Sustainable Mobility in Cities	GCU09-DURB
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

This course aims to provide the foundational knowledge required to understand and implement urban transport projects, including key issues, regulatory frameworks, diagnostics, and scenario development. It trains students in methods for collecting and analysing mobility data, as well as in microscopic and macroscopic transport modelling through practical applications using specialized software. Students learn to design and evaluate mobility plans based on real case studies, taking into account the external impacts of transportation on individuals, society, and the environment. Finally, the course includes a real-world case study focusing on the introduction of a dedicated public transport system.

Content :

1. Transport planning: issues, modes, data collection, legislation
2. Transport modelling: macroscopic and microscopic models
3. Urban Transport Plans: examples from various French urban areas
4. Development of diagnostics and transport organization scenarios (traffic management, parking, street space allocation)
5. External effects: pollution, noise, congestion, safety issues
6. Case study of a real project introducing a dedicated public transport system

Bibliography :

1. Quelle est la mobilité quotidienne des personnes dans les agglomérations : approche de la question et proposition d'indicateurs, 2004, CERTU
2. Les enquêtes déplacements « standard CERTU » Enquête Ménages-Déplacements, Enquête Déplacements Villes Moyennes, Enquête Déplacements Grand Territoire, CERTU, 2013
3. Etude Méthodologique de la connaissance des déplacements des périurbains, 2004, CERTU
4. Plan de déplacements urbains 2019-2030 DE RENNES MÉTROPOLE, 2022
5. Ingénierie du trafic routier - Eléments de théorie du trafic et applications, COHEN S., 1990, Presses de l'Ecole Nationale des Ponts et Chaussées

Requirements :

Organisation :

Lecture course with practical applications and the use of transport modelling softwares, mini-project.

Modalités d'évaluation :

Mini-Project (report and oral presentation).

Waste Management & Contaminated Sites	GCU09-GTD
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
Give a general training on urban waste management

Content :
1) Waste: Numbers and Definitions
2) socio-economic issues associated with waste
3) methods of management and treatment
4) Household waste: characterization, collection and sorting
5) GIS tools and waste management
6) Methane
7) Composting

Bibliography :

Requirements :

Organisation :
Education provided by professionals and researchers. Case study

Evaluation :
exam (2h)

Design of Water Supply & Waste Conveyance Systems	GCU09-HUR
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : BOURBATACHE Mohamed Khaled	

Objectives :
Hydraulic design of networks and gravity systems.
Study of hydraulic structures.
Regulatory aspect of sanitation and distribution of drinking water

Content :
1. Adduction systems
2. Water treatment
3. Calculation of Hydraulic networks: Hardy-Cross, Newton-Raphson, EPANET
4. Modeling
5. Structure sewerage (collection networks, buffer tank, alternative solutions)

Bibliography :
Jacques BONNIN, Hydraulique urbaine, Ed. Eyrolles, 1986
F. VALIRON, gestion des eaux, Presses de l'ENPC, 1990
W. H. GRAF et M. Altinakar, H ydraulique fluviale, PPUR, 2008
R. BOURRIER, Techniques de la gestion et de la distribution de l'eau, Ed. le Moniteur, 2010
R. BOURRIER , Les réseaux d'assainissement: calculs, applications, perspectives , Ed. Tec&Doc, 2008

Requirements :
Fluid mechanics; Hydraulics ; Hydrology

Organisation :
Project: Urban hydraulics engineering
Students are encouraged to analyse and criticise case studies

Evaluation :
Mini-Project

Urban Hydrogeology	GCU09-HYU
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : LOMINE Franck	

Objectives :
Urban Hydrology: This course is designed to familiarize students with the problems associated with stormwater management in urban areas. It aims to train the engineer to analyze the reaction of urban watersheds to precipitation, but also to calculate and design stormwater drainage structures.
With the aim of forming engineers to solutions often considered more efficient and sustainable, a presentation and analysis of alternative solutions to the "all in pipe" and more integrated strategies, will be conducted through case studies.

Content :
1. Characteristics of watersheds:
   - morphological and topographical characteristics of watersheds and river systems
   - Special case of urbanized watersheds
3. Statistical analysis of rainfall data
   - precipitation: formation, classification, measurement
   - rainfall intensity, frequency and return period
   - analysis of rainfall at a given station
   - analysis of rainfall over an entire basin
   - project rainfall
3. rainfall-flow transformation: temporal analysis
   -definition of the hydrograph: shape and factors influencing it, differentiation of flows
   -theory of the unit hydrograph
   -capacitive models
   -detailed models
4. estimation of flood flows by summary methods (in particular the rational method and the Caquot method)
5. Presentation of control structures and alternative techniques (Low Impact Development)
6. Sizing of retention structures
7 Application 1: Sizing of a stormwater evacuation network
8. application 2: detailed modeling of the response of basins and networks during rainy events: optimizations and alternative solutions

Bibliography :
Documentation available through the course website (Moodle).

