

28722 - Procedures and Organisation

Información del Plan Docente

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| Academic Year | 2018/19 |
| Subject | 28722 - Procedures and Organisation |
| Faculty / School | 175 - Escuela Universitaria Politécnica de La Almunia |
| Degree | 423 - Bachelor's Degree in Civil Engineering |
| ECTS | 6.0 |
| Year | 3 |
| Semester | First semester |
| Subject Type | Compulsory |
| Module | --- |

1.General information

1.1.Aims of the course

1.2.Context and importance of this course in the degree

1.3.Recommendations to take this course

2.Learning goals

2.1.Competences

2.2.Learning goals

2.3.Importance of learning goals

3.Assessment (1st and 2nd call)

3.1.Assessment tasks (description of tasks, marking system and assessment criteria)

4.Methodology, learning tasks, syllabus and resources

4.1.Methodological overview

The current subject "Construction equipment and methods" is organized into five main groups of activities: two of them run by the teacher (lectures and problems), another carry out by the students and teacher jointly, a forth one consisting of self-study and finally the assessment written test:

- Lectures: in which the teacher will explain the theoretical concepts of the subject topics.
- Practical sessions: The teacher will explain the practical application on the concepts developed at the theoretical lectures, resolving practical problems. This session will take place at the classroom or at the computer laboratory.
- Tutorship practical sessions: in which the students will resolve, individually or in groups of two of them, the practical applications of concepts detailed in above paragraphs. Depending on the duration of these practices it can be only initiated at class time and later on finished as a non-class activity bases.

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- Assessment written test: Students will demonstrate the knowledge gained through two not mutually exclusive methods. One by continuing assessment throughout the course or, if these midterms tests are not passed successfully, a global written test on two calls.
- Personal study: Non-class activities in which students have to study the topics learnt at the class activities in order to understand and assimilate the theory taught in lectures and train the practical cases solved in the practical classes and prepare the written test.

Besides these activities there will be individual tutorials based on personalized attention by the teacher in order to help and resolve doubts and questions about the specific areas in which students have found more difficulties to be understood.

4.2.Learning tasks

To the activity groups mentioned at the previous section the following workload has been assigned:

- Lectures / Theoretical classes 25 hours
- Practical classes 12 hours
- Tutorship practical sessions 14 hours
- Assessment written test 9 hours
- Personal study 90 hours

According this hours distribution a total 150 hours workload is reached, corresponding to the 6 credits ECTS that the subject has assigned during the second quarter of the third course of the Civil Engineer Bachelor's degree.

These 150 hours involve 15 week of class.

Individual tutorials are planned in two hours per week basis

4.3.Syllabus

To reach the subject aims, this one is structured in 18 topics grouped into 3 educational units.

The detailed content of these topics is as follows:

EDUCATIONAL UNIT I: EARTHWORKS METHODS

TOPIC 1. EARTHMOVING MACHINERY

1.1. Earthmoving

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- 1.2. Earthmoving basic operations and machinery
 - 1.2.1. Excavation o arranque
 - 1.2.2. Loading
 - 1.2.3. Hauling and dumping
 - 1.2.4. Grading
 - 1.2.5. Wetering or drying
 - 1.2.6. Compaction
 - 1.2.7. Refining
- 1.3. Land classification according their harness
- 1.4. Advantages and limitations of the earthmoving machines
- 1.5. Machinery election
- 1.6. Mechanization of a work

TOPIC 2. EARTHWORKS QUANTITIES

- 2.1. Earth volumes changes
- 2.2. Swelling and swelling factor
- 2.3. Consolidation and compaction
- 2.4. Swelling values
- 2.5. Practical considerations in soil layers extention
- 2.6. Land clearing and land filling.

