2010

Mastère spécialisé

Communication, Navigation, Surveillance and Satellite Applications for Aviation

Syllabus

ENAC

La référence en Aéronautique

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MASTERE SPECIALISE COMMUNICATION, NAVIGATION, SURVEILLANCE AND SATELLITE APPLICATIONS FOR AVIATION

CONTENT AND OBJECTIVES

The International Civil Aviation Organisation (ICAO) is leading research into improving air traffic control world-wide with a view to replacing different national systems with a harmonised global and cost effective system.

New space telecommunication technologies will provide an excellent means of achieving this goal.

Until now no comprehensive training has been available to the aeronautical community, to complement the technical developments of CNS systems.

This "Mastère Spécialisé" provides training in the various satellite technologies relevant to Communication, Navigation and Surveillance (CNS) applications. These are examined from the view point of air traffic control.

The Ecole Nationale de l'Aviation Civile has expertise in all aspects of this field and is able to offer a complete training package.

The "Research and expertise" on the CNS laboratory is integrated in the teaching department, this offering an updated and relevant teaching in the field of satellite based navigation.

PROFESSIONAL PROSPECTS AND CAREER OPPORTUNITIES

This "Mastère Spécialisé" was created to meet the needs of the equipment and avionics sectors as well as those of aircraft manufacturers, airlines and national and international organisations affected by developments in the CNS field.

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INTRODUCTORY COURSE, ELECTROMAGNETISM AND ANTENNAS

OBJECTIVES

The training deals with the theory of propagation, antennas and microwave. The main aim of this week of technical presentations, is to apprehend the medium transport for the transmission of information in the context of Global positioning with Satellite but also in any other application concerning by microwave communication like surveillance, conventional Navigation, voice exchange. Nevertheless, many example will be given in the context of the GNSS (Global Navigation Satellite System) , that represents the standard generic notions for satellite navigation systems that provide autonomous geo-spatial positioning.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Propagation applied to CNS systems :
• Propagation in free space.
• Propagation in the presence of diffracting objects.
• Propagation in the troposphere.
• Propagation in the ionosphere.
• Design office.

2. Antennas :
• General.
• Small antennas.
• Network antennas.
• Reflector antennas.
• Antenna pattern Diagram.
• Design office , simulation and Demos.

3. Microwave circuits :
• General.
• Fundamental concepts in lines, cavities and filters.
• Noise.
• Linearity of an element.
• Active elements.
• Technologies used.
• Simulation tools.
• Design office.

4. Presentation of Software/Tools in R.F Technics :
• ADS (Advanced Design System) : oriented for object target dimension inferior or closed the wave-length.
• MUSICA (Multi-path Simulator for Civil Aviation): oriented for Object Target dimension superior to wave-length.
• HFSS : High Frequency Structure System : oriented for object target dimension inferior to wave-length.

COURSE DURATION

7 days - 39 hours

INTRODUCTORY COURSE
BASIC DATA TRANSMISSION

OBJECTIVES

This training allows to the students to acquire the fundamental knowledge and theoretical concepts that are present and involved in a channel of analogical or numeric communication. Basic Theory of Base-Band signal and numeric modulation will be presented . It will be provided the fundamental communication theory in the fields of signal processing and transmission (Determinist and Random Signal, digital modulation, encoding, etc.). Simulations will be deployed to illustrate the courses.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Basic Theory of Analogical signal Processing :
• Definition Energy, Power of Signal, and classification.
• Determinist signal Theory in Continuous context : Fourier Transform, Dirac, Convolution, Correlation, Spectrum).
• System linear, and definition of linear Filter.
• Random signal in Continuous context : Definition, Autocorrelation, Distribution, Independent Notion, Stationary state of Random Signal, Ergodic property, Spectrum, linear filter of Random Signal.
• Sampled signal Theory, Shannon theorem.Notion of Decimated signal.
• Z-transform of a sampled signal and discrete linear filtered associated, Digital filter. Labworks of consolidation and explanation.

