# **Remote practical work of February , 2023**

# Discovery soft tool for avionics and radionavigation

Works **only on PC with Windows**, not on mac/apple OS

## Prerequisites

***Step 1: Please verify first that a version of LabVIEW later than 2018 is installed on the running computer or please download and install the* Runtime 2018 SP1 32 bits *from National Instruments website:*** [**https://www.ni.com/fr-fr/support/downloads/software-products/download.labview-runtime.html#329458**](https://www.ni.com/fr-fr/support/downloads/software-products/download.labview-runtime.html#329458)

*This download requires a user account on ni.com*

Check and specify the configuration of your PC below:

|  |  |  |
| --- | --- | --- |
| ***LabVIEW installed on your computer*** | ***LabVIEW not installed*** | ***Runtime required*** |
| ***Version :*** |  | ***Y or N ?*** |

***Step 2: Download*** (“Téléchargement” in French) ***the ZIP file named “Avionics\_RDNAV\_evering\_060123\_DM0071.zip” (Up-to-date version: January 6th, 2023) using the link below and extract it into a folder (UNZIP)***

***Step 3: Launching the executable “avionics\_RDNAV\_evering060123.exe”.***

 ***If the arrow is black, then everything is OK, the application is running…***

***If the arrow is WHITE click on the white arrow to use it***

***Optional step 4: If the arrow is black and crossed out,***

***then you will probably have to download the additional program from the following link:***

[**https://www.ni.com/en-vn/support/downloads/drivers/download.ni-daqmx.html#382067**](https://www.ni.com/en-vn/support/downloads/drivers/download.ni-daqmx.html%23382067)

**Check** your configuration and specify:

|  |  |
| --- | --- |
| * ***“Avionics\_RDNAV\_evering\_060123\_DM0071.zip”*** is download ?
 |  |
| * Is the Zip file unzipped (right mouse button and unzip) Y/N?
 |  |
| Specify the decompression directory on your computer: |
| * Run "avionics\_RDNAV\_evering060123.exe" Y/N?
 |  |
| * Is the arrow White, Black or Broken Black?
 |  |
| * If Broken Black, then load the driver at the link indicated in step 4. Y/N?
 |  |
| Name and location for lab report : |

## Lab report

* A pdf file has to be uploaded at the end of the lab inside the **Moodle session** or mail
* Commented screenshots of the different tasks welcome
* Name of your file for lab report:     M1\_***yourName***\_060223.pdf

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## Presentation of the main tabs



# Course 1 : Units in aeronautic, Data bus, dB

## Unit conversion to aeronautics : handling the tool.

Please select the **Manometric system** tab > **SIMULATOR Atmosphere ISA** tab

**Q01. Convert T1 = 55°C and T2 = 12°C into Fahrenheit and Kelvin.**



Figure 1: Done with teacher's help

**Q02a. Convert T3 = 96°F and T4 = 0°F into Celsius and Kelvin.**

**Q02b The temperature near the ground is +8°C and the dew point temperature is +6°C.
 The relative humidity RH is % ?**

**Q03. Convert D1 = 52 NM and D2 = 4 NM into km and ft.**

**Q04. Convert V1 = 56 km/h into FPM, m/s, knots.**

**Q05. Convert V2 = 650 KT into km/h, FPM, m/s, Beaufort unit.**

## Latitude & longitude coordinates system

Please select the **latitude/Longitude** tab > **Simulator Coordinates Latitude & Longitude** tab

**Q6. Compute the distance in NM and km and the time difference of the sunrise between:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Airports** | **NM** | **km** | **Time diff** |
| Brest and Strasbourg (both in France) |  |  |  |
| Mérignac (France) and Cincinnati (US) |  |  |  |
| Hanoi (Vietnam) and Barcelona (Spain) |  |  |  |
| Hanoi and Ho-Chi-Minh-Ville (both in Vietnam) |  |  |  |
| Tokyo and Sydney |  |  |  |
| Tokyo and San Francisco |  |  |  |
| 0°N – 25°E and Merignac airport |  |  |  |
| 5.33°S – 106.667°E and Toulouse-Blagnac (France) |  |  |  |