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- 2.7. Land movement cuttings and landfills
- 2.8. Cross sections areas
- 2.9. Determining the mass to be moved between two profiles
- 2.10. Mass diagram
- 2.11. Soil compensation

TOPIC 3. MACHINE POWER REQUIREMENTS

- 3.1. Required power
 - 3.1.1. Available power
 - 3.1.2. Usable power
- 3.2. Balance between available and usable powers
- 3.3. Resistance to the power
 - 3.3.1. Rolling resistance
 - 3.3.2. Slope resistance
 - 3.3.3. Acceleration resistance
 - 3.3.4. Air resistance
 - 3.3.5. Other resistances
- 3.4. Speed calculation. Equation of motion.
- 3.5. Practical exercises

TOPIC 4. PRODUCTION AND COST OF THE MACHINERY

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- 4.1. Costing of the work unit
- 4.2. Definition of production
 - 4.2.1. Time efficiency
 - 4.2.2. Production cycle
 - 4.2.3. Practical exercises on calculation of production
- 4.3. Cost of using machinery
 - 4.3.1. General considerations
 - 4.3.2. Variables to consider
 - 4.3.3. Cost structure
 - 4.3.3.1. Ownership cost
 - 4.3.3.2. Operating cost
 - 4.3.3.3. Total cost
 - 4.3.4. Calculating the direct cost
 - 4.3.5. Using SEOPAN tables
 - 4.3.6. Practical exercises on costing

TOPIC 5. MECHANICS & MACHINERY MAINTENANCE

- 5.1. Diesel engines
 - 5.1.1. Overview
 - 5.1.2. Extra engine feeding

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5.1.3. Power and torque of an engine

5.2. Gear systems

5.2.1. Direct gear

5.2.2. Hydraulic gear

5.3. Running assembly

5.3.1. Wheel assembly

5.3.2. Crawler assembly

5.4. Lubricants

5.4.1. Lubrication aims

5.4.2. Oils

5.4.3. Additives

5.4.4. Specific oils

5.4.5. Greases

5.5. Filters

5.5.1. Functionality

5.5.2. Types of filters

5.5.3. Using filters

TOPIC 6. EXCAVATION AND PUSHING: DOZER

6.1. Models and scope

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- 6.2. Mechanical properties
- 6.3. Working elements
- 6.4. Production cycle
- 6.5. Working capabilities
- 6.6. Excavation and pushing distances
- 6.7. Calculating dozer production
- 6.8. Excavation and pushing techniques
- 6.9. Ripping techniques
- 6.10. Practical exercises

TOPIC 7. EXCAVATION AND LOADING: FRONT LOADER

- 7.1. Definition, types and applications
- 7.2. Front loader elements and working equipment
- 7.3. Characteristic parameters
- 7.4. Working cycle
- 7.5. Buckets
- 7.6. Calculating front loader production
- 7.7. Match factor
- 7.8. Practical exercises

TOPIC 8. EXCAVATION, LOADING AND HAULING: SCRAPERS

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- 8.1. Scraper functions
- 8.2. Scrapers types and fields of application
- 8.3. Scraper elements and working equipment
- 8.4. Production cycle
- 8.5. Excavation methods
- 8.6. Different ways of working
 - 8.6.1. Pushing with a dozer
 - 8.6.2. Elevation blades
 - 8.6.3. Push & Pull
- 8.7. Working tips
- 8.8. Calculating scraper production
- 8.9. Match factor
- 8.10. Practical exercises

TOPIC 9. EXCAVATION MACHINERY: EXCAVATORS

- 9.1. Definition, types and applications
- 9.2. Hydraulic excavators
 - 9.2.1. Classification
 - 9.2.2. Elements and working equipment
 - 9.2.3. Excavation methods

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9.2.4. Calculating hydraulic excavator production

