Chapman & Hall, 1997).*
- *Atkinson, J.H. – The Mechanics of Soils and Foundations (Taylor & Francis, 2007).*
- *Hoyet, Nadia – Matériaux et architecture durable (Dunod, 2020).*
- *Fleury, François & Arab, Noura – Ressources pour l'architecture écologique (Presses des Mines, 2025).*
- *Ching, Francis D.K. – Architectural Graphics (Wiley, 2015).*

- Ching, Francis D.K. – *Building Construction Illustrated* (Wiley, 2014).
- Rosolen, Agnès et al. – *Architecture, construction, urbanisme : 600 ouvrages de référence* (Cité de l'architecture et du patrimoine).

Semester: 4
Methodological Teaching Unit: MTU 4.1
Title of subject: Risk and Climate Change
Annual hourly volume: 45h00
Credits: 3
Coefficients: 2

Objectives of teaching:

This course examines the multifaceted risks posed by climate change and explores frameworks for assessment, management, and adaptation. Students will analyze physical climate risks, socioeconomic vulnerabilities, and decision-making under uncertainty.

The course integrates scientific understanding with risk management theory, policy analysis, and practical applications across sectors including finance, insurance, infrastructure, agriculture, and public health.

Recommended Prerequisites:

Basic statistics, environmental science

Content of the subject:

Chapter 1: Foundations of Climate Science and Risk

- Climate system basics and greenhouse gas dynamics
- Observed and projected climate changes (IPCC frameworks)
- Introduction to risk concepts: hazard, exposure, vulnerability

Chapter 2: Physical Climate Risks

- Extreme weather events: heatwaves, droughts, floods, storms
- Wildfire risks and changing fire regimes
- Cryosphere changes: glaciers, permafrost, ice sheets

Chapter 3: Risk Assessment Methodologies

- Quantitative risk assessment: probability, impact, expected loss
- Climate risk modeling and simulation
- Spatial analysis and GIS in climate risk mapping

Chapter 4: Socioeconomic Vulnerabilities and Equity

- Social vulnerability indices and frameworks
- Differential impacts on marginalized communities
- Food security and water scarcity risks
- Climate migration and displacement

Chapter 5: Adaptation and Risk Management Strategies

- Adaptation planning frameworks
- Nature-based solutions and ecosystem-based adaptation
- Engineering and technological adaptations
- Behavioral and institutional adaptations

Chapter 6: Policy, Governance, and Decision-Making

- Climate risk governance structures
- International frameworks (Paris Agreement, Sendai Framework)
- Decision-making under deep uncertainty

Directed Works (DW):

- 1- Work Preparation

- 2- Road Geometry Design
- 3- Pavement Structure Design (Pavement Layer Dimensioning)
- 4- Sanitation Network Design
- 5- Stormwater Management (Sustainable Techniques)
- 6- Rinking Water Supply Network
- 7- Energy and Smart Lighting Systems
- 8- Fiber Optics and Underground Networks
- 9- Gas and District Heating Networks

GIS and Smart Infrastructure Management

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- *Downing, T.E. & Patwardhan, A. 2001. Assessing Vulnerability for Climate Adaptation (or similar comprehensive text)*

Semester: 4

Methodological Teaching Unit: MTU 4.1

Title of subject: Urban Sociology

Annual hourly volume: 45h00

Credits: 3

Coefficients: 2

Objectives of teaching:

This course aims to introduce students to the sociological analysis of the city as a space of social relations and collective dynamics. It helps students understand how social structures, human interactions, and urbanization processes shape urban space and influence the production of the city.

Content of the subject:

Chapter 1: Sociology of the City

- General introduction
- Society and social relations
- Social systems

Chapter 2: Social Actions in the City

- Social regulation
- Social mobility
- Social interaction
- Socialization

Chapter 3: Critical Approaches to Sociological Thought

- Robert Park and the ecological system
- Ernest Burgess and the natural system
- Louis Wirth and the moral system

Chapter 4: Urbanization and Urbanity

- Urbanization processes
- Spontaneous urbanism: social aspects
- Civil society and urban planning

Chapter 5: Social Analysis and Urban Problems

- Urban inequalities
- Social segregation
- Urban conflicts
- Exclusion and marginalization

Directed Works (DW) :

- 1- Identify key social concepts in urban space
 - ✓ Urban sociology
 - ✓ Society
 - ✓ Social relations
- 2- Society and Social Systems
- 3- Social Relations in Urban Space
 - ✓ Social relations
 - ✓ Collective behavior
- 4- Social Regulation in Cities
- 5- Social Mobility
 - ✓ Social mobility (vertical/horizontal)
 - ✓ Factors influencing mobility
 - ✓ Identify mobility patterns in urban areas
- 6- Social Interaction and Urban Life
- 7- Socialization in Urban Context
- 8- Robert Park and Urban Ecology
 - ✓ Social competition
 - ✓ City as an ecosystem
 - ✓ Apply ecological model to a city
- 9- Urbanization Processes
- 10- Social Inequalities and Urban Problems
- 11- Urban Conflicts and Marginalization

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Park, R. E., Burgess, E. W., & McKenzie, R. D. (1925). *The City: Suggestions for the Investigation of Human Behavior in the Urban Environment*. University of Chicago Press.
- Harvey, D. (2012). *Rebel Cities: From the Right to the City to the Urban Revolution*. Verso Books.
- Simmel, G. (1903). *The metropolis and mental life*. In D. Levine (Ed.), *The Sociology of Georg Simmel* (pp. 409–424). Free Press.

