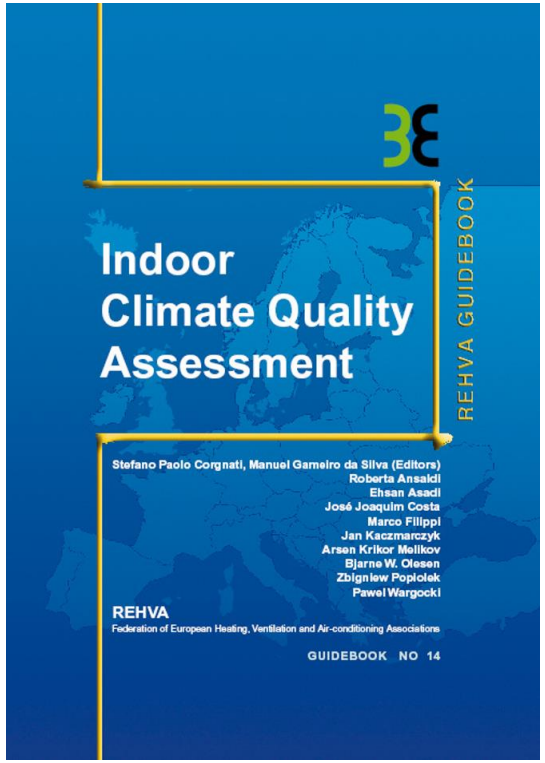
A DISTANCE-LEARNING COURSE ON INDOOR ENVIRONMENTAL COMFORT IN BUILDINGS



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Vice-President of Rehva, Chair of Training and Education Committee