9.3. Cable excavators

9.3.1. Classification

9.3.2. Dragline: description and working cycle

9.3.3. Stationary draglines: description and working cycle

9.4. Practical exercises

TOPIC 10. HAULING: TRUCKS AND DUMPERS

10.1. Typology

10.2. Dump trucks

10.3. Dump semi-trailers

10.4. Dumpers

10.5. Off-road dumpers: rigid frame and articulated rear-dump trucks

10.6. Dump bodies

10.7. Hauling cycle and match factor

10.8. Calculating dumpers production

10.9. Practical exercises

10.10. Transport of heavy machinery

TOPIC 11. FINISHING EQUIPMENT: GRADERS

11.1. Definition and field of applications

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11.2. Grader elements

11.3. Working equipment

11.4. Grader operations

11.5. Calculating grader production

11.6. Practical exercises

TOPIC 12. COMPACTION

12.1. Types of compacting equipment

12.2. Compacting diagram

12.3. Compacting methods

12.4. Factors affecting compaction

12.5. Compaction specification and control

12.6. Compaction tests

12.7. Calculating compaction production

12.8. Compaction tips

12.9. Selecting a compactor

12.10. Practical exercises

EDUCATIONAL UNIT II: OTHER ENGINEERING WORKS PROCEEDING

TOPIC 13. ANCILLARY EQUIPMENT

- 13.1. Electric generator
- 13.2. Air compressors and hammers
- 13.3. Equipment for pumping water
- 13.4. Gas cutting procedures
- 13.5. Welding procedures
- 13.6. Drilling rock and soil machinery

TOPIC 14. EXPLOSIVES AND BLASTING

- 14.1. Explosive characteristics
- 14.2. Types of explosives
 - 14.2.1. Gelatinous explosives
 - 14.2.2. Powder explosives
 - 14.2.3. Anfos
 - 14.2.4. Hidrogels
 - 14.2.5. Emulsions
 - 14.2.6. Heavy Anfo
- 14.3. Selecting the explosive

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14.4. Initiating systems

14.4.1. Safety fuse

14.4.2. Electric detonators

14.4.3. Detonating cords

14.4.4. Primers and boosters

14.4.5. Blasting machine

14.5. Electric firing

14.5.1. Types of connections

14.5.2. Tests before blasting

14.5.3. Firing

14.6. Open air blasting

14.6.1. Breakage shape

14.6.2. Influent factors

14.6.3. Bench blasting

14.6.4. Contour blasting

14.6.5. Pre split holes

14.6.6. Top stem

TOPIC 15. AGGREGATE PRODUCTION

15.1. General information:

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15.2. Aggregate production machinery