##

## Signals: voltage and power units

Please select the **radio VHF** tab > **Level dB dBm** tab

**Q7.a. Convert 1W into dBW and into dBm. Give the relation between dBW and dBm**

**Q7.b. Convert 10 mW into dBW and into dBm. What is the associated voltage with Z = 50?**

**Q7.c. Convert 10 mW into dBW and into dBm. What is the associated voltage with Z = 377?**

**Q7.d. Convert 20 mW into dBW and into dBm. What is the associated voltage with Z = 600?**

**Q7.e. Convert 2.2V into dBV and mW and into dBm when Z = 600.**

**Q8. Complete the table below, for the sum and difference of two powers among the 5 powers from P1 to P5 proposed (principle of conservation of energy)?**



|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **P1** | **P2** | **P3** | **P4** | **P5** | **P1+P2** | **P1-P2** | **P3+P4** | **P3-P4** | **P1+P3** |
| **(dBm)** | +10 dBm | +5 dBm | 0 dBm |  | **-**5 dBm |  |  |  |  |  |
| **(mW)** |  |  |  | 1 mW |  |  |  |  |  |  |

**Q9. Assuming that one uses the computation of P2-P4 (with the previous values), what will be the result?**

**Q10. The tracking sensitivity is the minimum power level at which a receiver can receive and maintain a connection with a satellite or constellation of satellites and is about -160 dBm. Convert back into W and mW.**

## ARINC 429 Databus

Please select the **DATABUS ARINC 429** tab **> Generalities ARINC 429** tab

**Q11. How many bits are there to code a 429 ARINC word?**

**Q12. What are the characteristics of the label part (coding, number of bits…)**

**Q13. Is the overall parity odd or even?**

**Q14. What are the communication rates within ARINC429 standards?**

Please select the **DATABUS ARINC 429** tab > **Simulator word Calculation 32 bits for ARINC 429** tab

and then SELECT **altitude feet**

**Q15. Which binary word is transmitted when the altitude is 6000 ft. With which label?**

**Q16. Which data encoding type is used for the altitude data?**

**Q17. Which binary word is transmitted when the altitude is 6300 ft. With which label in octal an binary?**

then SELECT **Bearing VOR**

**Q18. Which binary and hexadecimal words represent the bearing received
from the VOR station with QDR = 90° ?**

**With which label?**



then SELECT **DME ( 2 solutions )**

**Q19. Which binary word is transmitted for a DME distance equal to 125.8 NM? With which label? Check the parity bit. Is the encoding type in BCD or BNR format for DME distance information?**

Please select the **Manometric system** tab > **SIMULATOR Atmosphere ISA** tab

# Course 2 : Manometric, RDNAV, radio ,DME, XPDR

## Aerology

**Q20.a. Compute the True Air Speed, Mach number and density when IAS3 = 350 KT at FL380.**

**Q20.b. Compute the True Air Speed, Mach number and density when IAS4 = 350 KT at FL150.**

**Q20.c. Compute the True Air Speed, Mach number and density when IAS5 = 350 KT at FL050.**

**Q21.a. Convert P1 = 1040 hPa, P2 = 1013 hPa and P3 = 990 hPa into psi, bar, MPa, inHg and N/m².**

**Q21.b. Convert P4 = 30.25 inHg, P5 = 28.14 inHg into psi and mbar.**

You can either select the **Manometric system** tab > **Machmeter** tab

 

**Q22.a. Assuming an A380 aircraft flying at a IAS = 270 KT near FL350, QNH 1013, what is the Mach number and the temperature SAT when TAT measured is equal to –20°C? Compare to the temperature given by ISA modeling, quoted TISA.**

Mach Number =

SAT =

ISA +

**Q22.b. Assuming a Cessna aircraft flying at a speed of 200 km/h near FL100, QNH 1013, what is the SAT when TAT measured is equal to -8°C? Compare to the temperature given by ISA modeling, quoted TISA.**

Mach Number =

SAT =

ISA +/-

 ?