REHVA Seminar @ CCHVAC 2016, Haikou, 09.11.2016

Course Syllabus

› **Module 0 | Overall view (10 hours)**

0.1 | Virtual learning environments

0.2 | Objectives and modules of the course

0.3 | Comprehensive overview

› **Module 1 | Thermal environment (20h)**

1.1 | Thermal comfort concept

1.2 | Thermal balance of the human body

1.3 | Thermoregulation of the body

1.4 | Comfort indices

1.5 | Thermal comfort assessment

1.6 | Adaptive models

› **Module 2 | Indoor air quality (20h)**

2.1 | Fundamentals

2.2 | Ventilation elements

2.3 | IAQ instrumentation

2.4 | Analysis methodologies

2.5 | IAQ audits

› **Module 3 | Noise and vibrations (20h)**

3.1 | Fundamentals

3.2 | Generation and propagation of sound fields

3.3 | Urban noise - acoustic environment

3.4 | Acoustic quality in buildings

3.5 | Occupational vibrations

› **Module 4 | Lighting (11h)**

4.1 | Systems of units and quantities

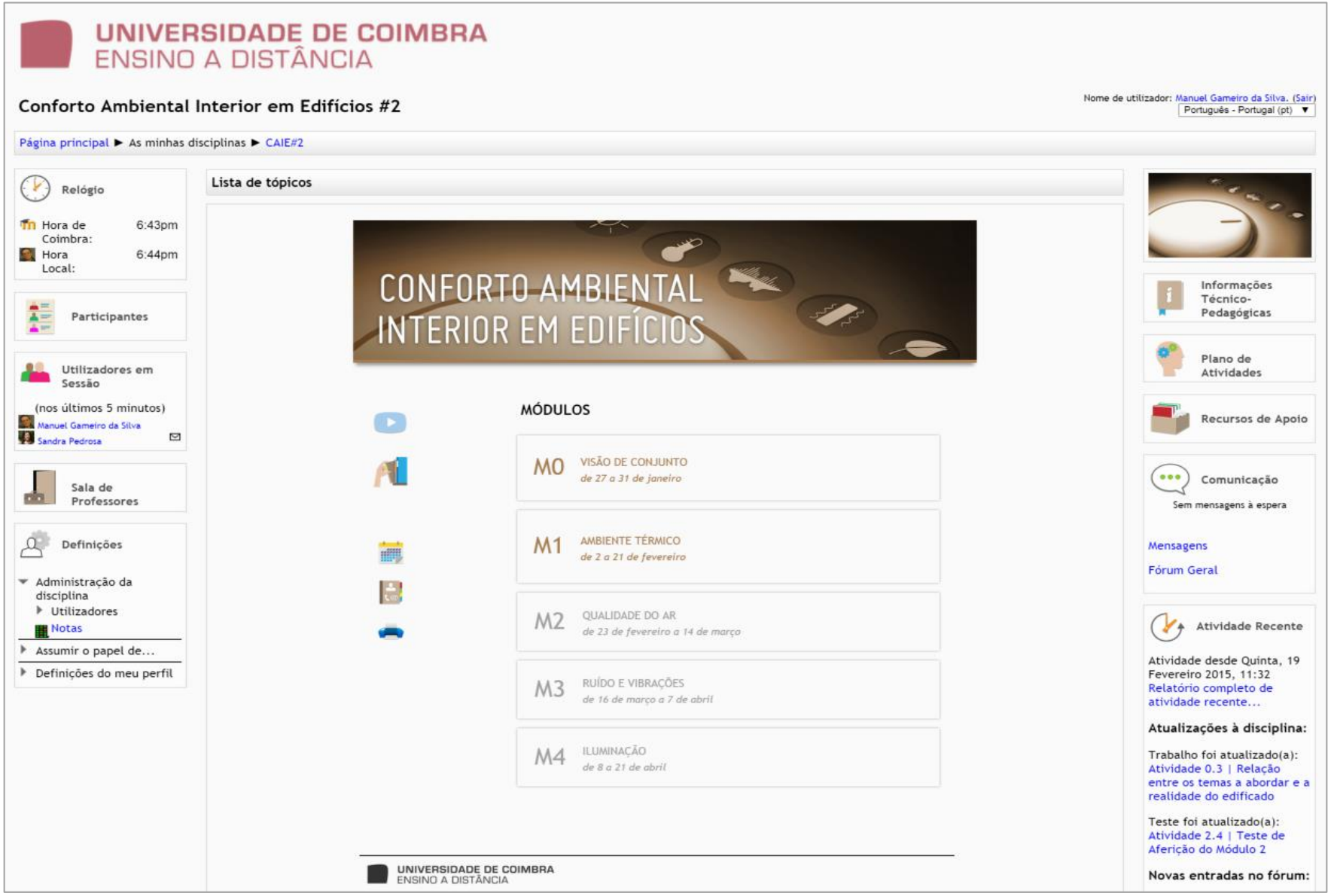
4.2 | Fundamentals

4.3 | Functioning of the human vision

4.4 | Visual environment testing

›

Moodle Platform