15.2.1. Jaw crushers

15.2.2. Impact and gyratory crushers: single and double effect

15.2.3. Roll crushers

15.2.4. Rod mills

15.3. Calculating aggregate production

15.4. Aggregates classification: Screeners

15.5. Aggregates washing

15.6. Feeders and belt conveyors

15.7. Surge piles

15.8. Facilities

15.9. Practical exercises

TOPIC 16. FLEXIBLE PAVEMENTS: MACHINERY AND EXECUTION

16.1. Soil stabilization

16.2. Bituminous coats: prime, tack and seal

16.3. Aggregate base or subbase and bituminous coats

16.3.1. Single coat execution

16.3.2. Double coat execution

16.3.3. Tack coats

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16.4. Bituminous concrete

16.4.1. Heat bituminous plants

16.4.2. Cold bituminous plants

16.4.3. Asphalt laying machines and compaction equipment (execution)

16.4.4. Requirements and quality tests

TOPIC 17. CONCRETE: EQUIPMENT AND PLACING

17.1. Concrete mixers

17.1.1. Concrete mixing techniques

17.1.2. Concrete drum / gravity mixer type

17.1.3. Concrete pan mixer type

17.1.4. Concrete mixer truck

17.1.5. Discharge belts / concrete mixer supply

17.2. Concrete plants

17.3. Execution: Concrete pumping

17.3.1. Pumping concrete mixture composition

17.3.2. Pumping

17.3.3. Concrete pumps machinery

17.4. Execution: Consolidating and finishing

17.4.1. Techniques

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17.4.2. Types and features

17.4.3. Vibrating equipment: rods, rules, tables.

17.4.4. Finishing machines

17.4.5. Cutting concrete joints

17.5. Execution: Concrete pavements

17.6. Execution: Shotcrete

17.6.1. Shotcrete mixture composition

17.6.2. Shotcrete equipment

17.6.3. Shotcrete usage

TOPIC 18. TIMBERING, FORMWORK AND FALSEWORK

18.1. Timbering

18.1.1. Characteristics

18.1.2. Types

18.1.3. Usage

18.2. Formwork

18.2.1. Classification

18.2.2. Materials

18.2.3. Execution

18.3. Concrete reinforcement

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18.3.1. Introduction

18.3.2. Types of reinforcement

18.3.3. Puesta en obra: Reinforced bar bent, distance, covering & splicing

18.4. Falsework

TOPIC 19. CRANES AND LIFTING SYSTEMS

19.1. Introduction

19.2. Mayor cranes types

19.3. Mobil cranes:

19.3.1. Telescoping-boom truck mounted, crawler and lattice-boom cranes

19.3.2. Components

19.3.3. Lifting capacities diagrams

19.3.4. Practical exercise

19.4. Tower cranes

19.4.1. Components

19.4.2. Support basement

19.4.3. Movements and rigging

19.4.4. Features

19.4.5. Practical exercise

TOPIC 20. PRACTICAL EXAMPLES OF CONSTRUCTION METHODS

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1.1. Sewage pipeline laid inside ditch reinforced for traffic circulation

1.2. Channelling of rivers and streams

1.3. Retaining console wall

1.4. Half-buried drinking water tank

1.5. Transversal transit and drainage reinforced concrete frame

1.6. Caisson dock

4.4.Course planning and calendar

The theoretical and practical workload of the different topics is distributed according the table below:

| N | TOPIC | T | P | PT | E | TI | TOTAL |
|---|--|---|---|----|---|----|-------|
| 1 | EARTHMOVING MACHINERY | 2 | | | | 1 | 3 |
| 2 | EARTHWORKS QUANTITIES | 1 | 2 | 2 | | 5 | 10 |
| 3 | MACHINE POWER REQUIREMENTS | 1 | 1 | 1 | | 5 | 8 |
| 4 | PRODUCTION AND COST OF THE MACHINERY | 1 | 1 | 1 | | 5 | 8 |
| 5 | MECHANICS & | 1 | | | | 4 | 5 |

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|------|---|---|---|---|---|---|---|
| | MACHINERY MAINTENANCE | | | | | | |
| 6 | EXCAVATION AND PUSHING: DOZER | 1 | 1 | 1 | | 5 | 8 |
| 7 | EXCAVATION AND LOADING: FRONT LOADER | 1 | 1 | 1 | | 5 | 8 |
| 8 | EXCAVATION, LOADING AND HAULING: SCRAPERS | 1 | 1 | 1 | | 6 | 9 |
| 9 | EXCAVATION MACHINERY: 1 EXCAVATORS | | 2 | 1 | | 5 | 9 |
| 10 | HAULING: TRUCKS AND DUMPERS | 1 | | 2 | | 6 | 9 |
| 11 | FINISHING EQUIPMENT: 1 GRADERS | | 1 | | | 5 | 7 |
| 12 | COMPACTION | | 1 | | | 6 | 8 |
| EV I | Written assessment test EU I | | | | 2 | | 2 |
| 13 | ANCILLARY EQUIPMENT | 3 | | | | 4 | 7 |

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| 14 | EXPLOSIVES AND BLASTING | 1 | 2 | | | 5 | 8 |
| 15 | AGGREGATE PRODUCTION | 1 | 1 | | | 4 | 7 |
| 16 | FLEXIBLE PAVEMENTS: MACHINERY AND EXECUTION | 2 | | | | 4 | 6 |
| 17 | CONCRETE: EQUIPMENT AND PLACING | 3 | | | | 7 | 10 |
| 18 | TIMBERING, FORMWORK, REINFORCEMENT & FALSEWORK | | | | | 4 | 6 |
| 19 | CRANES AND LIFTING SYSTEMS | 1 | | | | 4 | 5 |
| 20 | PRACTICAL EXAMPLES OF CONSTRUCTION METHODS | | 2 | | | | 2 |
| EV-II | Written assessment test EU III | | | | 2 | | 2 |
| EV-F | Final written assessment test | | | | 3 | | 3 |

