

DS415 : Introduction to Engineering Management

Titular:

COL IMM (Land) Geert Letens (3 ECTS)

ECTS: 3

Contact hours: 24 hr(s) theory ; 6 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral, written

Content

Major technological challenges require a structured management approach. Therefore, this course provides an overview of the main Engineering Management Domains and illustrates their relevance for Defense. Further the course clarifies how technical activities in Defense can be managed in compliance with the Internal Control Systems Guidelines of Defense, following the basic principles of project and risk management.

1. Definition of Engineering Management
2. Core principles and techniques of Project Management
3. Case studies: life cycle costing, maintenance management, ISO 17025

Final competences

- I. 1. Understanding of extensive subject matter in the field of Engineering and Military Sciences: DS
- II. 1. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: DS

Learning objectives

1. Understanding the various knowledge areas related to engineering management
2. Being able to assess the project management approach applied to a real life project

Required knowledge

CL317

Course material

Book (owned)
Slides (digital)
Articles

References

1. A guide to Engineering Management Body of Knowledge, American Society for Engineering Management, 5th edition.
2. Managing Successful projects with PRINCE II, Office of Government Commerce.
2. Farr, J, Systems Life Cycle Costing, 2011

Working methods

Ex Cathedra
Demonstration
Open Tasks

DS425 : Intelligent Decision Support Methods

Titular:

LCL (Air) Filip Van Utterbeeck (6 ECTS)

ECTS: 6

Contact hours: 30 hr(s) theory ; 30 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: written

Content

1. Introduction
2. Uninformed Search
3. Informed Search
4. Adversarial Search
5. Constraint Satisfaction Problems
6. Markov Decision Processes
7. Reinforcement Learning
8. Classification
9. Clustering
10. Deep Learning

Final competences

- I. 1. Understanding of extensive subject matter in the field of Engineering and Military Sciences: DS
- II. 1. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: DS
- IV. 2. Thinking critically and acting scientifically: Elaborating a research question with a critical and evidence-based approach
- IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

Learning objectives

The students obtain a general overview of the field of artificial intelligence and are able to explain and illustrate the different methods and algorithms. They are able to apply "classical" AI algorithms and design intelligent agents for a broad range of problems. They are able to identify the correct methods for a given problem and can formulate

conclusions or recommendations based on their analysis of the results of the (computer-based) calculations and experiments they have both designed and implemented.

Required knowledge

ES121
ES123
ES211

Course material

Book (loan)
Slides (digital)
Software
Hardware (laptop)

References

Russel & Norvig: Artificial Intelligence, a modern approach
Both Matlab and Julia are used for the lab sessions.

Working methods

Ex Cathedra
Demonstration
Closed Tasks
Open Tasks

EN417 : Soil Mechanics

Titular:

LCL (Land) David Lecompte (5 ECTS)

ECTS: 5

Contact hours: hr(s) theory ; hr(s) practice ;

Evaluation:

Daily work: amount written evaluations:

Daily work: amount oral evaluations:

Weight daily work: 0

Weight exam: 50

Type of exam:

Content

Final competences

Learning objectives

Required knowledge

Course material

References

Working methods

EN427 : Construction Engineering Design

Titular:

LCL (Land) David Lecompte (5 ECTS)

ECTS: 5

Contact hours: hr(s) theory ; hr(s) practice ;

Evaluation:

Daily work: amount written evaluations:

Daily work: amount oral evaluations:

Weight daily work: 0

Weight exam: 50

Type of exam:

Content

Final competences

Learning objectives

Required knowledge

Course material

References

Working methods

EN428 : Analysis of Constructions

Titular:

LCL (Land) David Lecompte (5 ECTS)

ECTS: 5

Contact hours: hr(s) theory ; hr(s) practice ;

Evaluation:

Daily work: amount written evaluations:

Daily work: amount oral evaluations:

Weight daily work: 0

Weight exam: 50

Type of exam:

Content

Final competences

Learning objectives

Required knowledge

Course material

References

Working methods

EN428 : Analyse des structures

Titulaire:

LCL (Land) David Lecompte (5 ECTS)

ECTS: 5

Heures de contact: hr(s) de théorie ; hr(s) pratique ;

Evaluation:

Travail journalier : nombre d'évaluations écrites:

Travail journalier : nombre d'évaluations orales:

Coefficient de pondération pour le travail journalier: 0

Coefficient de pondération pour l'examen: 50

Type d'examen:

Contenu

Acquis d'apprentissage

Objectifs

Connaissances préalables exigées

Matériel de cours

Références

Modes de travail

EN428 : Analyse van constructies, inleiding stabiliteit

Titularis:

LCL (Land) David Lecompte (5 ECTS)

ECTS: 5

Contacturen: u theorie ; u praktijk ;

Evaluatie:

Dagelijks werk: aantal schriftelijke evaluaties:

Dagelijks werk: aantal mondelinge evaluaties:

Gewichtscoefficiënt dagelijks werk: 0

Gewichtscoefficiënt examen: 50

Examenvorm:

Inhoud

Eindcompetenties

Leerdoelstellingen

Vereiste voorkennis

Cursusmateriaal

Referenties

Werkvormen

EP011 : Complements to piston engines

Titular:

LCL (Land) Kristof Harri (1 ECTS)

ECTS: 1

Contact hours: 7 hr(s) theory ; 3 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 0

Daily work: amount oral evaluations: 0

Weight daily work: 0

Weight exam: 10

Type of exam: written

Content

Introduction

General

Lubrication

Cooling

Ignition

Fuel

Mixture

Carburettors

Icing

Fuel Injection

Performance and power augmentation

Propellers

Final competences

I. 2. Understanding of extensive subject matter in the field of
Engineering and Military Sciences: EP

Learning objectives

Comply with the requirements of ATPL

Required knowledge

EP324

Course material

Book (loan)

References

ATPL Book 4 Powerplant

Working methods

Ex Cathedra

EP414 : Electrical Power Systems

Titular:

LCL (Land) Maarten Vergote (6 ECTS)

ECTS: 6

Contact hours: 37 hr(s) theory ; 25 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 0

Daily work: amount oral evaluations: 2

Weight daily work: 20

Weight exam: 40

Type of exam: Oral, written

Content

Basic Laws

- Circuit laws - Faraday, Laplace, Maxwell-Ampère - Active and reactive power, power balance, power factor - Phasors

General overview of electrical power systems

- Introduction: some numbers about electricity production
- General power system properties
- Electric power generation : Thermal power plants
- Nuclear physics in electric power generation : Nuclear Power Plants
- Renewable electricity production (hydropower - wind - solar)
- Energy storage.

Electric safety

- Earthing - Hazards - Switching devices - Over-current protection -

Protection against leakage currents

Electrical power systems components

- Transformers
- Three phase networks
- General overview of electrical machines (DC, induction, synchronous)
- Synchronous machines (alternator, motor)

Topical subjects presented in flipped classroom (electricity grid load - generation - interconnections - trading, modern electric motors / actuators, electric and more-electric ships, aircrafts and ground vehicles, ...)

Final competences

I. 2. Understanding of extensive subject matter in the field of Engineering and Military Sciences: EP

II. 2. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: EP

III. 2. Applying language and communication skills efficiently:
Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide

VI. 3. Acting autonomously: Practicing an attitude of lifelong learning

Learning objectives

At the end of the course, students are expected to be able to:

- Distinguish the dangers of electricity and use adequate protection means;
- Explain, criticize and discuss issues related to production (fossil, nuclear and renewable), transport, distribution, storage, transformation and consumption (including modern electric drives) of electric energy ;
- Select an appropriate mathematical model and use it to predict the behaviour of power system components ;
- Taking into account security measures and components limitations, design an experimental setup and use it to measure the quantities needed to characterize power system components,
- Assess the accuracy of the mathematical models used by comparing their predictions with measurements.