Moodle Basic Functionalities

Reserved access and different user profiles – each participant has its own private area and particular role in the course (student, teacher, manager, administrator or visitor).

Managing the access to contents – contents can be placed online in different formats, moments and in different forms of interaction with the students.

Synchronous and asynchronous communication tools – Messages, Participations in forum, Scheduled Skype meetings, etc..

Registration and controlling systems of the activities – automatic reports of the activities of the platform.

Forums, chats, glossaries, surveys, tests, wikis, workshops, works

Learning Process

Appropriation of concepts – Reading of texts and visioning of slides

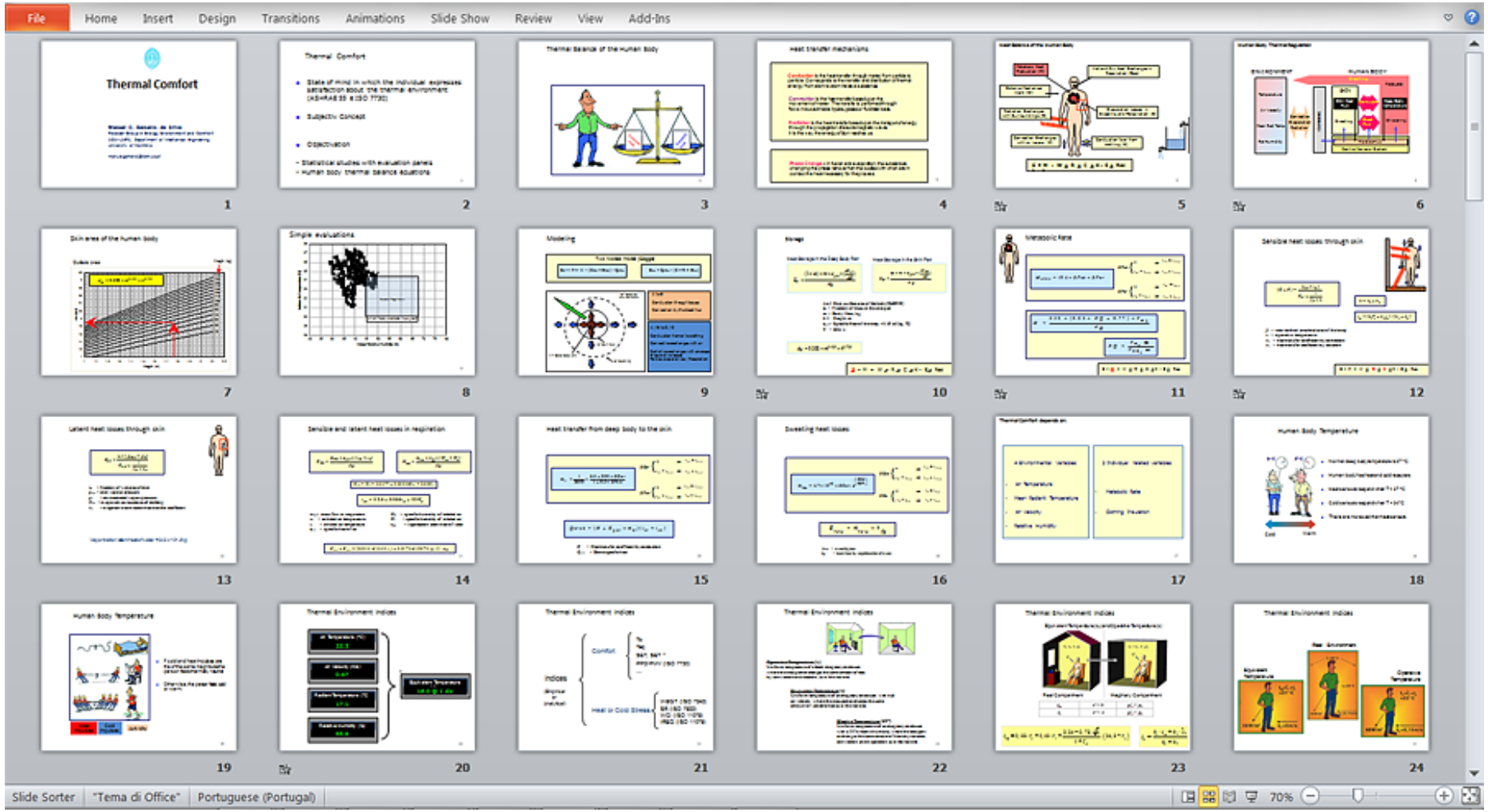
Consolidation – Visioning of videos and webinars

Implementation– Resolution of exercises and practical works

Development of Analysis Capacity – Data processing, Graphical representation of data

Development of Synthesis Capacity – Writing of reports**,** Participation in discussions