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|--|-------|----|----|----|---|----|-----|
| | TOTAL | 26 | 16 | 11 | 7 | 90 | 150 |
|--|-------|----|----|----|---|----|-----|

S.- Theoretical sessions / lectures

P.- Practical sessions /Problems

PT.- Computer lab workshop

E.- Written assessment test

TI.- Personal study

DESIGNATION OF SESSIONS ACCORDING TO THE WORKLOAD

| Nº | TOPIC | T | P | PT | E |
|----|--|-------|----------------|------------------|---|
| 0 | SUBJECT INTRODUCTION AND LEARNING AIMS | S-011 | | | |
| 1 | EARTHMOVING MACHINERY | S-111 | | | |
| 2 | EARTHWORKS QUANTITIES | S-211 | P-212 P-222 | PT-212 PT-222 | |
| 3 | MACHINE POWER REQUIREMENTS | S-311 | P-311 | PT-311 | |

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|----|---|--------|----------------|--------------------|--|
| 4 | PRODUCTION AND COST OF THE MACHINERY | S-411 | P-411 | PT-411 | |
| 5 | MECHANICS & MACHINERY MAINTENANCE | S-511 | | | |
| 6 | EXCAVATION AND PUSHING: DOZER | S-611 | P-611 | PT-611 | |
| 7 | EXCAVATION AND LOADING: FRONT LOADER | S-711 | P-711 | PT-711 | |
| 8 | EXCAVATION, LOADING AND HAULING: SCRAPERS | S-811 | P-811 | PT-811 | |
| 9 | EXCAVATION MACHINERY: EXCAVATORS | S-911 | P-912 P-922 | PT-911 | |
| 10 | HAULING: TRUCKS AND DUMPERS | S-1011 | | PT-1012 PT-1022 | |
| 11 | FINISHING EQUIPMENT: GRADERS | S-1111 | P-1111 | | |
| 12 | COMPACTION | S-1211 | P-1211 | | |

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| EV- II | Written assessment test EU I | | | | EV-I-1 EV-I-2 |
|--------|--|----------------------------|------------------|---------|----------------------|
| 13 | ANCILLARY EQUIPMENT | S-1313 S-1323 S-1333 | | PT-1311 | |
| 14 | EXPLOSIVES AND BLASTING | S-1411 | P-1412 P-1422 | | |
| 15 | AGGREGATE PRODUCTION | S-1511 | P-1511 | PT-1511 | |
| 16 | FLEXIBLE PAVEMENTS: MACHINERY AND EXECUTION | S-1612 S-1622 | | | |
| 17 | CONCRETE: EQUIPMENT AND PLACING | S-1713 S-1723 S-1733 | | | |
| 18 | TIMBERING, FORMWORK, REINFORCEMENT & FALSEWORK | S-1812 S-1822 | | | |
| 19 | CRANES AND LIFTING SYSTEMS | S-1911 | | | |

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| 20 | PRACTICAL EXAMPLES OF CONSTRUCTION METHODS | | P-2012 P-2022 | | |
| EV-II | Written assessment test EU III | | | | EV-II-1 EV-II-2 |
| EV-F | Final written assessment test | | | | EV-F-1 EV-F-2 EV-F-3 |
| | TOTAL | 26 | 16 | 11 | 7 |

(Eg. Designation meaning: PT-1723.- Computer lab workshop session corresponding to the topic 17, session 2 of 3)