Semester: 4
Methodological Teaching Unit: MTU 4.1
Title of subject: Urban Law and Regulations
Annual hourly volume: 45h00
Credits: 3
Coefficients: 1

Objectives of teaching:

This course introduces students to the legal and institutional framework governing urban planning, land management, and urban development. It enables students to understand the role of law in organizing urban space, regulating property, and managing urban services within the context of smart and sustainable cities

Content of the subject:

Chapter 1: Introduction to Law

- The legal rule: definition, characteristics, and types
- Legislation as a source of law
- Types of authorities: political, administrative, and legal

Chapter 2: Branches of Law

- Public law and private law
- Administrative law and the organization of the administrative system in Algeria
- Management of public services
- Associative organizations and legal frameworks

Chapter 3: Land Regulations

- Regulation of land ownership
- Land Orientation Law
- Private property and real rights
- Methods of acquiring land ownership
- Land intervention tools

Chapter 4: Urban Regulations

- Planning and urban development tools
- General urban planning rules
- Urban development contracts

Chapter 5: Urban Management

- Roles of urban stakeholders
- Organization of the production of the built environment
- Real estate development and promotion

Directed Works (DW) :

DW 1: Introduction to Legal Frameworks in Urban Context: Aims to understand fundamental concepts of law, including legal rules, legislation, and governmental authorities, and their application in the urban environment.

DW 2: Public Law, Administrative Law, and Urban Services: Focuses on differentiating between public and private law, understanding Algerian administrative law, and analyzing legal frameworks governing public urban services and associative organizations.

DW 3: Land Regulations and Property Rights: Aims to comprehend legal mechanisms for regulating land ownership, principles of Algerian Land Orientation Law (Law 90-25), private property rights, and land intervention tools for urban development.

DW 4: Urban Regulations and Planning Instruments: Focuses on understanding legal instruments and rules governing urban planning and development, including general planning rules and urban development contracts, with an emphasis on Algerian Law 90-29.

DW 5: Urban Management and Stakeholder Roles: Aims to examine the roles of various urban stakeholders, the organization of the built environment's production, and the processes of real estate development and promotion within the legal and regulatory context.

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Semester: 4
Methodological Teaching Unit: MTU 4.1
Title of subject: Mini Project Internship
Annual hourly volume: 45h00
Credits: 3
Coefficients: 1

Objectives of teaching:

This mini project aims to provide students with hands-on experience in diagnosing urban challenges and designing practical solutions to transform a traditional city into a smart and sustainable urban environment. Students will apply digital technologies, smart infrastructure concepts, and participatory approaches to enhance mobility, energy efficiency, environmental management, and municipal services.

Content of the subject:

Mini Project: Transforming a City into a Smart City

Axis 1: Diagnosis of the Current Urban Situation

Many cities still rely on traditional urban management systems, which limits their ability to respond effectively to rapid urban growth and citizens needs.

The main problems identified include:

- Limited use of technology in urban management
- Traffic congestion and inefficient transportation systems
- Excessive energy consumption
- Lack of coordination between urban sectors and public institutions

Axis 2: Proposal for Transforming the City into a Smart City

To address these challenges, the project proposes the adoption of smart city solutions based on digital technologies.

- Smart Mobility: intelligent traffic lights, real-time bus tracking systems, and mobility applications

- Smart Energy: smart public lighting systems and the use of renewable energy sources
- Digital Services: online platforms for municipal and administrative services
- Smart Environment: pollution monitoring systems and intelligent waste management Implementation Tools and Means
- Geographic Information Systems (GIS)
- Internet of Things (IoT)
- Urban databases and digital platforms
- Public–Private Partnerships (PPP)

The mini project focuses on implementing smart city solutions through the Directorate of Transport, the Directorate of Environment, and the Urban Planning and Development Offices, aiming to enhance mobility, ensure sustainable environmental management, and improve urban planning and municipal services.

Assessment Methods

- Continuous Assessment (100%)

Semester: 4
Discovered Teaching Unit: DTU 4.1
Title of subject: Open Source
Annual hourly volume: 45h00
Credits: 2
Coefficients: 1

Objectives of teaching:

This course provides students with a comprehensive understanding of open-source principles, tools, and community practices. It aims to equip students with the knowledge and practical skills necessary to use, contribute to, and manage open-source projects.