Slides Presentations



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Slides Presentations

UNIVERSIDADE DE COIMBRA
ENSINO A DISTÂNCIA

Conforto Ambiental Interior em Edifícios #2

Página principal ► As minhas disciplinas ► CAIE#2 ► Módulo 1 | Ambiente Térmico

Índice

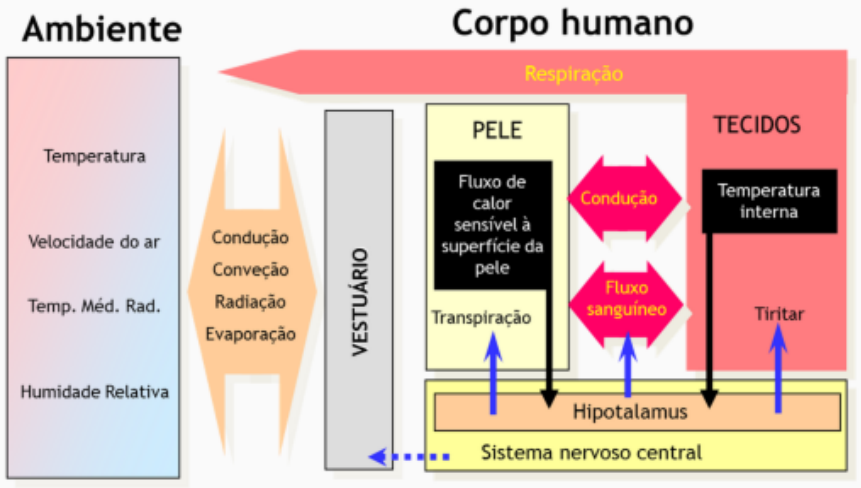
Módulo 1 | Ambiente térmico

- Tema 1.1 | Conceito de Conforto Térmico e Mecanismos de Transferência de Calor e Massa
- Tema 1.2 | Balanço Térmico do Corpo Humano
- **Tema 1.3 | Regulação térmica do corpo**
- Tema 1.4 | Índices de conforto térmico
- Tema 1.5 | Avaliação de conforto térmico
- Tema 1.6 | Modelo adaptativo de conforto térmico

Definições

- Book administration
  - Permissões
  - Registos de acesso
  - Print book
  - Print this chapter
- Administração da disciplina
- Assumir o papel de...
- Definições do meu perfil

TEMA 1.3 | REGULAÇÃO TÉRMICA DO CORPO HUMANO



*Complementar informação com a visualização do vídeo **REGULAÇÃO TÉRMICA DO CORPO HUMANO**, disponível nos Recursos de Apoio do Módulo 1*

WB01_balanco termico

WB02_regulacao termica

WB03_Modelo de 2 Nodos de Gagge

WB04_Software PMV-PPD

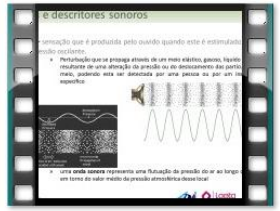
WB05_Manequins termicos

WB06_Classificacao dos Ambientes

WB07_Modelos Adaptativos

WB08_Evolucao Temporal Poluente

WB09_Evolucao Temporal Poluente_Ferramenta_Computacional



WB10_Nivel Pressao Sonora

Typical List of Activities

MODULE 01 | THERMAL COMFORT (20h) [03.02.2014 to 22.02.2014]					
Topics 1.1, 1.2 e 1.3	Send File	Text about the Human Body Thermal Balance and Thermal Regulation	03.02.2014 14h00m	07.02.2014 13h55m	30%
Topic 1.4	Send File Use of software	Sensitivity Analysis of PMV-PPD indices to the input parameters used on their calculation	08.02.2014 14h00m	14.02.2014 13h55m	40%
Module 1	Quizz	Evaluation Test of Module 1	20.02.2014 14h00m	22.02.2014 13h55m	30%
MODULE 02 | INDOOR AIR QUALITY (20h) [24.02.2014 to 15.03.2014]					
Topic 2.1	Quizz	Evaluation Test about Topic 2.1	27.02.2014 14h00m	01.03.2014 13h55m	25%
Topic 2.2	Forum	Discussion about Ventilation Requirements in Buildings	04.03.2014 14h00m	08.03.2014 13h55m	15%
Topic 2.3	Send File	Text about an IAQ monitoring equipment	05.03.2014 14h00m	08.03.2014 13h55m	15%
Topic 2.4	Use of Software	Data processing of the time evolution of metabolic CO2 in an indoor compartment (Excel spreadsheet)	08.03.2014 14h00m	12.03.2014 13h55m	35%
Topic 2.5	Forum & Report	Analysis of Results of an IAQ audit	14.03.2014 14h00m	16.03.2014 13h55m	10%

Virtual Lab Activity – Sensitivity Analysis of PMV and PPD indices

Model for the calculation of thermal comfort indices PMV and PPD (ISO 7730 - Fanger's method)

Input Data	
M (met) =	1,2
W (met) =	0
I cl (clo) =	0,9
Ta (ºC) =	22,0
Tr (ºC) =	22,0
pa (Pascal) =	1400
Va (m/s) =	0,10

M (W/m^2) =	69,8
W (W/m^2) =	0
Icl (m^2 ºC/W) =	0,1395

Control of Iterative Method	
($Tcl-Tcl_{ini}$) =	0,00

Enable Macros
After introducing data,
Press Run Button.
After calculation, ($Tcl - Tcl_{ini}$) must be equal to 0.

