310608 - Surveying Instruments and Methods

Coordinating unit: 310 - EPSEB - Barcelona School of Building Construction
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN GEOPHYSICS AND GEOPHYSICS ENGINEERING (Syllabus 2016).
(Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: Spanish

Teaching staff
Coordinator: ANA MARÍA TAPIA GÓMEZ

Prior skills
The student must have consolidated his knowledge in trigonometry that ha worked in previous courses.
In addition will be helpful if the student has high capacity of visión.

Degree competences to which the subject contributes

Specific:
2. Knowledge, use and application of instruments and topographic methods appropriate for the fulfillment of raisings and surveyings.

General:
1. Use of teams and instrumental: Capacity to select the necessary resources to the achievement of the planned goals according to the quality requirements. Use of the teams, in adequate conditions, with professional efficiency and taking into account the limitations of the instruments and its context of use, in relation with the required precisions.

Teaching methodology
The teaching methodology is based in the participative expositive class, that includes the exposition of theoretical foundations and the resolution of practical examples, in the realization of instrumental practices in the field with small groups and in the autonomous work of assimilation of the subject.

Learning objectives of the subject
Exhaustive comprehension of the foundation from work of the different instruments of distance measuring, angles and slopes, its use and optimal conditions of use.
Knowledge of the kind of errors that operate in the measurement of these magnitudes and its transmission according to the different techniques of observation.
Solvency in the determination of the most probable value of a magnitude and of the associated confidence to this data.
Command in the practical manipulation of the different instruments in a quick and efficient way.
### Study load

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 24h 16.00%</th>
<th>Hours medium group: 36h 24.00%</th>
<th>Hours small group: 0h 0.00%</th>
<th>Self study: 90h 60.00%</th>
</tr>
</thead>
</table>

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## Content

<table>
<thead>
<tr>
<th>C1 Topographic Elements.</th>
<th>Learning time: 17h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Practical classes: 4h</td>
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<tr>
<td></td>
<td>Self study: 10h</td>
</tr>
</tbody>
</table>

**Description:**
- Definition and object of the topography.
- Representation and reference systems. Coordinate calculus.
- Process of a topographic hoisting.
- Topographic magnitudes. Units of measurement.

**Related activities:**
- P1: Basic trigonometric calculus for the obtention of coordinates in a point.
- P2: Change of angular units.

<table>
<thead>
<tr>
<th>C2 Errors committed in the measurements for direct observation.</th>
<th>Learning time: 13h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 3h</td>
</tr>
<tr>
<td></td>
<td>Self study: 10h</td>
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</tbody>
</table>

**Description:**
- Precision and accuracy.
- Sistematic and accidental errors.
- Errors that define precisión.
- Transmission of errors.

<table>
<thead>
<tr>
<th>C3 Direct measurement of distances.</th>
<th>Learning time: 7h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Theory classes: 1h</td>
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<tr>
<td></td>
<td>Practical classes: 2h</td>
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<tr>
<td></td>
<td>Self study: 4h</td>
</tr>
</tbody>
</table>

**Description:**
- The metallic tape. Use methods of different precisión. Errors and corrections.
- Invar threads
- Rulers.

**Related activities:**
- P3: Practice in the field about the use of the tape and the surveying rod.
<table>
<thead>
<tr>
<th><strong>C4 Measurement of angles in topography I. The theodolite.</strong></th>
<th><strong>Learning time:</strong> 20h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
</tr>
<tr>
<td>- Previous definitions.</td>
<td></td>
</tr>
<tr>
<td>- Scheme of a goniometer.</td>
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<tr>
<td>- Components of horizontalization and of collimation.</td>
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<tr>
<td>- Lay in station.</td>
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<tr>
<td>- Vertical and horizontal angles medition.</td>
<td></td>
</tr>
<tr>
<td><strong>Related activities:</strong></td>
<td></td>
</tr>
<tr>
<td>P4, P5, P6: Field practice of parking of a theodolite and angular lectures.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>C5 Measurement of angles in topography II. Errors in the measuring.</strong></th>
<th><strong>Learning time:</strong> 35h</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>- Systematic errors. Definition, comprobation and correction / compensation.</td>
<td></td>
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<tr>
<td>- Accidental errors. Analysis of the sources and trasmission.</td>
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<tr>
<td>- Estimation of the precisión of data.</td>
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<tr>
<td><strong>Related activities:</strong></td>
<td></td>
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<tr>
<td>P7: Field practice about the comprobation of systematic errors of a theodolite.</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>C6 Indirect measurement of distances by stadimetric methods. The tachymeter.</strong></th>
<th><strong>Learning time:</strong> 13h</th>
</tr>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td></td>
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<tr>
<td>- Foundation of the stadimetric rangefinding.</td>
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<tr>
<td>- Calculation of the distance with leaning visuals.</td>
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<tr>
<td>- Calculation of the slope.</td>
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<tr>
<td>- Units of precisión. Stadiametric prism and horizontal stay invar.</td>
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<tr>
<td><strong>Related activities:</strong></td>
<td></td>
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<tr>
<td>P8, P9, P10, P11, P12: Field practices in the class about the observation of taquimetric data and calculation of distances and slopes.</td>
<td></td>
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</tbody>
</table>
# C7 Electromagnetic measurement of distances

**Description:**
- Foundation of electronic distanometer.
- Notions about wavy movement.
- Fundamental equation of the waves distanometer. Expression of distance.
- Precision in the measurement. Errors.
- Use of an integrated instrument, the total station.