Content of the subject:

Chapter 1: Introduction to Open Source

- History and definition
- Objectives to be achieved
- The GNU Project
- Advantages of open source (difference between open-source software and proprietary software)
- Community in open source
- Licensing in Open Source

Chapter 2: Open-Source Licenses Deep Dive

- Understanding different license types (GPL, MIT, Apache, BSD)
- Copyleft vs permissive licenses
- License compatibility and compliance
- Choosing the right license for your project
- Case studies: License conflicts and resolutions

Chapter 3: Open-Source GIS and Geospatial Tools

- Introduction to Geographic Information Systems (GIS)
- QGIS: Installation and basic operations
- Working with spatial data (shapefiles, GeoJSON, rasters)

- OpenStreetMap and collaborative mapping
- Practical applications: Creating maps and spatial analysis
- Case studies: Open-source GIS in research and industry

Chapter 4: Version Control with Git

- Introduction to version control systems
- Git fundamentals (clone, commit, push, pull)
- Branching and merging strategies
- Git workflows (centralized, feature branch, gitflow)
- Hands-on: Setting up your first repository

Chapter 5: Open-Source Writing and Documentation Tools

- La TeX for academic writing and reports
- Markdown for documentation
- Zotero for reference management
- Libre Office Writer for collaborative documents
- Overleaf for collaborative LaTeX editing
- Converting between formats (Pandoc)
- Best practices for academic and technical writing

Chapter 6: GitHub and Collaboration Platforms

- GitHub fundamentals (repositories, issues, pull requests)
- Collaboration features (reviews, discussions, projects)
- Alternative platforms (GitLab, Bitbucket, Gitea)
- GitHub Actions and CI/CD basics
- Project management in open source

Chapter 7: Building Open-Source Communities

- Community governance models
- Contributor onboarding and retention
- Communication channels (forums, chat, mailing lists)
- Organizing events (hackathons, sprints, conferences)
- Code of conduct and conflict resolution

Chapter 8: Open-Source Business Models

- Sustainability in open source
- Business models (dual licensing, SaaS, support services)
- Funding sources (donations, sponsorships, grants)
- Case studies: Successful open-source companies
- Balancing community and commercial interests

Chapter 9: Open-Source Security and Beyond Software

Chapter 10: Legal, Ethical Considerations and Future of Open Source

Directed Works (DW):

- 1- Git and GitHub
- 2- QGIS for geospatial analysis
- 3- LaTeX/Overleaf for academic writing
- 4- Zotero for reference management
- 5- Libre Office Suite
- 6- Pandoc for document conversion
- 7- Slack/Discord for class communication
- 8- Issue tracking systems
- 9- Code editors with Git integration

10- Documentation tools (Markdown, Sphinx, MkDocs)

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Raymond, E. S. (2001). *The Cathedral & the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary* (2nd ed.). O'Reilly Media.
- Rosen, L. (2005). *Open Source Licensing: Software Freedom and Intellectual Property Law* (2nd ed.). Prentice Hall.
- Haklay, M., & Weber, P. (2008). *OpenStreetMap: User-generated street maps*. *IEEE Pervasive Computing*, 7(4), 12–18. <https://doi.org/10.1109/MPRV.2008.80>

Semester: 4

Discovered Teaching Unit: DTU 4.1

Title of subject: Artificial Intelligence (2)

Annual hourly volume: 45h00

Credits: 2

Coefficients: 1

Objectives of teaching:

This course introduces students to probabilistic reasoning, decision-making under uncertainty, and the fundamentals of machine learning. It equips students with theoretical knowledge and practical skills for modeling uncertainty, performing inference, and applying statistical and neural learning methods. The course also prepares students to integrate these concepts into AI-driven applications.

Recommended Prerequisites:

Completion of **AI1** or an equivalent introductory AI course, Basic calculus and linear algebra.

Content of the subject: Probabilistic Reasoning and Machine Learning Fundamentals

Probabilistic Reasoning

- Inference
- Making Decisions
- Reinforcement Learning
- Introduction to Machine Learning
- Statistical Learning Methods
- Neural Networks
- Review and Integration Project

Directed Works (DW):

DW1: Advanced preprocessing of geographic data using Python

DW2: Implementation of advanced classification algorithms

DW3: Integration of spatial data and machine learning

DW4: Multi-source data fusion

DW5: Advanced model evaluation

DW6: Introduction to automation of GIS processing using Python scripts

DW7: Mini-project: Predictive modeling of a geographic phenomenon

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- *Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach (4th ed.). Pearson.*

Semester: 5
Fundamental Teaching Unit: FTU 5.1
Title of subject: Smart Decision Making
Annual hourly volume: 45h00
Credits: 5
Coefficients: 3

Objectives of teaching:

This course aims to provide students with the economic, legal, and governance tools required to design and manage sustainable smart city projects. It focuses on innovative economic models, data governance, and citizen-centered approaches to ensure long-term value, transparency, and social acceptance of urban technologies.