2. Introduction in coding :
• Context.
• Linear Code in Blocks.
• Convolution Code and representation.
• Algorithm of Viterbi Decoding .
• Punctured Code.
• Implication on the Gain Coding for the transmission.
• Associated Performance of the coding theory.

3. Digital Transmission theory, involvement on the performance :
• Basic principle of Digital Communication chain.
• Principle of Modulation and Demodulation in Digital Transmission.
• Signal Space Analysis and optimal detection.
• Base-Band signal on limited Bandwisth, Nyquist's Crieria.
• Coding on digital Information : NRZ, NRZ Sinus, Manchester, Code Mac Inversion. Application to the coding in CDMA (Code Division Time Multiple Access).
• General notion of performance on noised Channel, and concret expression of the "Bit Error Rate".
• Digital Modulation and Performance : Amplitude Shift Keying (ASK), Phase Shift Keying (PSK).
- Differential Phase Shift Keying (DPSK), QPSK Quadrature Phase Shift Keying , PSK M-Ary, - Amplitude Shift Keying with Phase Shift Keying in Phase/Quadrature Modulation (QAM),
- Frequency Shift Keying (FSK) , GMSK Gaussian filtered Minimum Shift Keying.

COURSE DURATION

8 days - 42 hours

NETWORK OVERVIEW

OBJECTIFS

This training covers the fondamental of Datalink Telecommunication Network. It allows to acquire the definition, the main environment and technical topics of a protocol of local or wide aera network. The illustration through IP stays a consequence of these network notions.
Due to the generalisation of IP technology, this formation allows to apprehend the basic notion of design of a realistic firm network. The routing, quality and security techniques will be also teach and developed.
Some new tendency of Internet protocol will be explored.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

- Principe of Communication Network and formalism
  - OSI Model , Seven Layer Model of functioning
  - Network architecture
  - Standard Networks
- Physical Architecture
- Application on IP Suite
  - IP Protocol , ARP, ICMP
  - Associated Protocol, Transport Control Protocol and User Data Protocol
  - Notion of Multicast
  - Upgrade protocol
- Overview of the Dynamic behaviour in Network/Interconnection Theory
  - Spanning tree
  - Routing technique and Protocol and routing architecture
  - Principe of Routing IP Map
- Quality/Security with networking
- Quality of service
- Overview of implementation of Aeronautical Networks
- Practical Labwork and illustration of the previous theoretical concept

COURSE DURATION

5 days - 25 hours

AERONAUTICAL ENVIRONMENT, OPERATIONAL REQUIREMENTS AND AIR TRAFFIC CONTROL FAMILIARISATION

This course allows to introduce the reality of the Aeronautical environment and of organisation of the aeronautical space for Air Traffic Control aims. It provides the necessary knowledge in the fields of navigation and airspace management enabling the entire problem set to be defined.

OBJECTIVES

This training will propose to :
- Define the main terms related to Air Traffic Management.
- State the main rules of the air and describe the air traffic services.
- Understand the essential of procedure design process and extract from an Instrument Approach Chart the main information for discover the navigation requirement. Awareness in the particular of RNAV Procedures.
- Describe the Air Traffic Control services and explain the interaction between radar and control service.
- Describe the ATM concept in term of Operational Requirement, and the involvement of Management of Risk in Aeronautical Environment.
- Describe the main ATM systems and explain the computer architecture trends.
- Describe the flexible use of airspace between the two users of the ATC spaces : the Military and the Civils.
- Describe the air traffic flow management principles and role, with its European implementation.

PARTICIPANTS

Executive or Engineers, that expect to acquire a knowledge and a overview panel of the ATM requirements, and the actual implementation of their responses.

TOPICS COVERED INCLUDE

Part I : Introduction to Air Traffic Management.