Run

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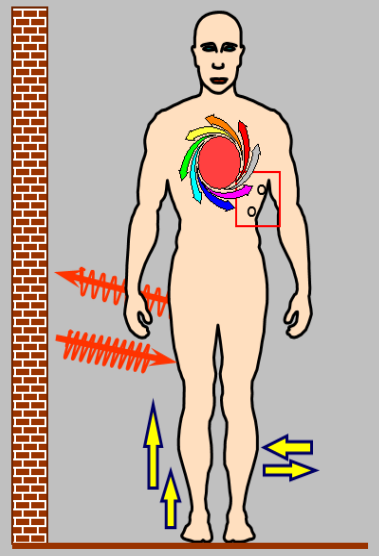
Intermediate Calculations

T skin =	33,7	ºC
hc natural conv =	3,589	
hc forced conv =	3,826	
max hc =	3,826	(W/m^2 ºC)
Tcl =	27,2	ºC
fcl (Icl<0.5 clo) =	1,180	
fcl (Icl>0.5 clo) =	1,140	
min fcl =	1,140	(m^2 ºC/W)



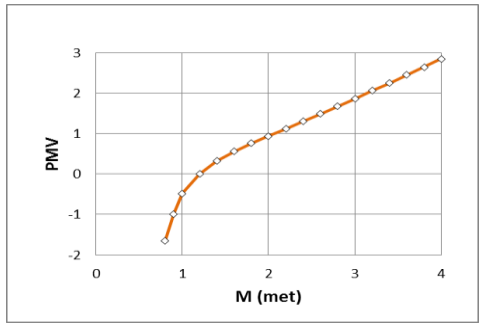
Heat Fluxes		
perspiration	11,73	(W/m^2)
sweating	4,88	(W/m^2)
breathing (latent)	5,30	(W/m^2)
breathing (sensible)	1,17	(W/m^2)
radiation	24,60	(W/m^2)
convection	22,55	(W/m^2)
Total Flux (Q)	70,23	(W/m^2)
Balance [(M-W) - Q]	-0,45	(W/m^2)

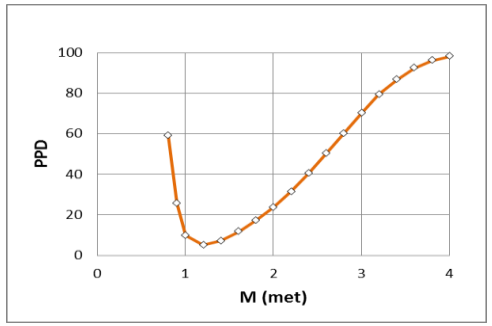
Output Data

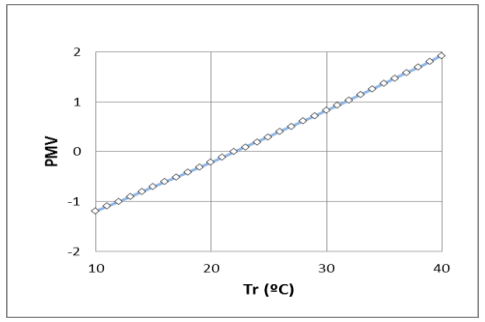
PMV =	-0,02
PPD (%) =	5,0

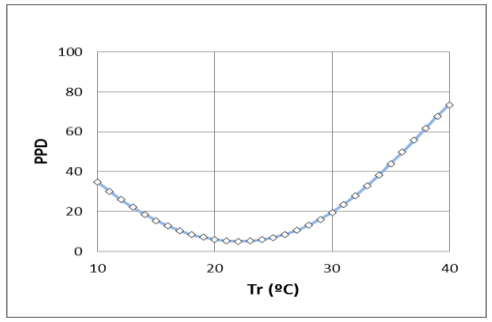
Virtual Lab Activity – Sensitivity Analysis of PMV and PPD indices

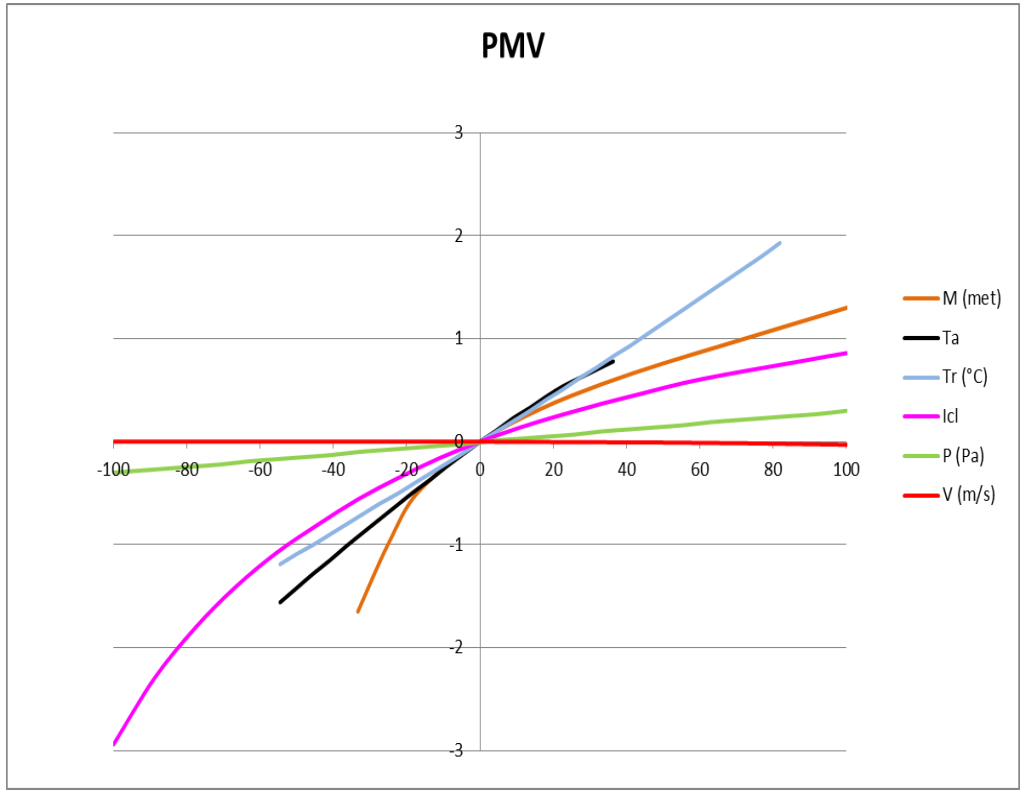
Parameter	Reference Value	Interval of variation
Ta	22°C	10°C to 30°C
Tr	22°C	10°C to 40°C
Va	0.05 m/s	0 to 1m/s
Pa	1350 Pa	0 to 2700 Pa
M	1.2 Met	0.8 to 4 Met
Clo	0.9 Clo	0 to 2 Clo