Requirements :
Statistics, Free Surface Flow, Hydraulics, Hydrogeology

Organisation :
Lecture followed by application sessions. Realization of a project.

Evaluation :
project

Urban air quality	GCU09-QAIR
Number of hours : 12.00 h	1.00 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : MEFTAH Fekri	

Objectives :
This course aims at presenting physico-chemical and environmental parameters that control the air quality in urban sites. Pollutants and pollution origins, methods and indicators of the analysis of air quality together with methods and tools for air handling are presented and articulated with regard to regulatory frameworks. Finally, methods and tools for supervision, modelling approaches and tools for the estimation / forecast of air quality and post-processing data / results for decision-making are also covered.

Content :
Part I

Introduction to air quality

Pollution : origins and consequences
International protocols and national regulation
Methods of air quality analysis
Methods of dandling polluted air
Regulated / partially regulated / lowly regulated compounds

Part II

Quality air supervision: Setups – Data processing
Forecast models and tools
Models for Chemistry – Transport
Site modelling: Region scale / Urban site scale
Post-processing of results
Confrontation Modelling – Measurements
Case studies
Exploitation of results in the context of urban policy of planning / regulation

Bibliography :

Requirements :

Organisation :
12 hours of plenary lectures for presenting the main concepts of urban quality air assessment, supplemented by different case studies for illustrating the approaches and tools.

Evaluation :
One final-term exam.

Urban planning 2	GCU09-URBA2
Number of hours : 12.00 h	1.50 ECTS credit
CM : 12.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :
This course aims to understand the meaning of urban morphologies .Courses explore the conditions of formation of cities : internal part system ; relationship centers on the other. Why and how a hierarchy of cities and their geographical distribution . How their functions are expressed in a particular type.

Courses voluntarily offer a wide range - in a very short available time-, in order to offer students a synthetic overview, but which allows them to understand a city map. It is trying to understand how urban typologies are related to a part in political and social contexts that are expressed in a system of urban law waveform generator, and other systems to local organizations that value infrastructure networks and balances or imbalances space built and unbuilt space.

Content :
The course is provided by a professional (architect-planner) .
The syllabus is :
1 . Urban Explosion : This course covers . Synthetically passing the ancient city to the metropolis and the question of land.
2 . Planning and training centers morphology 1: Understanding the forms of territorial organization : a study in parallel with the formation of the rural system and the urban system
3 . Planning and training centers morphology 2 : Urban organic The city inside / outside.
4 . Planning and training centers morphology 3: Comic - Reading City: city paths and islands.
5 . Formation of the modern city : the theme of the city infrastructure , the course covers the formation of the modern city.
6 . Contemporary City: structure and challenges : Urban Study : Methodology.
This course is associated with a common planning workshop with MASTER 2 AUDIT from the University of Rennes 2 . In this context the students are working on a public commission more or less fictitious , with the aim to go to APS to define a sketch of realistic action program. This workshop is being accompanied by methodological design of an urban development project carried out by a teacher from the University of Rennes 2 .

Bibliography :
Classic urban palling bibliography

Requirements :
Previous related courses in 3GCU and 4GCU

Organisation :
This course includes 12 hours of analysis of urban morphologies and 12 hours of organization of an urban planning project methodology. Concrete urban development project is given to mixed groups of students from INSA / 5GCU and UR2 / AUDIT to accustom our future engineers to work in multidisciplinary urban engineering.

Evaluation :

Public Road & Transportation Infrastructure	GCU09-VIT
Number of hours : 24.00 h	1.50 ECTS credit
CM : 24.00 h	
Reference Teacher(s) : KAMALI BERNARD Siham	

Objectives :

This course aims to provide the fundamental principles of geometric design and pavement dimensioning, taking into account the specific constraints of the urban context.
It also addresses the design of urban expressways and raises students' awareness of the various types of pavement deterioration.
Through this course, students develop the ability to evaluate and assess urban infrastructure design projects.

Content :

1. Urban roads
   - Geometric design
   - Structural design
   -
2. Urban crossroads
   - The different types of urban crossroads
   - Geometric design
   - Structural design.
   -
3. Urban expressways

4. Road system for public transportation

5. Some equipment for urban roads: signaling

6. Degradation of urban roads

Bibliography :

1. "Dimensionnement des structures des chaussées urbaines", 2000, CERTU
2. "Carrefours urbains : guide", 1999, CERTU
3. "Conception structurelle d'un giratoire en milieu urbain", 2000, CERTU
4. "Guide pratique de la voirie urbaine", 1999, RGRA
5. "Catalogue des dégradations de surface des chaussées", 1998, LCPC
6. "ICTAVRU, Instructions sur les conditions techniques d'aménagement des voies rapides urbaines", 2009, CERTU

Requirements :

Basics of the French method of road design.

Organisation :

Courses, Applications and use of software, mini-project

Evaluation :

Mini-project (report and oral presentation).