Part II : Basic regulation, rules and concepts :
- Main rules of the air.
- IFR and VFR operating rules.
- Introduction to ATM , Air Traffic Services and ESARR.
- Airspace : classes, IFR and VFR traffic, Transition.
- Flight information service , Flight plan content and use.

Part III : Air Traffic Services description et Classification :
- Aerodrome control service
- Approach control service
- En-route control service

Part IV : Introduction to the Air Traffic Flow Management (ATFM) :
-The requirement and the Central Flow Management Unit (CFMU) architecture and principles.

Part V : First Basics of Procedures Design :
- Description of the main segments of arrival and approach trajectories.
- Differentiation of Classic, Precision, departure Approach and RNAV and Procedure APV.
- Protection areas, Minimum Obstacle Clearance.
- Aircraft categories.
- Information from existing Instrument Approach Charts.
- Short introduction to the RNP/RNAV/P-RNAV concept.

Part VI : Awareness in Operational Requirement, and Management of Risk in Aeronautical Environment :
- Introduction of the culture toward “Analysis of Risk” : Safety Objectives, Safety Analysis.
- Safety Demonstrations, Aviation System structure and interactions, Management of the whole. Examples for providing practical demonstration of Safety Risk Management and for demanding for quality on precision approach and implication on the :
- Operational Requirement.
- Communication ? Navigation ? Surveillance ? ATM ? Others ?
- About Systems Management ?
- Operational needs ? Systems requirements ?
- Why is it necessary to define needs, requirements ?
- How to define operational needs for the various components : Communication, Navigation, Surveillance and Others such ATM Tools ?
- Place of Operational Requirements in Systems Service Life ?
- Flight Safety is of paramount importance and integral part of Systems Requirements.
- Awareness of necessity of “project management vision” and linked methodology in aeronautical environment domain.

Part VII : Demonstrations and Simulations in Aerodrome and in Upper Information Region context, on the ATC simulator of ENAC.

COURSE DURATION

4 days - 24 hours

AERONAUTICAL INSTITUTIONS AND STRATEGY FOR ATM/CNS

(application through SESAR Program)

OBJECTIVES

The formation answers to the question : What are the future Communication, Navigation and Surveillance infrastructure likely to be in the next decade in ATM context in ECAC aera (European Civil Aviation Conference) ? This 4 days strategic course aims to cover both the institutional and technical aspects of current and future CNS. The course will start by discussing the development of the current Air Traffic Management concept through the overview of ICAO Institution and the Eurocontrol/CNS Strategies, then what they are being implemented today through the SESAR program (Single European Sky ATM Research).

The presentation of the different industrial institutional Stakeholder (Eurocae , RTCA) that are involved in those plans , will be put in place. Each of the three panels “Com-Nav-Surv” of the planned programmes, with their new main required developments, will be in a equal way separately explored.

PARTICIPANTS

The course is designed for people with a perception of the current Communication, Navigation and Surveillance domains and wanting to take part in an in-depth analysis of the strategies, their sources and implications, or for people involved in the planning of national CNS infrastructures.

TOPICS COVERED INCLUDE

Part I : The Global Context

The course will start with an overview and analysis of the 'Strategy of CNS/ATM' in Europe. First the challenges of ATM in Europe will be presented.

Following that, the players (ICAO, EU, ECAC, EUROCONTROL, ...) and their answers to the problems in ATM in Europe will be reviewed . A description of the structure of the main actors ICAO and Eurocontrol will be realized. The notion of certification linked with the EASA (European Aviation Safety Agency) will be explained.

We will establish the connection with the role of the aviation industrial stakeholder « EUROCAE, RTCA ».

Part II : The Communication Plan

According to the concept of the ATM2000+ Strategy and of the ECAC area , this part of Module covers the full communication domain and includes strategic direction for :

• Ground-Ground Data Communication.
• Ground-Ground Voice Communication (telephony).
• Air-Ground Voice Communication (RT).
• Air-Ground Data Communication (datalink).
• The impact of the Internet and Internet Technology on the Aviation Community.
• The Aeronautical Fixed Telecommunication Network (AFTN) be replaced by regular e-mail ?
If that is the case, when is it expected to happen ?
• The use of VHF radio to implement air-ground voice communication.
• Datalink communication an enhancement of voice communication or is it seen as a replacement of voice in the futur.