**Learning time:** 19h  
- Theory classes: 4h  
- Self study: 15h

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# C8 Instruments for the determination of slopes

**Description:**
- Levelling systems.
- Barometric nivelation. Foundation. Types of barometer.
- Geometric nivelation. Foundation.
- Types of levels. Classification.

**Related activities:**  
P13, P14, P15: Field practices of levelling with line and automatic levels.
## Planning of activities

### P1: TRIGONOMETRY. CALCULATION OF COORDINATES.

| Description: | Exercises of applied trigonometry |
| Support materials: | Problems to solve. |
| Descriptions of the assignments due and their relation to the assessment: | Memory of practices. |
| Specific objectives: | Assimilation of the official measurement units and its use. |

| Hours: | 2h |
| Practical classes: | 2h |

### P2: UNITS OF MEASUREMENT. ANGLES AND DISTANCES.

| Description: | Exercises to solve about the change of measurement units. |
| Support materials: | Problems to solve. |
| Descriptions of the assignments due and their relation to the assessment: | Memory of practices. |
| Specific objectives: | Assimilation of the calculation processes in topography. |

| Hours: | 2h |
| Practical classes: | 2h |

### P3: MEASUREMENT OF DISTANCES BY DIRECT METHODS.

| Description: | Direct measurement of distances with metallic tape. |
| Support materials: | Tapes and surveying rods of the topographic laboratory. |
| Descriptions of the assignments due and their relation to the assessment: | Memory of practices. |

| Hours: | 2h |
| Practical classes: | 2h |

### P4: PARKING OF A THEODOLITE.

| Description: | Field practices of parking a theodolite and identification of its elements. |
| Support materials: | Theodolites of the topographic laboratory. |

| Hours: | 2h |
| Practical classes: | 2h |
### P5: MEASUREMENT OF ANGLES WITH THEODOLITE.

**Description:**
Field practices of angles measurement with theodolite.

**Support materials:**
Theodolites at the topographic laboratory.

**Hours:**
2h
Practical classes: 2h

### P6: MEASUREMENT OF ANGLES AND DISTANCES WITH TAQUIMETER.

**Description:**
Field practices about angle and distance measurement with taquimeter.

**Support materials:**
Taquimeters of the topographic laboratory.

**Hours:**
3h
Practical classes: 2h
Self study: 1h

### P7: COMPROVATION OF SYSTEMATIC ERRORS OF A THEODOLITE

**Description:**
Field practices about the comprobation of systematics errors of a theodolite.

**Support materials:**
Theodolites of the topographic laboratory.

**Hours:**
2h
Practical classes: 2h

### P8: POLIGONAL I

**Description:**
Beginning of a complete itinerary's observation.

**Support materials:**
Taquimeters of the topographic laboratory
### P9: THE ITINERARY METHOD OR POLIGONAL.

- **Description:** Explanation about the purpose of the method and his processes of observation and calculation.

- **Descriptions of the assignments due and their relation to the assessment:**
  - Memory of practices

- **Hours:** 2h
  - Practical classes: 2h

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### P10: ERRORS IN THE OBSERVATIONS. TOLERANCE.

- **Description:** Exposition about the accidental errors that operate in an angular observation and the processes of estimation calculation.

- **Descriptions of the assignments due and their relation to the assessment:**
  - Memory of practices

- **Hours:** 2h
  - Practical classes: 2h

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### P11: POLIGONAL II

- **Description:** Field practices of development of observation in a poligonal.

- **Support materials:**
  - Taquimeters of the topographic laboratory

- **Descriptions of the assignments due and their relation to the assessment:**
  - Memory of practices

- **Hours:** 3h
  - Practical classes: 2h
  - Self study: 1h

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### P12: POLIGONAL III

- **Description:** Field practices of observation of a poligonal.

- **Support materials:**
  - Taquimeters of the topographic laboratory

- **Descriptions of the assignments due and their relation to the assessment:**
  - Memory of practices

- **Hours:** 3h
  - Practical classes: 2h
  - Self study: 1h
### P13: LEVELLING I

**Hours:** 2h  
Practical classes: 2h

**Description:**  
Exposition about taking data of a levelling and the correspondent calculation of heights and precisions.

**Descriptions of the assignments due and their relation to the assessment:**  
Memory of practices

### P14: LEVELLING II

**Hours:** 3h  
Practical classes: 2h  
Self study: 1h

**Description:**  
Field practices of observation of a levelling itinerary.

**Support materials:**  
Line and automatic levels of the topographic laboratory.

**Descriptions of the assignments due and their relation to the assessment:**  
Memory of practices

### P15: LEVELING III

**Hours:** 3h  
Practical classes: 2h  
Self study: 1h

**Description:**  
Field practices of observation of a levelling

**Support materials:**  
Line and automatic levels of the topographic laboratory.

**Descriptions of the assignments due and their relation to the assessment:**  
Memory of practices

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### Qualification system

Midterm exams: 20%  
Individual memory of practices: 20%  
Individual and team projects: 20%  
Final exam: 40%  
The attendance and work in class will be valued.

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### Regulations for carrying out activities

The attendance to the practices and the delivery of the memories and projects is mandatory and, therefore, necessary condition to be evaluated.
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Bibliography

**Basic:**


Gim: international for geomatics. Lemmer: GITC.

**Complementary:**