Content of the subject:

Chapter 1: New Urban Economic Models

- Global Cost / Total Cost of Ownership (TCO).
- CAPEX vs OPEX transformation in urban investments.
- Economy of functionality (As-a-Service models).
- Public-Private Partnerships (PPP): risk and revenue sharing.

Chapter 2: Data Governance and Digital Sovereignty

- Open Data vs data monetization.
- Data as a common good.
- Ethical and legal limits of commercial data use.
- Urban digital sovereignty and governance models.

Chapter 3: Design Thinking in Urban Innovation

- Empathy and observation of real urban usage.
- User-centered problem definition.
- Ideation techniques (brainstorming, empathy maps).
- Rapid prototyping and low-cost testing.
- User feedback and iterative improvement.

Chapter 4: Living Labs and Co-Creation

- Real-life experimentation in urban spaces.
- Co-construction with citizens and stakeholders.
- Role of the facilitator in smart city projects.

Practical Works (PW) :

- 1- Analysis of Smart City Economic Models
 - ✓ Case Study: Choose an existing smart city project
 - ✓ Cost Analysis: Analyze the Total Cost of Ownership (TCO) for the chosen project.
- 2- Identify CAPEX and OPEX components.

- ✓ As-a-Service Model
- ✓ Public-Private Partnership (PPP)
- 3- Data Governance and Digital Sovereignty in Smart Cities
 - ✓ Data Governance Scenario.
 - ✓ Open Data vs Data Monetization: Research open data initiatives in smart cities.
 - ✓ Digital Sovereignty
 - ✓ Ethical Framework: Develop a concise framework of ethical and legal principles that a smart city should follow when using data to ensure transparency, fairness, and protection of citizens.
- 4- Applying Design Thinking in Urban Innovation
 - ✓ Problem Identification: Choose a specific urban problem in your city
 - ✓ Empathize: Conduct interviews or observations with stakeholders affected by the problem (citizens, officials, service providers).
 - ✓ Define: Based on the empathy phase, rephrase the problem in a user-centered way.
 - ✓ Ideate: Use ideation techniques to generate a wide range of possible solutions for the identified problem.
- 5- Living Labs and Co-Creation in Smart City Projects
 - ✓ Living Lab Concept: Research the definition, objectives, and principles of a Living Lab.
 - ✓ Designing a Living Lab Project.
 - ✓ Facilitator's Role: Discuss the critical role of the Facilitator in Living Labs and co-creation projects.
 - ✓ Co-Creation Challenges.

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- OECD. (2018). *Financing Smart Cities: Public-Private Partnerships and Innovative Investment Models*. OECD Publishing. <https://doi.org/10.1787/9789264298372-en>

Semester: 5
Fundamental Teaching Unit: FTU 5.1
Title of subject: Sustainable and Smart Mobility
Annual hourly volume: 45h00
Credits: 5
Coefficients: 3

Objectives of teaching:

This course aims to equip students with the knowledge and skills necessary to design, implement, and manage sustainable and smart urban mobility systems. By the end of the course, students will be able to integrate multiple modes of transport into a seamless and efficient Mobility-as-a-Service (MaaS) framework, apply standards and protocols for interoperable transport systems, and optimize traveler information using real-time data.

Content of the subject:

Chapter 1: Intermodality and Mobility as a Service (MaaS)

The **Mobility as a Service (MaaS)** concept aims to integrate all modes of transport into a single user interface.

✓ **Multimodal Information Systems (MIS):**

- Data aggregation: Combining theoretical schedules (GTFS) and real-time information (SIRI/RT).
- Multimodal route calculation: Algorithms considering walking, cycling, bus, and train.

✓ **Ticketing Interoperability:**

- Single supports (contactless cards, NFC-enabled smartphones).
- Open Payment: Use bank cards as transport tickets.

✓ **Real-Time Traveler Information:**

- Dynamic information terminals (DIT).
- Push notifications on smartphones in case of disruption.

Chapter 2: Smart Parking and EVSE

Parking accounts for nearly 30% of urban traffic caused by searching for a parking space. The goal is to guide users directly to an available spot.

✓ **Detection Technologies:**

- Ground sensors (magnetic/infrared) for individual spaces.
- Image analysis with AI/Computer Vision for street parking.
- Counting at entrances/exits for enclosed parking lots.

✓ **Electric Vehicle Supply Equipment (EVSE):**

- Types of chargers: Slow (AC), Fast (DC), Ultra-fast.
- Communication protocols: OCPP (Open Charge Point Protocol) for management and payment.
- Smart Charging: Adjusting charging power based on grid load (linked to Smart Grids).

Chapter 3: New Mobilities and Micro-mobility

Managing the proliferation of personal mobility devices and shared vehicles.

✓ **Shared Fleet Management:**

- Free-floating models (stationless) vs. station-based models (VLS – Bike Sharing).
- Operational logistics: Fleet redistribution (re-dispatching), maintenance, and battery charging.