Part III : The Navigation Plan

According to the concept of the ATM2000+ Strategy and ECAC area, this part of Module covers the full Navigation domain and includes strategic direction for :

• the future of the conventional navigation aids (VOR, DME) still be used in the long end term.
• The next role of the Satellite Positioning Systems, the impact of Galileo on the Navigation Strategy.
• The next accuracy with which aircraft will be expected to fly their planned route in the next year
• Will the changes in the navigation environment have an impact on the airborne equipment ?

Part IV : The Surveillance Plan

According to the concept of the ATM2000+ Strategy and ECAC area, this part of Module covers the full Surveillance domain and includes strategic direction for :

• The future use of the the Primary Radar.
• The replacement of the use of conventional Secondary Radar by the Secondary Radar with MODE-S.
• The future role of Automatic Dependent Surveillance (ADS).
• Will ADS replace or enhance MODE-S ?
• What is the transmission technology used for ADS ?
• When will air-to-air surveillance be introduced and which technology will this application use ?

COURSE DURATION

4 days - 20 hours

SPACE FLIGHT DYNAMICS AND SATELLITE CONSTELLATIONS

OBJECTIVES

This training aims to present an overview of the fundamentals of space flight dynamics. Mathematical principles will be explored for apprehending the physics of orbital motion, but they will be associated with descriptions of real implementations of space systems according to various mission requirements. The trainees will acquire a basic knowledge of the models that describe trajectories and attitudes of space vehicles. They will also learn how to assess space related performances of a satellite based system.

After completing this course you will be able to :
• understand the dynamics of the orbital motion,
• understand the complexity of the choice of a good time and reference system,
• select an orbit according to the main mission requirements,
• compute orbital manoeuvres for simple orbital transfers,
• select a satellite constellation or a formation flying system according to the mission performance requirements,
• understand the basic principles of space navigation systems.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Fundamentals of Space Flight Dynamics
• Kepler and Newton laws
• 2-body and 3-body problems
• Orbital elements
• Time and terrestrial reference systems

2. Orbital Perturbations
• Modelling of the gravitational field
• Detailed effect of the main zonal term (J2)
• Sun and Moon gravitational effects (illustrations with GPS orbits)
• Atmospheric drag
• Solar pressure

3. Orbital Manoeuvres
• Impulsive manoeuvres
• Modification of the orbital elements
• Hohmann orbital transfer
• Rendezvous
• Station keeping
• Deorbitation

4. Orbit Design
• Main types of Earth orbits and basic properties
• Earth-phased orbits
• Geosynchronous orbits
• Sunsynchronous orbits
• Grounds tracks

5. Satellite Constellations
• Constellation design
• Visibility coverage
• DOP coverage
• Launch and deployment of satellite constellations
• Station positioning strategies
• Satellite renewal strategies
• Examples of satellite constellations

6. Formation Flying Missions
• Design of a formation flying system
• Station keeping strategies
• Examples of formation flying missions

7. Introduction to Satellite Navigation Systems
• Previous navigation systems (TRANSIT, LORAN C)
• Presentation of GPS, GLONASS and GALILEO
• Principles of satellite positioning systems
• Geometric dilution of precision (GDOP, PDOP, HDOP, VDOP, TDOP)
• User equivalent range error (UERE)

COURSE DURATION

5 days - 24 hours

GPS AND OTHER CONSTELLATIONS OF NAVIGATION

OBJECTIVES

This training provides the fundamental knowledge concerning the satellite-based localisation , with a progress to the required performance by the aeronautical participating users.
The R.F principle and detail of the GPS characterisation will be explored . The signal structure and signal processing techniques will be detailed . The interest of the augmentation of performances , proposed by the DGPS will be showed
and explained . Those formations introduces also the present and future constellations of the satellite that deal with the Navigation purpose.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. GPS System Description
• Basic radio-navigation measurements and principles : distance, velocity, time . Principe of measurement of solution of navigation.
• Four Satellite ranging system Principle.
• Military/Civil dual use.
• Time and coordinates reference system.

