



Affiliated to the UN

Global Navigation Satellite System

Modules of the Master



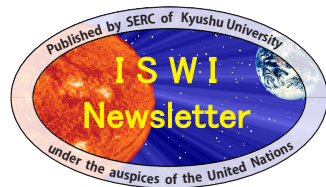
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Materials of Semester 1	Contents	VH
Module 1 : Basic Mathematics		80
Reminders Mathematics	<ul style="list-style-type: none"> • Complex analysis • Numerical Analysis • Geometry of surfaces 	25
Signal processing	<ul style="list-style-type: none"> • Basics of analog signal processing and digital • Fourier analysis • Signal acquisition • Signal processing 	25
Statistics	<ul style="list-style-type: none"> • Descriptive analysis (mean, standard deviation, variance ...) • Statistical modeling of spatial data • Interpolation methods 	30
Module 2 : Basic physical		80
Electronics	<ul style="list-style-type: none"> • Mathematical Foundations • Electrical signals • Electronic components • Electronic circuits • Transmitters, sensors 	30
Space mechanics	<ul style="list-style-type: none"> • Components and types of satellites • Keplerian Elements • Modeling the movement of satellites • Description and orbit determination 	30
Earth Physics	To be completed by the team of the Scientific Institute	20
Module 3 : Computers		80
Databases	<ul style="list-style-type: none"> • Development cycles • Stages of design • Relational databases • Database objects • Analysis databases 	16
Object-Oriented Programming	<ul style="list-style-type: none"> • Fundamental OO programming • Encapsulation, inheritance and polymorphism • Constructors and destructors • Virtual methods, dynamic and abstract • Visibility • Variables and Operators • Conditions and loops and arrays • Class methods • Classes • Object modeling 	24
Network architecture and protocols	<ul style="list-style-type: none"> • Signaling and modulation • LAN • Connection diagrams • Data Services • TCP / IP • ATM 	24

Embedded Systems	<ul style="list-style-type: none"> • Types of embedded systems • Features and Architecture • Programming languages • Fields of application 	16
Module 4 : Signals and Receivers		80
Structure and transmission of signals	<ul style="list-style-type: none"> • Standard signal transmission • Signal structure • Signal Processing • Coding techniques 	40
Receivers	<ul style="list-style-type: none"> • Architecture receivers • Types of antennas and components • Propagation of electromagnetic waves • Atmospheric effects • Sources of errors • Navigation algorithms • Filtering • Modulation techniques 	40
Materials of Semester 2	Contents	VH
Module 5 : Fundamentals of Geodesy and Topography		80
Geodesy	<ul style="list-style-type: none"> • Ellipsoid of revolution • Types of repositories • Geodetic coordinate systems • Transformations between coordinate systems • Measurements and errors in geodesy • Law of propagation of errors • Principle of least squares • Compensation methods : Method of condition method of variation of parameters • Map projections 	50
Physical geodesy	<ul style="list-style-type: none"> • Gravimetry • Leveling • Geoid determination. 	12
Digital topography	<ul style="list-style-type: none"> • Measures of angles, distances and height differences • Measurement errors • Processes topographic horizontal and vertical • Survey methods and Instrumentation digital survey • Processing and automatic establishment plans 	18
Module 6 : Positioning Satellite		80
Introduction to Systems Global Navigation Satellite System (GNSS)	<ul style="list-style-type: none"> • Scientific positioning systems. • Study of global systems GPS, GLONASS, Galileo, COMPASS : <ul style="list-style-type: none"> – Historical – Segments – Reference systems – Services available – Signal structure and messages • Regional systems (IRNSS, QZSS, ..) 	20
Processing GNSS observations	<ul style="list-style-type: none"> • Types of GNSS measurements 	60

	<ul style="list-style-type: none"> • Noise measurements • Mathematical model by measuring Doppler • Mathematical model by measuring pseudorange • Mathematical model by phase measurement • Linearization and filtering • Detection of cycle slips • Combination of measures • Resolution of ambiguities • Methods adjustments • Quality indicators positioning 	
Module 7 : Techniques for positioning and navigation satellite		80
Technical positioning and navigation	<ul style="list-style-type: none"> • Autonomous positioning methods • Methods of precise positioning • Dynamic positioning methods 	40
Differential positioning and augmentation systems	<ul style="list-style-type: none"> • Principle • Differential systems • Solution of differential positioning • Augmentation systems (EGNOS, WAAS, MSAS, GAGAN) • Assisted positioning • Geo-location by mobile network • Permanent stations 	40
Module 8 : Practices positioning techniques		80
Precise static positioning		40
Kinematic positioning and real-time kinematic		40
Materials of Semester 3	Contents	VH
Module 9 : Representation of geographic data		80
Cartography	<ul style="list-style-type: none"> • Representation of topographic data • Representation of qualitative and quantitative data • Preparation of maps and Skin 	20
Web-Mapping	<ul style="list-style-type: none"> • Foundations, software architectures, programming languages, standards. 	20
Design of geographic databases		20
Mini-Project (part 1 of the pilot project)	Thematic applications of GNSS	20
Module 10 : Management of geographic data		80
Geographic Information Systems	<ul style="list-style-type: none"> • Components of GIS • Data Types • Acquisition and Preprocessing • Spatial analysis • Thematic analysis • Spatial modeling • Geographic databases • Standards 	50
Mini-Project (2nd part of the pilot project)	Thematic applications of GNSS	30
Module 11 : GNSS Applications thematic and Complementary Systems		80
Thematic applications	<ul style="list-style-type: none"> • Geodesy, Photogrammetry and Cartography 	40

	<ul style="list-style-type: none"> • Civilian navigation • Civil engineering works and auscultation • Precision agriculture and natural resources • Lands, cadastre • Disaster Monitoring • Regulatory and Legal Aspects of GNSS 	
Inertial systems	<ul style="list-style-type: none"> • Operating principle and Technologies • Measuring acceleration, angle and angular velocities • Reckoning • Coupling (reckoning and satellite navigation) 	20
Mini-Project (3 rd element of the pilot project)	Thematic applications of GNSS	20
Module 12 : Communication and Project Management		80
Technical English		20
Project Management		20
Mini Project (4 th element of the pilot project)	Thematic applications of GNSS	40
Materials of Semester 4	Contents	VH
Module 13, 14, 15, 16: Final Project study		320



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