**Q22.c. Assuming a Concorde aircraft flying at Mach 2 with an altitude of 16000 m, what is the TAT measured? Same question at Mach 2.2 and Mach 0.85. Compare to the temperature outside the aircraft.**

**Q23. What are the composition and the percentage of the two main gas components of the atmosphere?**

## Airport data

Please select the **Manometric system** tab **> Chart & weather** tab > **Vietnam approach chart** >

***Click on USTH logo*** *for more information*

**Q24. For the Hanoi and Ho-Chi-Minh-Ville airports, identify:**

|  |  |  |
| --- | --- | --- |
|  | **Hanoi** | **Ho-Chi-Minh** |
| - Runway numbers and airport QFU  |  |  |
| - ILS frequencies and Morse-code identifiers  |  |  |
| ATIS and VOR frequencies |  |  |
| ICAO and IATA code |  |  |
| Magnetic declination |  |  |
| Pressure difference between QNH and QFE |  |  |

Please select the **latitude/Longitude** tab > **LFBD**

**Q25. For the Merignac airport, identify:**

* Runway numbers and airport QFU
* ILS frequencies and Morse-code identifiers
* Magnetic declination
* Pressure difference between QNH and QFE

## DME

Please select the **DME & ATC** tab > **SIMULATOR XPDR – DME** tab > **Simulator DME** tab

You can also select the **DME & ATC** tab > **principle DME** tab ….

**Q26. What are the DME frequencies associated to the VOR at frequency 113.75 MHz?**

**Q27a. What is the jitter for DME?**

**Q27b. What is its frequency band of DME?**

**Q28. What is the frequency gap between transmission and reception signals?**

**Q29. What is the DME frequency associated to the frequency 114.95 MHz? Is it a VOR or ILS frequency?**

**Q30a. Tmeasured = 1.34 ms of time taken for DME range has been measured in X mode. What is the corresponding distance shown by DME?**



Please use **DME TTS simulator 3**

**Q30b. What is the Time To Station TTS for a GroundSpeed = 200 KT and DME = 12 NM**

## XPDR transponder

Please select the **DME & ATC** tab > **SIMULATOR XPDR - DME** tab > **XPDR ATCRBS** tab

**Q31. How many bits are needed to code the transmitted altitude using C mode?**

**Q32. What is the altitude resolution (in ft)?**

**Q33. With how many bits is coded the SQUAWK identification code transmitted using A mode?**

## Virtual alticoder

Please select the **DME & ATC** tab > **SIMULATOR XPDR -DME** tab > **Virtual Alticoder** tab

**Q34. What is the coding name used by the transponder alticoder for altitude transmission using C code? Is it ASCII, O’BRIEN, OCTAL, GILHAM, binary?**