2. GPS Architecture and Technique
• GPS : space , control and users segments . GPS Architecture.
• Signal structure : frequencies, multiple access technique, spread spectrum technique , Code C/A , P(Y).
• GPS Data Message.
• GPS receivers : antenna , Block Diagram , and architecture. Signal Processing.
• Transmission channel : ionosphere and troposphere propagation properties, interferences, multipath, localisation Indoors.
• Performances : D.O.P, Accuracy, Availability, Integrity, Continuity.
• Correlation, Acquisition, tracking, impact of the perturbation on the tracking.

3. Differential techniques : DGPS
• Principles of correction of common bias systematic error : code differential and phase differential techniques.
• Performances.
• Introduction to the Policy of Augmentation of Accuracy, Availability, Integrity (RAIM, EGNOS...)

4. Others Satellites Constellation for Navigation
• GLONASS, GALILEO, Modernized GPS .

5. Simulations and Labwork
• Navigation constellation session.
• Receiver simulation session.
• Multipath effect simulation session.
• Code and phase simulation session.

COURSE DURATION

10 days - 50 hours

KALMAN FILTER - THEORY AND HYBRIDATION

OBJECTIVES

This training allows to present the concept of Kalman Filter as a particular and efficient application of the Least Mean Square error Concept in the Signal Theory . Numerous use of this linear filtering technique could be explored , but the solution navigation in the context of Global Navigation Satellite System will stay the main illustration , in this formation . Some others examples in Surveillance and in Navigation for positioning an aircraft will be explained . The lecturers will also insist on the possibilities of utilization of merging various sources of measurement (multi-sensor systems).

PARTICIPANTS

Engineers and executives with a knowledge of basic theory of signal processing

TOPICS COVERED INCLUDE

1. State space model, Overview of Continuous and Discrete Problematic.

2. Recall of Random signal, Overview of the Problematic of optimum estimation.
• Overview and Recall of Random Signal/Processing Theory.

3. Notion of the "Least Mean Square Error (LMSE)" concept in estimation theory.

4. Kalman filtering Theory and its extension
• The main notion in linear and Gaussian noise context . Definition of the Equation System and Kalman filter Algorithm.
• The extended case (Extended Kalman Filter) in non linear model. Definition of the Equation System and E.K.F Algorithm.

5. Additional of External signal Measurement of information. Illustration with the Inertial Navigation Case.
• Overview of the problematic of the hybridation and Coupling in Kalman filter theory.
• Example : GPS/Inertial System Coupling.

6. Case Study and Simulation :
• Basic example in Surveillance of Aircraft (Radar, Multilateration - Surveillance)
• Completed Simulation with GPS sensor.

COURSE DURATION

5 days - 27 hours

SPATIAL TELECOMMUNICATIONS

OBJECTIVES

This formation insists on the communications, data transmissions and payloads techniques, provided on satellites environment. In particular the performance of link and its power balance sheet in the context of TDMA, FDMA, CDMA (Time, Frequency, Code Division Multiple Access) is exposed. The problematic of the tropospheric and ionospheric propagation effect will be explained. the proposed case study will allows to apprehend the rough value of the present characteristic parameters. The earth station aspect and the main mission of Satellite communication will be presented, as VSAT (Very Small Aperture Terminal) Application, Broadcast and Internet / Multicast Service.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Introduction, Definition, Characteristics of Space System
• Main Missions and Services.
• R.F Link and Principles.
• Characteristics of a SAT and Payload.
• Launcher.