✓ **Regulation and Data:**

- Mobility Data Specification (MDS): Allowing the city to track scooters in real-time and define no-parking zones (Geofencing).

✓ **Micro-mobility and Urban Planning:**

- Tactical urbanism and connected bike lanes.

- Bike counting to support infrastructure planning and improve urban mobility strategies.

Practical Works (PW) :

- Introduction to Sustainable and Smart Mobility
 - ✓ Sustainable mobility
 - ✓ Smart mobility
 - ✓ Mobility-as-a-Service (MaaS)
- Intermodality in Urban Transport
 - ✓ Analyze intermodality
 - ✓ Intermodality vs multimodality
- Mobility as a Service (MaaS)
 - ✓ Advantages of MaaS for users and cities
- Multimodal Information Systems (MIS)
 - ✓ GTFS (static data)
 - ✓ SIRI/RT (real-time data)
- Ticketing Interoperability
 - ✓ Contactless payment
 - ✓ Open payment systems
- Real-Time Traveler Information
 - ✓ Analyze real-time mobility services
 - ✓ Dynamic information systems
 - ✓ Push notifications
- Smart Parking Systems
 - ✓ Parking challenges in cities
 - ✓ Role of sensors and AI
 - ✓ Design a smart parking solution
- Parking Detection Technologies
 - ✓ Analyze technical solutions
 - ✓ Ground sensors
 - ✓ Computer vision systems
- Electric Vehicle Infrastructure (EVSE)
 - ✓ AC vs DC charging
 - ✓ Ultra-fast charging
 - ✓ Plan EV charging infrastructure
- Smart Charging and Energy Integration
 - ✓ Link mobility with smart grids
 - ✓ Smart charging
 - ✓ Grid load management
- New Mobilities and Shared Systems
 - ✓ Free-floating vs station-based
 - ✓ Design a shared mobility service

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- UITP (2020), *Mobility as a Service: Transforming the Transport Experience*.
- Shaheen, S., Cohen, A., *Shared Mobility and the Transformation of Urban Transport*, Elsevier, 2018.

- *European Commission, Smart and Sustainable Mobility, 2021.*
- *ITF (International Transport Forum), Urban Mobility and Smart Cities, OECD, 2019.*

Semester: 5
Fundamental Teaching Unit: FTU 5.1
Title of subject: Smart Buildings and (BIM)
Annual hourly volume: 67h30
Credits: 5
Coefficients: 3

Objectives of teaching:

This course introduces students to the concepts and applications of Intelligent Buildings and Building Information Modeling (BIM) for operation, maintenance, and sustainable urban integration. Students will learn to use digital models (BIM), smart building management systems (BMS/GTB), and digital twins to optimize building performance, energy consumption, and integration with urban networks.

Content of the subject:

Chapter 1: BIM for Operation and Maintenance (BIM GEM)

BIM (Building Information Modeling) does not stop at the building handover. This is where “BIM 7D,” dedicated to sustainability and management, begins.

✓ **Fundamental Concepts of BIM GEM:**

- Transition from the digital as-built documentation (DOE) to the operational model.
- Digital Twin: Synchronization between the real building and its 3D model.

✓ **Interoperability and Standards:**

- IFC format (Industry Foundation Classes) for data exchange
- COBie standard: for maintenance data organization

✓ **Link with CMMS (Computerized Maintenance Management System):**

- Accessing technical data, installation dates, and failure history directly from the 3D model.
- Planning preventive interventions through the digital model.

Chapter 2: Building Automation Systems (GTB/GTC) – The Brain of the Building

✓ **System Architecture:**

- Level 0 (Field): Sensors (temperature, CO₂, occupancy) and actuators (valves, blinds).
- Level 1 (Automation): DDC controllers and programmable logic controllers.
- Level 2 (Supervision): Human-Machine Interface (HMI) for remote control.

✓ **HVAC Control:**

- Water laws and regulation: optimize temperature based on occupancy and outdoor weather.
- Variable Air Volume (VAV) ventilation: adjust airflow based on CO₂ to ensure air quality and energy efficiency.

✓ **Communication Protocols:**

- Standard protocols: BACnet (BAS standard), KNX (home/tertiary automation), Modbus (energy metering), LonWorks.

Chapter 3: Convergence of BIM and BAS

✓ **Real-time Visualization:** Display real temperatures and fire alarms directly on the 3D model.

✓ **Smart Readiness Indicator (SRI):** Introduction to the European indicator measuring a building's ability to adapt to occupants' needs and the energy network using digital technologies.