Required knowledge

ES212

ES213

ES222

ES223

ES311

ES322

ES323

Course material

Notes (printed)

Slides (digital)

Book (loan)

References

Loan: Electrical Power System Essentials, P. Schavemaker, L. van der Sluis, ISBN: 978-1-118-80347-9

An introduction to electrical machines and transformers (Second edition), George McPherson, Robert D. Laramore, ISBN: 978-0-471-63529-1

Working methods

Ex Cathedra

Closed Tasks

Open Tasks

EP522 : Turbomachines

Titular:

LCL (Land) Bart Janssens (3 ECTS)

ECTS: 3

Contact hours: 15 hr(s) theory ; 15 hr(s) practice ; 4 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations:

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

- "-@ Fundamental equations for turbomachines
- @ Centrifugal turbopumps
- @ Axial turbines
- @ Axial and radial compressors

Final competences

I. 2. Understanding of extensive subject matter in the field of

Engineering and Military Sciences: EP

II. 2. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: EP

Learning objectives

- * The student describes and applies the basic thermodynamic equations for turbomachinery
- * The student describes, explains and applies the basic equations for turbomachinery
- * The student describes, explains and applies the principles of centrifugal pumps, axial compressors and axial turbines, including losses and off-design operation
- * The student applies the aforementioned theories to estimate the performance of and to do preliminary design studies for centrifugal pumps, axial compressors and axial turbines
- * The student appreciates the technological evolution in turbomachinery

Required knowledge

ES312

Course material

Notes (digital)

Slides (digital)
Software

References

Balje O.E., 1981, "Turbomachines: A Guide to Design, Selection and Theory". John Wiley & Sons Inc.

Working methods

Ex Cathedra
Closed Tasks
Open Tasks

EP543 : Aircraft Propulsion

Titular:

LCL (Land) Bart Janssens (3 ECTS)

ECTS: 3

Contact hours: 18 hr(s) theory ; 13 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

- Introduction
- Thrust and Efficiency
- Turbojet Engines
- Turbofan Engines
- Turboprop and Turboshift Engines
- Engine Performance
- Subsonic and supersonic inlets
- Exhaust nozzles and afterburners

Final competences

I. 2. Understanding of extensive subject matter in the field of Engineering and Military Sciences: EP

II. 2. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: EP

Learning objectives

- Analyze the thermodynamic cycle of aircraft jet engines
- Analyze the aerothermodynamics of inlets and nozzles
- Independently apply the operating principles of jet engines to an existing design, discussing its strengths and weaknesses
- Discuss the matching between an engine and an aircraft

Required knowledge

EP522

Course material

Book (loan)

Slides (digital)

Software

References

Farokhi, Saeed. Aircraft propulsion. John Wiley & Sons, 2014.

Working methods

Ex Cathedra

Demonstration

Closed Tasks

Open Tasks

EP553 : Ship Propulsion

Titular:

LCL (Land) Benoît Marinus (3 ECTS)

ECTS: 3

Contact hours: 18 hr(s) theory ; 10 hr(s) practice ; 6 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

1 The Propeller Screw

- Blade Shape, Blade Section Shape

2 Theory of Propeller Action

- Propeller Forces, Theory of Propeller Action, Screw Operating Conditions, Propeller-Hull Interaction, Propulsive Efficiency

3 Cavitation,

4 Secondary Forces

5 Ducted Propellers

6 Hull-Propeller-Engine Matching

- Propeller design point PD, Engine layout diagram, Standard load diagram, Limits to continuous operation, Recommendation, Extended engine load diagram, Propeller-Engine matching

7 Propulsion System Selection

- Selection and dimensioning of the source, Selection of a transmission, Combined types, Hybrid types, Fixed or controllable pitch propellers

8 Induction motors

Final competences

I. 2. Understanding of extensive subject matter in the field of Engineering and Military Sciences: EP

II. 2. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: EP

III. 1. Applying language and communication skills efficiently: Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach

VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide

VI. 3. Acting autonomously: Practicing an attitude of lifelong learning

VII. 1. Collaborating in a multidisciplinary environment: Collaborating beyond the borders of specific disciplines to reach a common goal

Learning objectives

At the end of the course, the student is expected to:

- * Elaborate on the constitutive items of the propulsion chain,
- * Design at a preliminary level a classical and a hybrid propulsion chain,
- * Implement his/her knowledge and insight in the design task and in his/her report,
- * Evaluate the existing technologies applicable to ship propulsion,
- * Understand and use an appropriate mathematical model to characterize the steady state operation of an induction motor,
- * Taking into account security measures and components limitations, implement an experimental setup and make the measurements needed to characterize an induction machine, study its steady state operation and assess the accuracy of the corresponding mathematical models,
- * Perform a critical analysis of computational and experimental results.