2. Space and Satellites Environment
• On board Receivers / Transmitters.
• Antenna.
• General propagation effects.
• Spectral Management and organisation.

3. Communications and Access Techniques for Physical Layers
• Budget / Balance sheet and associated performances of a link satellite transmission.
• Multiple Access, problematic (TDMA, FDMA, CDMA) of network .
• Example .

4. Earth Stations
• Standard Architecture.
• Antenna, RF Equipment.

5. Provided Service of Communication
• Broadcast Service (Multimedia Application).
• Provision with VSAT Implementation.
• Quality of service.

6. Case study (Link Budget)

COURSE DURATION

5 days - 24 hours

CNS SYSTEMS - COMMUNICATION

OBJECTIVES

This formation covers the analysis of the aeronautical communication requirements (Air Traffic Management, Aircraft operation and passenger communications), the current technical solutions and their evolutions requiring new innovative technical solutions.

This course address in particular :
- The air/ground voice communications, the current technologies (25 kHz, 8.33 kHz, HF voice, Satellite voice) and their evolutions and the future role of voice communication in the context of a wide move toward data exchanges
- The current datalink technology based on ACARS (Airline Communication, Addressing and Reporting System) protocols and the key applications of the ATM domain
- ATN (Aeronautical Telecommunication Network) that is the air/ground common data transport layer from an engineer point of view.
- The various sub-networks that could be interconnected through the ATN: VDL mode 2, Satellite D/L, HF D/L
- The main air/ground data-link services that have been defined at ICAO level (CPDCL, ADS, ..) and their deployment foreseen in Europe (Link 2000+ programme)
- The status of the selection of new technologies to support the future needs for air/ground data communication : new terrestrial cellular system, new airport surface solution and new satellite solution
- The evolution of the key ground/ground data communications services in the perspective of usage of native IP network service.

The topics of overall system certification and Radio spectrum management will be also explored.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Introduction, context of the Aeronautical communications.

2. Voice communications : Case study, en route VHF coverage.

3. Data communications :
• ACARS, ARINC 622/623 evolution. Description and application.
• OSI model, X25, ISO protocols and IP Routing.
• Aeronautical Telecommunication Network, and ATN-Subnetwork (ATN Routing, VDL mode 2 ....).
• VHF sub-network.
• AMSS sub-network.
• HF sub-network.
• SATCOM sub-network, future component satcom in L Band.
• Future communication components (terrestrial, airport).

4. Ground Telecom Service over IP
• Deployment of Internet Protocol (IP) : the future based networks in aviation.
• Data sharing information ; System Wide Information Management (SWIM Concept).

5. Spectrum Management.

6. Overall system certification : integration Onboard/Ground Safety and Performance requirements.
7. Strategy EuroLink 2000 and Programme, and Future Communication System.

COURSE DURATION

10 days - 48 hours

CNS SYSTEM - NAVIGATION : Navigation services in civil aviation : Conventional Navaids, GNSS (ABAS, GBAS, SBAS, GALILEO)

OBJECTIVES

We will analyse the Navigation needs of aeronautics, and demonstrate that their evolution require the implementation of global solutions with a satellite component. This course allows to have a overview of the techniques of navigation that are deployed in Europe, and around the world. At the introduction we develop the Navigation generic requirement for systems (Conventional Nav Aids and GNSS), recommended by OACI , then the operational requirements (RNAV.RNP, PBN criteria).
This course is designed for anyone wishing to have a broad understanding of navigation technique (from the conventional nav-aids and the future one), their currents limitations, and what the next decade may bring. There is a full review of satellite augmentations in Navigation domain. The course ends with a view of future GNSS developments including a discussion on GALILEO.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. General consideration on navigation and Operational requirements :
• Navigation and different phase of flight. Notion of general Navigation errors
• Landing phase (non-precision, precision).
• RNAV. Concept
• Requirement Navigation performance overview and operation benefits .
• PBN concept (Performance Based Navigation)