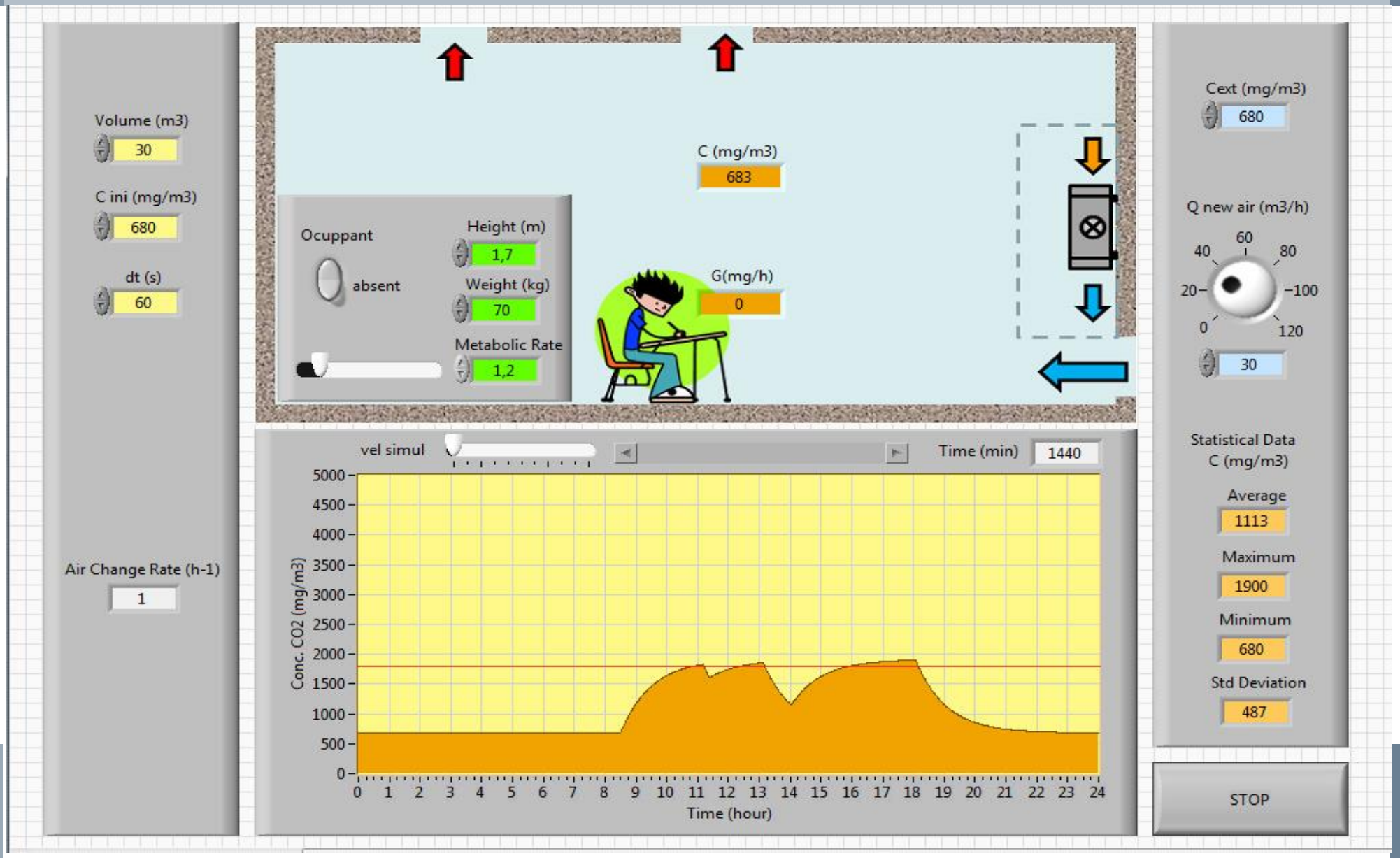




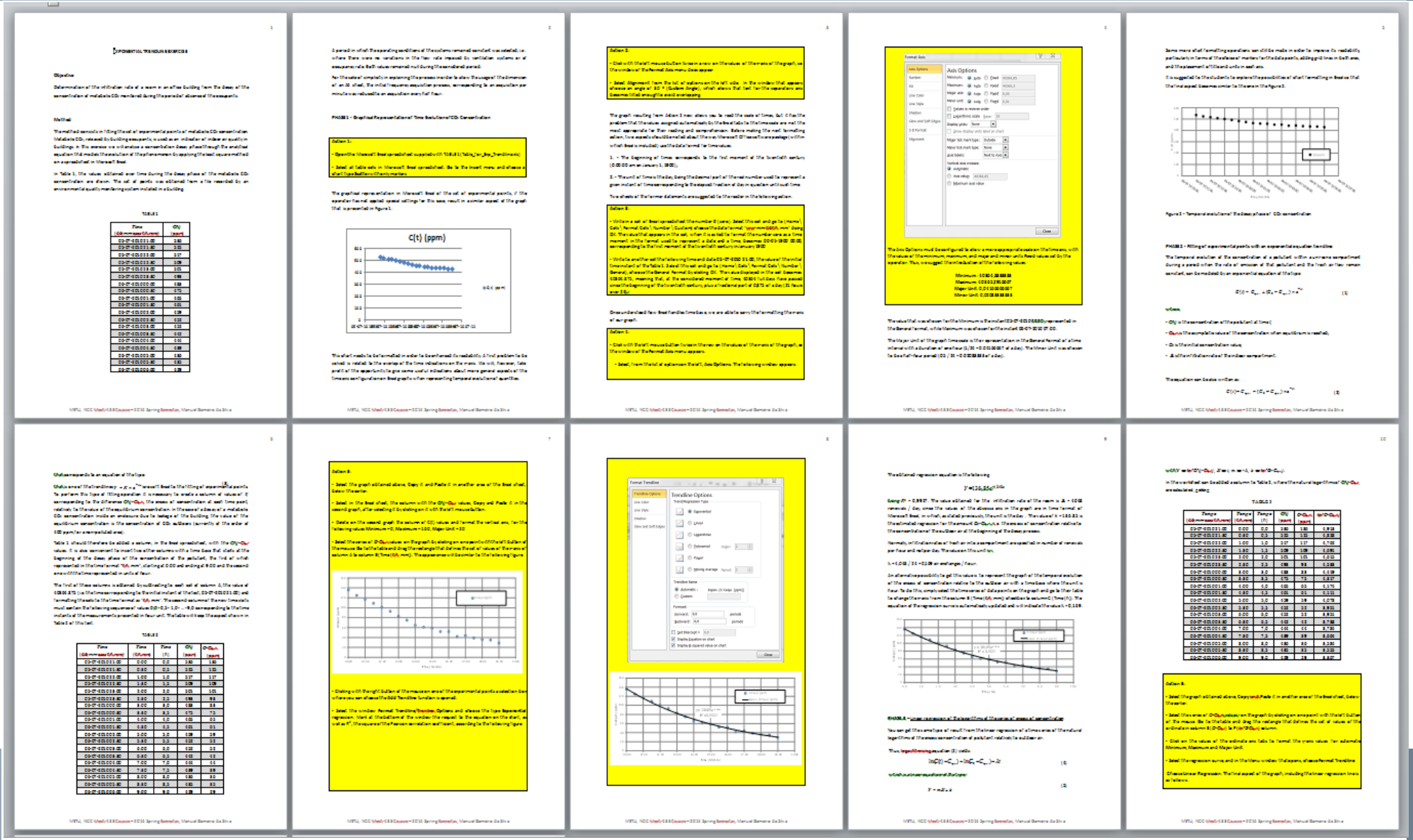




Virtual Lab for IAQ



“Guided tour” exercise