Practical Works (PW) :

- Introduce BIM and its role in building lifecycle
 - ✓ Smart building
 - ✓ BIM (Building Information Modeling)

- BIM Fundamentals and Lifecycle
 - ✓ Analyze BIM across building lifecycle
 - ✓ Role of BIM in design vs operation
- BIM for Operation and Maintenance (BIM GEM)
 - ✓ BIM GEM
 - ✓ Transition from construction to operation
- Digital Twin and Smart Buildings
 - ✓ Digital Twin vs BIM
 - ✓ Benefits of real-time synchronization
- Interoperability and BIM Standards
 - ✓ IFC
 - ✓ COBie
- BIM and CMMS Integration
 - ✓ Link BIM with maintenance systems
 - ✓ CMMS systems
- Introduction to Building Automation Systems (BAS/GTB)
 - ✓ GTB / BMS
 - ✓ Role of automation in smart buildings
- HVAC Smart Control Systems
 - ✓ VAV systems
 - ✓ Temperature regulation

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- McDowall, R., & New, C. (2012). *Smart Buildings: Advanced Materials and Technologies for Intelligent Buildings*. Woodhead Publishing.
- Pietrucha, K., & Krzysztof, S. (2015). *Building automation systems and smart buildings*.

Semester: 5

Methodological Teaching Unit: MTU 5.1

Title of subject: Resilience cities and adaptations

Annual hourly volume: 45h00

Credits: 4

Coefficients: 2

Objectives of teaching:

The concept of community resilience in the contexts of climate change and disasters draws increasing attention and interest. This course helps students to analyze climate change risks, and decision-making under cities adaptation or resilience

Content of the subject:

Chapter 1: Conceptual foundations

- Definitions: urban resilience, adaptation, vulnerability, risks
- Historical evolution of the concept of resilience applied to cities
- Difference between adaptation, mitigation and transformation

Chapter 2: Contemporary urban challenges

- Climate change and urban impacts (heat islands, floods, droughts)

- Population growth and rapid urbanization
- Natural and technological risks
- Socio-spatial inequalities and differentiated vulnerabilities

Chapter 3: Dimensions of urban resilience

- Environmental resilience: green infrastructure, water management, biodiversity
- Social resilience: cohesion, social capital, citizen participation
- Economic resilience: diversification, local employment
- Institutional resilience: governance, adaptive planning

Chapter 4: Adaptation strategies

- Nature-based solutions (green roofs, wetlands, ecological corridors)
- Adapted grey infrastructure (dikes, drainage systems)
- Hybrid solutions and integrated approaches
- Climate-aware urban planning

Chapter 5: Case studies

- Coastal cities facing rising waters (Rotterdam, Venice, Dakar)
- Metropolises and heatwaves (Paris, Phoenix)
- Cities and flood management (Tokyo, Copenhagen)

Directed Works (DW) :

- 1- Conceptual foundations of urban resilience
- 2- Contemporary urban challenges and climate-related risks
- 3- Dimensions of Urban Resilience
- 4- Adaptation Strategies
- 5- Social, economic, and institutional dimensions of resilience
- 6- Comparative assessment of adaptation strategies
- 7- International case studies in urban resilience

Final mini-project: resilient urban action plan

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Meerow, S., Newell, J.P., & Stults, M. (2016). "Defining urban resilience: A review" *Landscape and Urban Planning*, 147, 38-49.
- Rosenzweig, C., et al. (2018). *Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network*. Cambridge University Press.
- Anguelovski, I., et al. (2016). "Equity Impacts of Urban Land Use Planning for Climate Adaptation". *Journal of Planning Literature*, 31(4), 419-432.
- Frantzeskaki, N., et al. (2019). *Nature-Based Solutions for Urban Climate Change Adaptation*. Springer.

Semester: 5
Methodological Teaching Unit: MTU 5.1
Title of subject: Urban Cybersecurity
Annual hourly volume: 45h00
Credits: 4
Coefficients: 2

Objectives of teaching:

This course aims to equip students with the knowledge and practical skills required to design, deploy, and secure IP networks for smart cities. It focuses on protecting connected urban systems and critical infrastructures against cyber threats, while ensuring data confidentiality, integrity, and availability. The course integrates networking concepts with applied cybersecurity strategies for resilient urban management.

Content of the subject:

Chapter 1: Administration of Municipal Networks (LAN & WAN)

- Network architecture and segmentation (VLAN).
- Switch configuration and broadcast domain management.
- Inter-site routing (static routing, OSPF, BGP).
- Bandwidth management and Quality of Service (QoS).
- WAN access technologies: fiber optics, radio links, secure remote access

Chapter 2: Securing Communications

- Applied cryptography: symmetric and asymmetric encryption (AES, RSA).
- Hashing and message integrity verification.
- Secure transport protocols: TLS/SSL.
- Secure remote access: SSH, VPN (IPsec, OpenVPN).

Chapter 3: Protection of Critical Urban Infrastructures

- Denial of Service (DDoS) attacks and mitigation strategies.
- Firewalls, IDS/IPS, and rate limiting.
- Securing SCADA systems and urban automation.
- Protocol filtering (Modbus, BACnet).
- Audit and Business Continuity Plan (BCP).