2. Conventional navigation Systems :
• Presentationnof the main technical function of VOR, NDB, DME.
• Principle of functioning of ILS, MLS.
• Description of characteristics of LORAN/C LORAN.
• Inertial Navigation system (INS)

3. ICAO and the GNSS Concept
• The basic Requirement of ICAO
• The technical answer of augmentation : ABAS, GBAS, SBAS

4. On-board augmentation technique (ABAS)
• RAIM functions
• AAIM functions

5. Augmentation based on satellites (SBAS)
• EGNOS.
• WAAS

6. Augmentation based on ground stations (GBAS)
• GBAS/Cat I
• GBAS/CAT II and III

7. Navigation and interference.

8. International terrestrial reference systems : the needs and the principles.

9. GNSS – Description of the next constellation for positioning and other services : GALILEO.

10. Demos and practical on GNSS System.

COURSE DURATION

10 days - 48 hours

CNS SYSTEM - SURVEILLANCE

OBJECTIVES

Overview of all the Sensor of Surveillance which are used and spread in ATM context of Surveillance.

Analyse the surveillance needs and requirements of the civil aeronautics. Explain the Principals Theory of detection of all the present tools of surveillance in civil aviation.

Demonstrate the global integration in a more complete of surveillance ATM/CNS Strategy . Illustrate the evolution that requires the implementation of coordinated facilities with communication and navigation functions.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Operational requirements :
• En route surveillance.
• Airport and Terminal surveillance .
• On-board surveillance.
• Standards Separation.

2. Radar-based surveillance techniques :
• Primary radar, Airport System Detector Equipment.
• Conventional Secondary radar (Mode A/C).
• Secondary Radar (Mode S).

3. Multilateration : LAM-WAM
• Principle of Detection.

4. Automatic Dependent Surveillance :
• ADS-Contract.
• ADS-Broadcast.
• ADS-Europe project.

5. Surveillance processing and application:
• Radar and Surveillance tracking.
• Surveillance server.
• Data fusion.
• ASMGCS concept (Advanced Surface Mouvement Guidance and Control System).
• STCA concept (Short Term Conflict Alert).

6. European Normalised Digital Format of messages for Surveillance (ASTERIX)

7. European Standard Radar assessments and radar processing assessment (SACC)

8. Anti collision system :
ACAS : "Airborne Collision Avoidance System"
TAWS : “Terrain Awareness & Warning System”
ASAS : “Airborne Separation Assurance System".

COURSE DURATION

10 days - 48 hours

ARCHITECTURES OF CNS AVIONICS SYSTEM

OBJECTIVES

This training will allow to present the systems integrator's industrial point of view on the avionics architecture system, which is connected with the CNS concepts.
This formation will describe the architectures of avionic computer and aeronautical data, Telecom buses, and illustrate their evolution.
The lecturers will resituate all the presentation in the present situation of “ATM/CNS” technical strategy.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Engineering, Standardisation, qualification, certification, Avionics :
• ATA and ARINC standards.
• Qualification : Eurocae Documents (EDxx)
• Safety Certification CS25 /FAR25 (1301, 1309) .

2. Systems design :
• Systems workshop design:
- ARP 4754
- ARP 4754 (System Safety Access).

3. Conventional CNS avionics :
• Communications architecture.
• Navigation architecture.
• Integration surveillance architecture.
• Sensors, computers, antennas, control boxes, displays.

4. Evolution of conventional Avionics :
• FMS : Overview , concept and Data base.
• Communications (CMU, CPLDC).
• Navigation (RVSM, FMS, MMR).
• Surveillance (ADS) - Man-Machine Interface.

5. Integrated Modular Avionics and CNS :
• IMA concept.
• IMA technology.
• Installation of CNS functions.

6. On-board databases and Integrity :
• Navigation databases.
• Terrain databases.
• Data collection.
• Formatting, validation.

7. “Airbus” avionics Architecture.