CALENDAR

| HOUR | SESSION | TOPIC |
|------|---------|---|
| 1 | S-011 | Subject submission |
| 2 | S-111 | Introduction to earthmoving operations and machiney |
| 3 | S-211 | Earthmoving quantities |
| 4 | P-212 | Practical exercises on cross section |

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| | | areas |
| 5 | P-222 | Practical exercises on mass diagram |
| 6 | PT-212 | Practical exercises on cross section areas |
| 7 | PT-222 | Practical exercises on mass diagram |
| 8 | S-311 | Machine power requirements |
| 9 | P-311 | Practical exercises on machine power requirements (1) |
| 10 | PT-311 | Practical exercises on machine power requirements (2) |
| 11 | S-411 | Production and cost of machinery |
| 12 | P-411 | Calculating cost unit and cost of using machinery (1) |
| 13 | PT-411 | Calculating cost unit and cost of using machinery (1) |
| 14 | S-511 | Mechanics & machinery maintenance |
| 15 | S-611 | Excavación and pushing: Dozer |
| 16 | P-611 | Practical exercises on dozers (1) |
| 17 | PT-611 | Practical exercises on dozers (2) |
| 18 | S-711 | Excavation and loading: Front loader |

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| 19 | P-711 | Practical exercises on front loader (1) |
| 20 | PT-711 | Practical exercises on front loader (2) |
| 21 | S-811 | Excavation, loading and hauling: Scrapers |
| 22 | P-811 | Practical exercises on scrapers (1) |
| 23 | PT-811 | Practical exercises on scrapers (2) |
| 24 | S-911 | Excavation machinery : Excavators |
| 25 | P-912 | Practical exercises on excavators (1) |
| 26 | P-922 | Practical exercises on excavators (2) |
| 27 | PT-911 | Practical exercises on excavators (3) |
| 28 | S-1011 | Hauling: Truncks and dampers |
| 29 | PT-1012 | Practical exercises on different earthmoving machinery integration (1) |
| 30 | PT-1022 | Practical exercises on different earthmoving machinery integration (1) |
| 31 | S-1111 | Finishing equipment: Graders |
| 32 | P-1111 | Practical exercises on graders |

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| 33 | S-1211 | Compaction |
| 34 | P-1211 | Practical exercises on compaction |
| 35 | EV-I | EU I (Chapters 1 to 12) |
| 36 | EV-I | |
| 37 | S-1313 | Ancillary equipment (1) |
| 38 | S-1323 | Ancillary equipment (2) |
| 39 | S-1333 | Ancillary equipment (3) |
| 40 | S-1411 | Explosives and blasting |
| 41 | P-1412 | Geometric dimensions of drill holes |
| 42 | P-1422 | Drill hole explosive charge distribution |
| 43 | S-1511 | Aggregate production |
| 44 | P-1511 | Calculating aggregate production (1) |
| 45 | PT-1511 | Calculating aggregate production (1) |
| 46 | S-1612 | Flexible pavements: Machinery and execution (1) |
| 47 | S-1622 | Flexible pavements: Machinery and execution (1) |
| 48 | S-1713 | Concrete: Concrete mixer and its characteristics |

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| 49 | S-1723 | Concrete punpung. Characteristics & Preassure claculation |
| 50 | S-1733 | Concrete: Consolidating and finishing |
| 51 | S-1812 | Timbering, formwork and falsework |
| 52 | S-1822 | Concrete iron reinforcement |
| 53 | S-1911 | Cranes and lifting systems |
| 54 | P-2012 | Construc Methods: Seewage pipeline, channeling of stream and retaining console wall |
| 55 | P-2022 | Construc Methods: Water tank, Concrete frame and Caisson dock |
| 56 | EV-II | EU II (Chapters 13 to 20) |
| 57 | EV-II | |
| 58 | EV-F-1 | Final exam EU I (Chapters 1 to 12) |
| 59 | EV-F-2 | |
| 60 | EV-F-1 | Final exam EU II (Chapters 13 to 20) |

4.5. Bibliography and recommended resources