**Q35. What is the pressure setting of the alticoder for transponder?**

**Q36. What does ATCRBS stand for?**

Please select the **DME & ATC** tab > **Virtual Alticoder** tab > clic on 

* Select **SQUAWK** or **FL** tab

**Q37. What are the SQUAWK codes equivalent to the following altitude:**

**12300ft? SQUAWK =**

**1200ft?**

**FL195?**

**FL250?**

**What are the equivalent altitude and FL for de SQUAWK code :**

**For SQUAWK = 7000 ? altitude Z = ft ? FL =**

**For SQUAWK = 4200 ? altitude Z = ft ? FL =**

# Course 3 : Maintenance Troubleshooting, ACARS, avionics

## Avionics

Please select the **ILS LOC GLIDE** tab > **ILS PRINCIPLE** tab

**Q38. What is the dedicated ARINC standard and ATA chapter for the ILS?**

Please select the **Avionics** tab > **black box**

**Q39. Which system stores the flight data? (useful in case of an accident)**

Please select the **Avionics** tab > **Cockpit** tab

**Q40. Inside the cockpit, how many screens are there in the Airbus A320? Boeing 777 ?**

## Maintenance Please select the **Maintenance** tab > “**ACARS**” tab

**Q41a. What is the role of the ACARS system?**

**Q41b. Which associated ARINC standard and ATA chapter are required for ACARS?**

**Q41c. What is the ATA chapter for the “black boxes”?** Please select the **Avionics** tab > **Black Box** tab

## Airspeed Please select the **Manometric system** tab > **SIMULATOR Atmosphere ISA** tab

**Q42a. Compare the different AirSpeed CAC EAS TAS GS for IAS = 250 KT at Z = 36 000 ft**

**Mach number = ?**

**Impact Pressure**

**Total Pressure ?**

## System EWIS Please select the **Maintenance** tab > **EWIS** tab

**Q42b. Which EWIS is relevant for avionics?**

**According to AWG specifications,** > **EWIS & CABLE & Wire GAUGE & AWG** tab

**What is the diameter of a cable with AWG10 in mm?**

**What is the Max Current carrying capacity in ampere (AWG10)?**

**Is the cross-section of an AWG3 cable smaller or larger than the cross-section of an AWG10 cable?**

**Is an AWG3 cable heavier or lighter than an AWG10 cable of the same length?**

# Course 4: RDNAV, VOR, ILS, ADF, angle for navigation

## Instrument Landing System

Please select the **ILS LOC GLIDE** tab > **ILS PRINCIPLE** tab > **ILS principles** tab or **LOC** tab or **GLIDE** tabs….

Please select the **ILS LOC GLIDE** tab > **SIMU LOCALIZER** or **SIMU GLIDE** tab

**Q43a. What are the carrier frequency bands for ILS Localizer and Glide path?**

Carrier frequency LOC :

Carrier frequency GLIDE :

**Q43b. What are the signal bandwidths for the Loc and Glide carriers?**

Bandwidth LOC :

Bandwidth GLIDE :

**Q43c. Which frequency is preponderant should the needles go up and left, 90Hz or 150Hz?**

Preponderant frequency for UP:

Preponderant frequency for Left :



Please select the **ILS LOC GLIDE** tab > **SIMU LOCALIZER**

**Q43d. Test the “Self test” mode (grey button on your left).**

**Observe the harmonic frequencies… oDD / even ?**

**What shows the indicator and the modulating signal spectrum?**

**In test mode, Aircraft is too UP or Down ?**

**In test mode, Aircraft is too LEFT or RIGHT ?**

**Q44.a. What is the Glide and DME frequencies for the ILS on the 23rd runway in Merignac airport?**

Please select the **latitude/longitude** tab > **LFBD** tab > **red** selector

Frequency LOC for RWY 23 on LFBD = MHz

Please select the **DME & ATC** tab > **Simulator DME** tab & DME SIMULATOR 1 selector ->

Frequency GLIDE for RWY 23 on LFBD = MHz
Frequency DME interrogation for RWY 23 on LFBD = GHz
Frequency DME reply for RWY 23 on LFBD = GHz

**Q44.b. What is the Glide and DME frequencies associated with the Localizer frequency 109.35 MHz?**

Frequency GLIDE for paired 109.35 LOC = MHz
Frequency DME interrogation for paired 109.35 LOC = GHz
Frequency DME reply for paired 109.35 LOC = GHz

**Q44.c. What is the Glide and DME frequencies associated with the Localizer frequency 108.15 MHz?**

Frequency GLIDE for paired 108.15 LOC = MHz
Frequency DME interrogation for paired 108.15 LOC = GHz
Frequency DME reply for paired 108.15 LOC = GHz

## VOR understanding: the 21 aircrafts situation

Please select the **VOR** tab > **Simulator VOR** tab

* Click on the left button “exercices 21 aircrafts” 
* The following window pops up



* Select the button Zoom picture to resize the picture with the 21 aircrafts 
* Enter the number of the chosen aircraft for your study 
* The software will set the values according to chosen aircraft position regarding to the VOR station.
* You can then set the desired OBS



* Instruments will then indicate from/To and left/right for the selected OBS.

**Q46. Choose 3 aircrafts and set the magnetic declination to 13°W.** 

**What are the QDM, QDR, relative bearing and heading for the aircrafts?**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Aircraft N°** | **QDM** | **QDR** | **Relative bearing** |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

**Q47. For the chosen aircrafts and for the 2nd and 14th aircraft, indicate if they are from/to/limit between from and to and left/right/align according to the OBS selected values.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Selected OBS  | 090° | 030° | 305° | 035° |
| Aircraft n° |  |  |  |  |
| Aircraft n° |  |  |  |  |
| Aircraft n° |  |  |  |  |
| Aircraft n° 14 |  |  | **Align** |  |
| Aircraft n° 2 |  |  | **Right, Neither From nor To** | **Align From** |

# Conclusion

Please quote remarks and improving methods or suggestions that can be used in this lab.