Practical Works (PW) :

- 1- Introduction to Urban Cybersecurity
 - ✓ Cybersecurity
 - ✓ Smart city infrastructure
- 2- Network Fundamentals (LAN & WAN)
- 3- Network Architecture and Segmentation
- 4- Routing and Network Communication
 - ✓ Static routing
 - ✓ OSPF
 - ✓ BGP
- 5- Bandwidth Management and QoS
 - ✓ Bandwidth
 - ✓ QoS
- 6- WAN Technologies and Remote Access
 - ✓ Fiber optics

- ✓ Wireless links
 - ✓ Secure remote access
 - 7- Fundamentals of Cryptography
 - ✓ Symmetric vs asymmetric encryption
 - ✓ AES vs RSA
 - 8- Data Integrity and Secure Protocols
 - ✓ Hashing
 - ✓ TLS/SSL
 - 9- Secure Remote Access
 - ✓ SSH
 - ✓ VPN (IPsec, OpenVPN)
 - 10- Cyber Threats in Smart Cities
 - ✓ DDoS attacks
 - 11- Security Systems and Defense Mechanisms
- Firewall

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Forouzan, B. A. (2017). *Data Communications and Networking (5th ed.)*. McGraw-Hill.
- Cisco Systems. (2020). *CCNA Certification Guide: Networking Fundamentals, LAN/WAN, Routing and Switching*. Cisco Press.

Semester: 5

Methodological Teaching Unit: MTU 5.2

Title of subject: Geospatial Web service

Annual hourly volume: 45h00

Credits: 3

Coefficients: 2

Objectives of teaching:

This course consists of offering students a set of methodological and practical technics rely on create and handling geospatial data online -Web mapping-. The proposed technics are open-source solution.

Recommended Prior Knowledge

Basic geographic information system (GIS), database management, basic programming language (HTML, JavaScript, python)

Content of the subject:

Chapter 1: Desktop GIS

- ✓ **Introduction to open source (OS)**
 - History and definition.
 - Objectives to be achieved
 - The GNU Project
 - The advantages of open source (difference between open-source software and proprietary software).
 - Community in open source
 - Licensing in Open Source

✓ **Presentation of the range of desktop GIS OS software and selection of the "QGIS" software**

- A reminder about GIS
- Structure of the QGIS software.
- QGIS User Interface
- Analysis and processing tools in QGIS

Chapter 2: Introduction to Databases

✓ **Overview of Database Management Systems and selection of the DBMS: PostgreSQL**

- Difference between a spatial database management system and a database (table).
- structure: PostgreSQL and its spatial cartridge Postgis.
- DBMS management via QGIS.
- SQL language and queries on PostgreSQL on QGIS.

Chapter 3: Mapping and the Web

✓ **Definition and role of web mapping.**

- Concepts about web architecture.
- Definition of WMS WFS WFS-T.
- Range of client/server options and choice of Geoserver/Openlayers or QGIS.
- Dissemination of geographic information on the web using QGIS
- The role of open data and the importance of interoperability and information sharing.

Directed Works (DW) :

DW1:

- ✓ Getting started and using the QGIS software:
- ✓ Layer management.
- ✓ Calibration.
- ✓ Management of attribute data.
- ✓ Manipulation of vector data.
- ✓ Layout.
- ✓ Operations on vector, raster, and interlayer layers
- ✓ Statistical processing and graphical representations

DW2:

- ✓ Creation of a database on QGIS
- ✓ Importing the database into PostGIS using shp2pgsql
- ✓ Data manipulation using PgAdmin
- ✓ SQL query on the DBMS.
- ✓ Connecting QGIS with PostgreSQL (Postgis).
- ✓ Example of data processing.

DW3:

- ✓ Installation of the Geoserver server locally
- ✓ Importing a layer for diffusion
- ✓ Access to and manipulation of the layer of the layer by a web browser.
- ✓ Layer processing using QGIS

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Bibliography and References

- Stallman, R. (2002). *Free software, free society: Selected essays of Richard M. Stallman* . Lulu. com.
- Cutts, A., & Graser, A. (2018). *Learn QGIS: Your step-by-step guide to the fundamental of QGIS 3.4* . Packt Publishing Ltd.
- DiBona, C., & Ockman, S. (1999). *Open sources: Voices from the open source revolution* . "O'Reilly Media, Inc."
- Graser, A. (2016). *Learning Qgis* . Packt Publishing Ltd.
- Youngblood, B. (2013). *GeoServer Beginner's Guide* . Packt Publishing Ltd.
- Graser, A. (2016). *Learning Qgis* . Packt Publishing Ltd.

Semester: 5

Methodological Teaching Unit: MTU 5.2

Title of subject: Entrepreneurship

Annual hourly volume: 45h00

Credits: 2

Coefficients: 1

Objectives of teaching:

This course introduces students to the fundamentals of creating, managing, and developing enterprises. It covers legal, financial, technical, and marketing aspects, emphasizing the practical application of entrepreneurship in a professional and digital context.