8. Visit to the ENAC avionics laboratory :

9. Emerging technologies

COURSE DURATION

5 days - 24 hours

NON-AERONAUTICAL SATELLITE POSITIONING APPLICATIONS

OBJECTIVES

This training analyse the existing and potential needs for localisation, navigation and dating and survey in the domain that are not directly linked with the aeronautical ATM/CNS Domain.
So the field of the civil Transport (Road Transport , Land , sea , sea, rail) , geodesics and farming-agriculture application will be explored . The necessary needs of high precision of the Military and Geodesy area will be also explained.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. Utilisation of satellites In transport :
• Localisation aspect :
• localisation used in navigation.
• localisation for vehicle tracking.
• Telecommunications aspect.
• Observation aspect.
• Examples of Survey.

2. Terrestrial and civil applications :
• Fleet management.
• Public transport surveillance.
• Maritime navigation.
• Guidance systems with or without traffic information.
• Marking (trains, wagons, containers , etc.).
• Examples of Survey.

3. Applications in the field of agriculture :
• Positioning of agricultural vehicles.
• Precision farming.
• Agricultural foodstuffs transport management.

4. Geodesic applications.

5. Military applications.

6. Base Data Base of Map Issue.

7. Mini-project.

COURSE DURATION

8 days - 39 hours

SYSTEM ENGINEERING AND SAFETY MANAGEMENT IN CNS/ATM

OBJECTIVES

The objectives of this course are to provide participants:

- an overall view of System Engineering Process for CNS systems, and the stakes of System Engineering for CNS project management
- knowledge of bases and stakes of Safety Management in the ATM domain, and to develop participants' ability to accept and oversight, or to implement and operate, Safety Management System (SMS)
- knowledge of the key safety assessment process for ATM changes, including relationships with system engineering process, and to develop participants' ability to conduct safety studies and to build safety cases.

PARTICIPANTS

Engineers and executives

TOPICS COVERED INCLUDE

1. System Engineering : bases and stakes for project management

The main system engineering activities is illustrated in order to :

• set up for the successful development of product "fit to purpose",

• optimizetheoverallpossessioncost, andthusstakes of system engineering for project management. It is a solving process to be applied on the entire system life cycle from the need to the solution up to its disposal, integrating disciplines and all the dimensions of a complex system, thus its total cost of ownership, the various point of views of all stakeholders, etc.

The overall organisation of the course is structured following the SE technical processes ISO 15288 but other standards such as EIA 632 are also introduced.

But some other system engineering linked activities are also described (SE history, modelling, value analysis, CMM, acquirer / supplier relationships) This training is centred on an active participation of the attendees. The different concept will be discovered through exercises based on a case study.

2. Safety Management in the ATM domain

Efficient Safety Management is a new challenge for the worldwide air navigation community, and especially for the ATM services providers. Recent ICAO performance-based regulation (SARPs, Annex 11) has established the framework for ATM providers to implement and operate Safety Management Systems (SMS) and for States to develop and maintain Safety Programs (SSP).

The focus will be done on the ICA0 regulation framework and on the actual international safety management best-practises. The course will be centred on numerous study cases. The main contents are :

- The need for safety management
- Basic principles of risk management and stakes for safety management
- Safety management regulation : State's Safety Program (SSP) , Safety Management Systems (SMS)

3. Safety Assessment of ATM changes

The safety assessment of changes to ATM system is a key activity of the Safety Management System of an ATM services provider. The associated process outcome key results for the go/delay decision about the entry into service of such ATM changes.

The focus will be done on the actual international best-practises of safety assessment, within the ICAO and EUROCONTROL regulation frameworks, and the course will be centred on numerous study cases. The main contents are :

- ATM changes and overall safety assessment process
- Safety Plan
- Functional Hazard Assessment (FHA)
- Preliminary System Safety Assessment (PSSA)
- System Safety Assessment (SSA) , cases and safety monitoring.

COURSE DURATION

10 days - 50 hours