A DISTANCE-LEARNING COURSE ON INDOOR ENVIRONMENTAL COMFORT IN BUILDINGS

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

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Conforto Ambiental Interior em Edifícios #2

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.

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# Typical List of Activities

## MODULE 01 | THERMAL COMFORT (20h) [03.02.2014 to 22.02.2014]

<table>
<thead>
<tr>
<th>Topic</th>
<th>Activity</th>
<th>Description</th>
<th>Start Date</th>
<th>End Date</th>
<th>Duration</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1, 1.2 e 1.3</td>
<td>Send File</td>
<td>Text about the Human Body Thermal Balance and Thermal Regulation</td>
<td>03.02.2014</td>
<td>07.02.2014</td>
<td>14h00m</td>
<td>30%</td>
</tr>
<tr>
<td>1.4</td>
<td>Send File Use of software</td>
<td>Sensitivity Analysis of PMV-PPD indices to the input parameters used on their calculation</td>
<td>08.02.2014</td>
<td>14.02.2014</td>
<td>14h00m</td>
<td>40%</td>
</tr>
<tr>
<td>Module 1</td>
<td>Quizz</td>
<td>Evaluation Test of Module 1</td>
<td>20.02.2014</td>
<td>22.02.2014</td>
<td>14h00m</td>
<td>30%</td>
</tr>
</tbody>
</table>

## MODULE 02 | INDOOR AIR QUALITY (20h) [24.02.2014 to 15.03.2014]

<table>
<thead>
<tr>
<th>Topic</th>
<th>Activity</th>
<th>Description</th>
<th>Start Date</th>
<th>End Date</th>
<th>Duration</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Quizz</td>
<td>Evaluation Test about Topic 2.1</td>
<td>27.02.2014</td>
<td>01.03.2014</td>
<td>14h00m</td>
<td>25%</td>
</tr>
<tr>
<td>2.2</td>
<td>Forum</td>
<td>Discussion about Ventilation Requirements in Buildings</td>
<td>04.03.2014</td>
<td>08.03.2014</td>
<td>14h00m</td>
<td>15%</td>
</tr>
<tr>
<td>2.3</td>
<td>Send File</td>
<td>Text about an IAQ monitoring equipment</td>
<td>05.03.2014</td>
<td>08.03.2014</td>
<td>14h00m</td>
<td>15%</td>
</tr>
<tr>
<td>2.4</td>
<td>Use of Software</td>
<td>Data processing of the time evolution of metabolic CO2 in an indoor compartment (Excel spreadsheet)</td>
<td>08.03.2014</td>
<td>12.03.2014</td>
<td>14h00m</td>
<td>35%</td>
</tr>
<tr>
<td>2.5</td>
<td>Forum Report</td>
<td>Analysis of Results of an IAQ audit</td>
<td>14.03.2014</td>
<td>16.03.2014</td>
<td>14h00m</td>
<td>10%</td>
</tr>
</tbody>
</table>
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
- clo (clo) = 0.9
- Ta (°C) = 22.0
- Tr (°C) = 22.0
- pa (Pascal) = 1400
- Va (m/s) = 0.10

<table>
<thead>
<tr>
<th>M (W/m²)</th>
<th>69.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>W (W/m²)</td>
<td>0</td>
</tr>
<tr>
<td>Icl (m²°C/W)</td>
<td>0.1395</td>
</tr>
</tbody>
</table>

**Intermediate Calculations**
- T skin = 33.7 °C
- hc natural conv = 3.589 W/(m²°C)
- hc forced conv = 3.826 W/(m²°C)
- min fcl = 1.140 m²°C/W
- max hc = 3.826 W/(m²°C)
- Tcl = 27.2 °C
- fcl (Icl<0.5 clo) = 1.180
- fcl (Icl>0.5 clo) = 1.140

**Heat Fluxes**
- perspiration: 11.73 W/m²
- sweating: 4.88 W/m²
- breathing (latent): 5.30 W/m²
- breathing (sensible): 1.17 W/m²
- radiation: 24.60 W/m²
- convection: 22.55 W/m²

**Output Data**
- PMV = -0.02
- PPD (%) = 5.0
- Total Flux (Q): 70.23 W/m²
- Balance [(M-W) - Q]: -0.45 W/m²

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Virtual Lab Activity – Sensitivity Analysis of PMV and PPD indices

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

![Graph showing PMV and PPD indices with varying parameters](image)
“Guided tour” exercise
Remote access lab exercise

Students are asked to visit a webpage where the environmental noise data about a city area 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.

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Lighting Exercise - Evaluation of illuminance in a working place

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Lighting Exercise- Evaluation of illuminance in a working place

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

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

\[ \epsilon = \frac{-29,54}{343,1} \times 100 = -8,6\% \]
An e-learning course model well-accepted by the learners has been developed.

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 success of the course.

The feedback in time of teachers is required to keep the motivation of students.
Thank you very much for your attention!

Contact:

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