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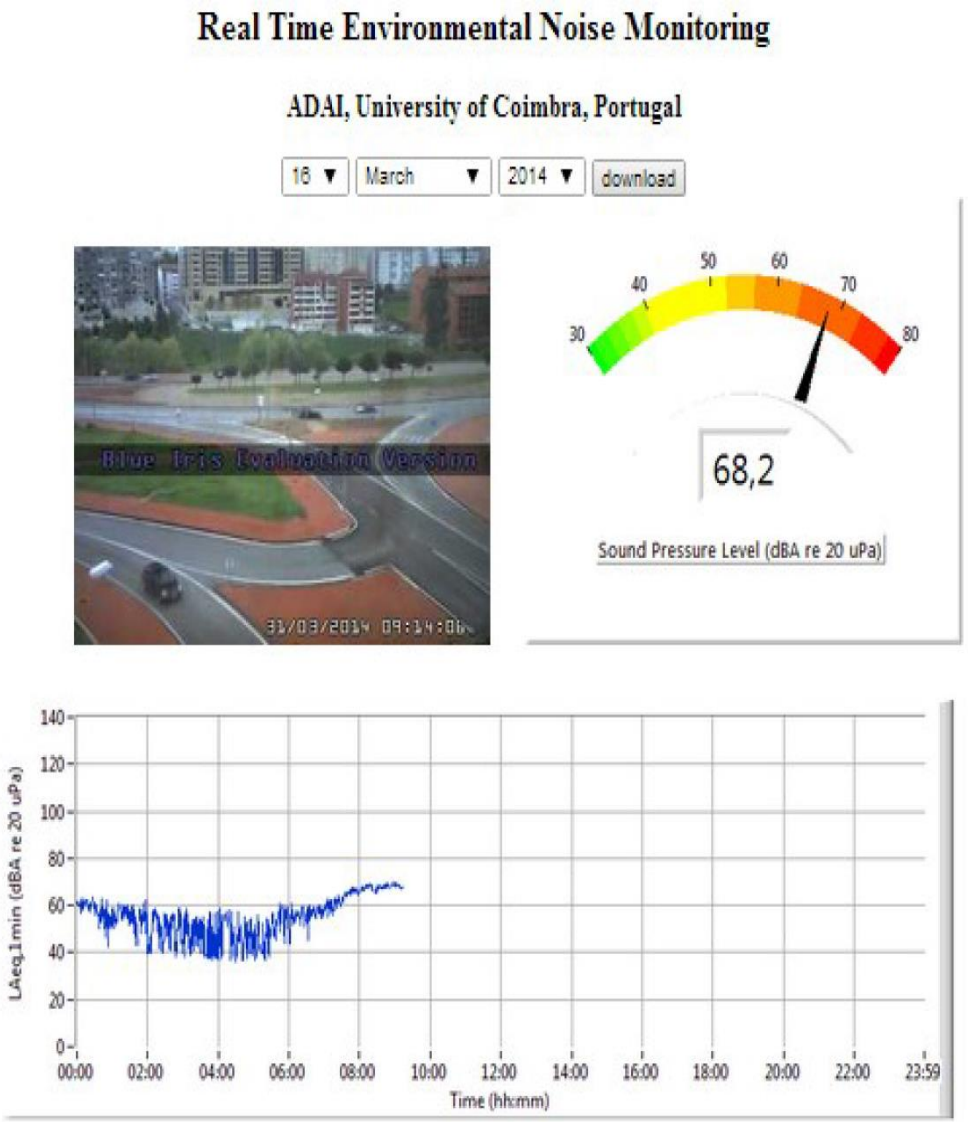
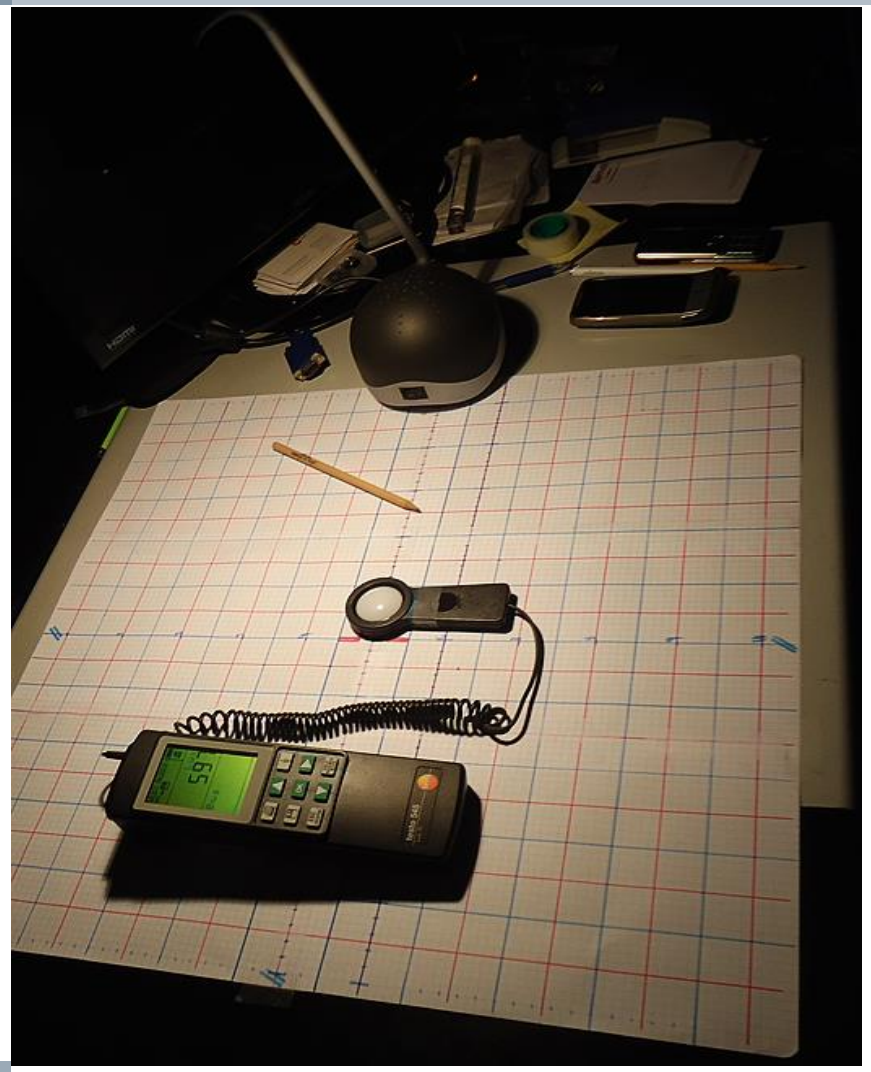
Remote access lab exercise