Content of the subject:

Chapter 1: Concept and Classification of Enterprises

- Definition of an enterprise and its role in the economy.
- Classification of commercial establishments.
- Types of emerging institutions, small enterprises, and consulting/engineering offices (accreditation required from the competent ministry).

Chapter 2: Establishment Creation and Legal Framework

- Steps to create an enterprise.
- Legal and regulatory requirements.
- Registration and licensing procedures.

Chapter 3: Financial and Human Resource Management

- Financial management: identifying and managing enterprise resources.
- Technical and scientific supervision: organizing human resources, continuous training, and professional development.

Chapter 4: Organization of Public Tenders (Procurement)

- Types of tenders: services, works/execution, and supply contracts.
- Contract and market management:
 - ✓ Terms of reference (specifications document)
 - ✓ Project execution and monitoring
 - ✓ Certificate of proper completion

Chapter 5: Marketing and Digital Enterprise Management

- Marketing strategies for enterprises.
- Use of digital tools for promotion, sales, and customer engagement.

Practical Works (PW) :

- 1- Classification of Enterprises
 - ✓ Small, medium, and large enterprises
 - ✓ Consulting and engineering offices
- 2- Enterprise Ecosystem and Economic Role
 - ✓ Role of enterprises in job creation
 - ✓ Impact of SMEs in Algeria
 - ✓ Challenges faced by startups
- 3- Steps to Create an Enterprise
 - ✓ Arrange steps of enterprise creation
 - ✓ Key success factors
- 4- Legal and Regulatory Framework
 - ✓ Registration
 - ✓ Licensing
- 5- Financial Management of Enterprises
 - ✓ Revenue, costs, profit
 - ✓ Prepare a simple budget for a startup
- 6- Human Resource Management
 - ✓ Understand HR organization
 - ✓ Recruitment
 - ✓ Training
- 7- Technical and Scientific Supervision
 - ✓ Technical supervision
 - ✓ Professional development
- 8- Introduction to Public Procurement
 - ✓ Public tender
 - ✓ Procurement
- 9- Types of Tenders
 - ✓ Works
 - ✓ Services
 - ✓ Supply contracts

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Semester: 5
Discovered Teaching Unit: DTU 5.1
Title of subject: Artificial Intelligence (3)
Annual hourly volume: 45h00
Credits: 2
Coefficients: 1

Objectives of teaching:

By the end of this course, students will be able to:

- Apply Natural Language Processing techniques to analyze, understand, and generate human language.
- Design multi-agent systems and simulate their interaction for urban, industrial, or research scenarios.
- Apply advanced planning and reinforcement learning methods to optimize decisions in dynamic environments.

Content of the subject:

- Deep Learning Architectures
- Natural Language Processing
- Multi-Agent Systems
- Advanced Planning and Learning
- AI Ethics and Future Directions
- Capstone Integration Project

Directed Works (DW):

DW 1: Introduction to Deep Learning frameworks

DW 2: Satellite image classification using Convolutional Neural Networks (CNN)

DW 3: Automatic detection of geographic objects

DW 4: Multi-temporal analysis using Recurrent Neural Networks (RNN, LSTM)

DW 5: Modeling natural hazards (landslides, floods) using Deep Learning

DW 6: Advanced evaluation of Deep Learning models

DW 7: Deployment of a geospatial AI model (API or simple application)

DW 8: Mini-project: End-to-end design of an AI model for a problem in Earth Sciences

Assessment Methods

- Continuous Assessment (40%)
- Exam (60%)

Semester: 6
Fundamental Teaching Unit: FTU 6.1
Title of subject: Final Studies Project (FSP)
Professional Internship
Annual hourly volume: 360h00
Credits: 30
Coefficients: 17

10- Final Studies Project (FSP)

Objectives:

To enable the student to lead a complete project from the diagnostic phase to the final technical design phase by following these stages:

Phase 1:

- Topic selection and problem statement definition.
- Selection of a real-world study area suffering from urban challenges (e.g., congestion, pollution, lack of services).
- Collection of field and digital data using advanced analysis tools (GIS, Data Analytics).

Phase 2:

- Design of an integrated technical/urban solution (e.g., a neighborhood energy management system, a community engagement platform, redesign of a smart plaza).
- Preparation of engineering drawings and technical descriptions of the sensors and software used.

Phase 3:

- Conducting an economic and environmental feasibility study for the proposed solution.
- Creating a simulation or a prototype of the solution.

Phase 4:

- Preparation of the final project report and academic posters.
- Public defense in front of a committee of academics and professional experts.

11- Final Studies Project (FSP)

Objectives: To integrate into a real-world work environment (e.g., municipalities, consulting firms, technology companies).

Suggested Internship Providers:

- Municipalities and Local Administrations: To participate in digital transformation and urban management projects.
- Urban Planning and Consulting Firms: To work on modern development plans.
- Technology and Telecommunications Companies: To understand the infrastructure of the Internet of Things (IoT).

Assessment Methods

- Continuous Assessment (100%)