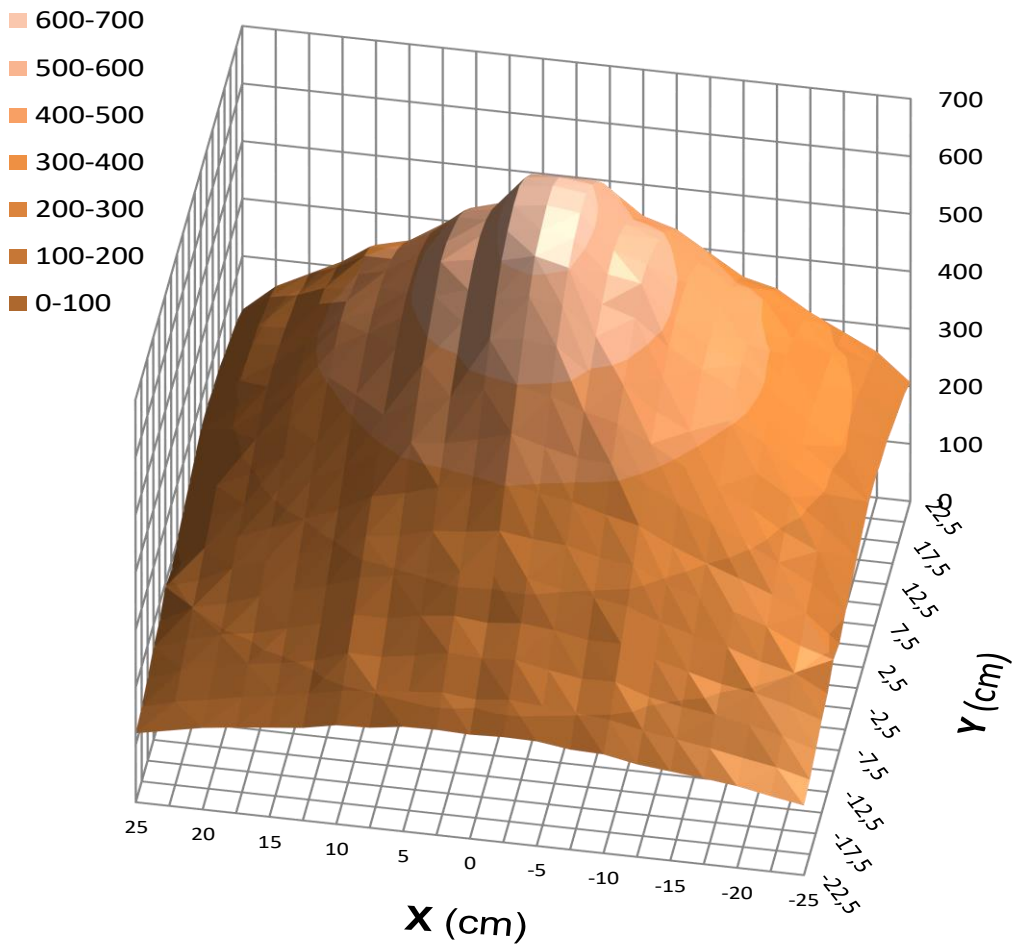


Students are asked to visit a webpage where the environmental noise data about a city área is displayed in real-time.

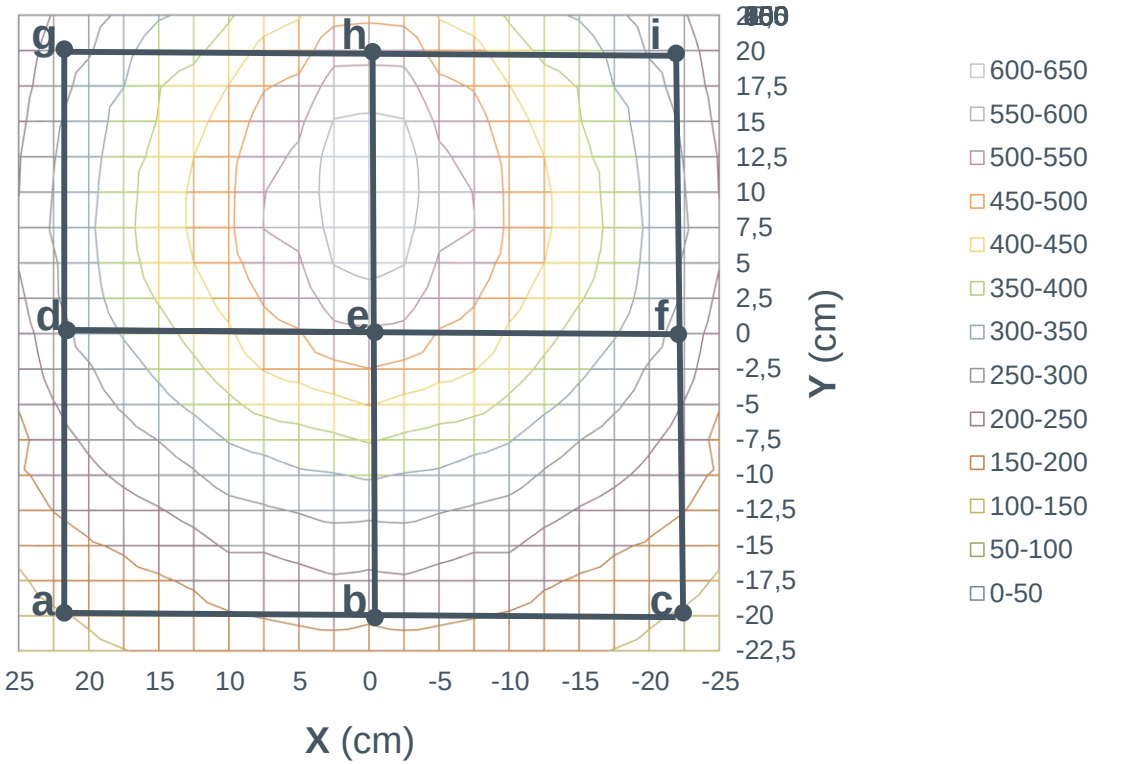
They may download files with the time evolution of noise signals and use them to calculate the environmental noise descriptors.

Lighting Exercise- Evaluation of iluminance in a working place





Lighting Exercise- Evaluation of iluminance in a working place



	X (cm)	Y (cm)	I (lux)
a	20	-20	155
b	0	-20	206
c	-20	-20	155
d	20	0	319
e	0	0	542
f	-20	0	319
g	20	20	296
h	0	20	534
i	-20	20	296

$$E_{med} = \frac{\sum I_i}{n} = \frac{155+206+155+319+542+319+296+534+296}{9} = \frac{2822}{9} = 313{,}56 \quad \text{lux}$$

$$\Delta E_{med} = 313{,}56 - 343{,}1 = -29{,}54$$

$$\varepsilon = \frac{-29{,}54}{343{,}1} \times 100 = -8{,}6\%$$

Conclusions

An e-learning course model well-accepted by the learnershas been developped

Participants highlighted the role of training activities and the contribution of webinars as fundamental on the learning process

Virtual labs and remote access labs were also considered strategic for the sucess of the course

The feedback in time of teachers is required to keep the motivation of students

Thank you very much for your attention!

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