Required knowledge

SM551

SM551

EP414

EP324

SM315

ES312

ES213

Course material

Notes (printed)

Notes (digital)

Slides (digital)

Articles

References

Working methods

Ex Cathedra

Teaching Conversation

Closed Tasks

Open Tasks

LC416 : Leadership

Titular:

LCL MAB (Land) Hans De Smet (3 ECTS)

ECTS: 3

Contact hours: 22 hr(s) theory ; 2 hr(s) practice ; 6 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

The course LS416 develops the academic basis relative to different leadership aspects. It focuses on the personality of the leader (BE, KNOW, DO), the situation (mainly how a group works) and the mutual influences. These aspects are developed through interactive classes.

Final competences

I. 3. Understanding of extensive subject matter in the field of

Engineering and Military Sciences: LC

II. 1. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: DS

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

Learning objectives

At the end of the course LS416, the student possesses the competencies required to :

- explain and illustrate the basic leadership styles;
- explain and illustrate the basic notions of leadership;
- explain the Vision of Leadership at Defence;
- explain and illustrate what effective leaders must be (Vision);
- explain and illustrate what effective leaders must know (Vision);

- explain and illustrate what effective leaders must do (Vision);
- explain and illustrate the main monofactorial and bifactorial models;
- apply the decision making model of Maier;
- apply the steps of the decision making process;
- explain and illustrate the main motivation theories;
- explain and illustrate the notion of social cohesion;
- explain and illustrate the notion of social influence;
- explain and illustrate the principles of interpersonal communication;
- explain and illustrate the principles of feedback;
- explain and illustrate the notion of individual and group resilience;
- analyse a personality based on the leadership models and formulate a judgement on his/her leadership style;

Required knowledge

CL116

BS227

Course material

Book (owned)

Slides (digital)

Notes (digital)

Articles

References

The vision of leadership at Defence

Working methods

Ex Cathedra

Teaching Conversation

Class Discussion

Closed Tasks

Open Tasks

RS561 : Master Thesis Supervisor

Titular:

GHL (Civ) Cindy Du Bois (12 ECTS)

ECTS: 12

Contact hours: hr(s) theory ; hr(s) practice ;

Evaluation:

Daily work: amount written evaluations:

Daily work: amount oral evaluations:

Weight daily work: 0

Weight exam: 120

Type of exam:

Content

Referece: P-RMA-105: The Master thesis (MAT) is a written work that is also defended orally and with which the student, under the supervision of a supervisor, demonstrates that he has reached the final objective levels of the curriculum. The student analyses responsibly a complex issue and provides it with an original solution and commentary, prepares a written report of this analysis in a clear, well-founded and convincing manner, presents it to a jury and defends it against critical questions. The subject of the MAT should be chosen within a departement of the POL-faculty. The student conducts an independent and creative research that is substantively relevant for the field and for Defense.

Final competences

I. 1. Understanding of extensive subject matter in the field of Engineering and Military Sciences: DS

II. 1. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: DS

III. 1. Applying language and communication skills efficiently: Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach

V. 1. Working with people as an individual or in a group: Adapting to individual human behavior and group dynamics

VI. 1. Acting autonomously: Shaping and regulating his/her own learning process in function of his/her results

VII. 1. Collaborating in a multidisciplinary environment: Collaborating beyond the borders of specific disciplines to reach a common goal

Learning objectives

With the MAT, the student demonstrates that he/she can: - elaborate a research project - select independently information, evaluate it critically and assess its relevance for answering the research questions - communicate in a scientifically correct language - use modern and adapted methods and/or techniques - analyse critically the results obtained and their interpretation - report and defend the results in a coherent whole - respect the deontological rules when conducting the research

Required knowledge

CL116

ES223

ES323

Course material

References

TBD in agreement with supervisor

Working methods

Open Tasks

RS562 : Master Thesis 2nd supervisor

Titular:

GHIL (Civ) Cindy Du Bois (8 ECTS)

ECTS: 8

Contact hours: hr(s) theory ; hr(s) practice ;

Evaluation:

Daily work: amount written evaluations:

Daily work: amount oral evaluations:

Weight daily work: 0

Weight exam: 80

Type of exam:

Content

Final competences

Learning objectives

Required knowledge

Course material

References

Working methods

RS563 : Master Thesis Jury

Titular:

GHIL (Civ) Cindy Du Bois (4 ECTS)

ECTS: 4

Contact hours: hr(s) theory ; hr(s) practice ;

Evaluation:

Daily work: amount written evaluations:

Daily work: amount oral evaluations:

Weight daily work: 0

Weight exam: 40

Type of exam:

Content

Final competences

Learning objectives

Required knowledge

Course material

References

Working methods

SE412 : Tactical Military Sensors

Titular:

LCL (Air) Marijke Vandewal (7 ECTS)

ECTS: 7

Contact hours: 48 hr(s) theory ; 20 hr(s) practice ; 4 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 23

Weight exam: 47

Type of exam: written

Content

This course starts with a general introduction on military remote sensing. Based on the spectral domain where the sensors are operating they will be subdivided in electro-optical/infrared (EO/IR) sensors and radar systems. This subdivision is the basis for the general structure of the course which will consist of 3 parts: (1) passive EO/IR sensors, (2) active EO/IR sensors, (3) radar. For each part, the information is structured in the same way. First the relevant phenomenology is described, explaining the proper emission of the sources and targets, their reflection properties, and the transmission behavior of the atmosphere. Then the description of the sensor itself follows including hardware, signal/image processing and measurement principles. Combining all that information leads to an understanding of the sensor performance and limitations, and how countermeasures could work. Directed Energy Weapons are also discussed here. A wrap-up is foreseen for each part and each sensor, describing military applications and future trends.

Final competences

- I. 4. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SE
- II. 4. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SE
- IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

Learning objectives

After completion of the course, the student is expected to be able to:

- Clarify and illustrate the main components of the discussed military sensors and DEW
- Interpret and evaluate technical specifications linked to these systems
- Link the sensor and weapon performances to these technical specifications and to the limits of the main system components
- Use international norms and standards to assess sensor performance
- Select the applications made possible by the use of the sensors
- Apply the acquired knowledge to analyse existing remote sensing systems and DEW

Required knowledge

ES211
ES213
ES222
WS225
ES311
TN325

Course material

Slides (printed)
Slides (digital)
Notes (printed)
Notes (digital)
Book (loan)
Articles

References

Working methods

Ex Cathedra
Demonstration
Teaching Conversation
Closed Tasks

SE422 : Digital Technology for Sensors and Weapons

Titular:

CDT (Land) Koen Boeckx (5 ECTS)

ECTS: 5

Contact hours: 36 hr(s) theory ; 12 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 17

Weight exam: 33

Type of exam: Oral

Content

The course material will cover :

- Integrated circuit technology (CMOS/BJT/BiCMOS)
- Transistor modelling
- Current and voltage reference circuits
- Basic building blocks (amplifiers, buffers, differential amplifier)
- Comparator Design
- OPAMP Design (Miller OPAMP)
- Stabilization techniques
- Noise in electronic circuits
- Sensor integration
- Integrated sensor types
- Sensor characteristics
- Sensor interfacing
- MEMS integration
- Read-out circuit design
- Readout modes
- Optical camera design and implications
- Computer Architecture

Final competences

I. 4. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SE

II. 4. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SE

IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach

IV. 2. Thinking critically and acting scientifically: Elaborating a research question with a critical and evidence-based approach

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach

Learning objectives

After finishing the course the student will be able to :

Characterize using mathematical models the operation of integrated circuits and verify their performance against the specification (Understanding of extensive subject matter in the field of Engineering and Military Sciences).

Read, evaluate and understand scientific papers on electronic circuit theory and sensor systems, synthesis conclusions and present as well defend these conclusions in a written paper (Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions, as well as thinking critically and acting scientifically)

Required knowledge

ES222

Course material

Book (owned)

Software

Slides (printed)

References

Working methods

Ex Cathedra

Closed Tasks

Open Tasks

SE426 : Military Satellite based Positioning

Titular:

GHL (Civ) Alain Muls (3 ECTS)

ECTS: 3

Contact hours: 20 hr(s) theory ; 10 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 0

Daily work: amount oral evaluations: 1

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

- Satellite geodesy made easy
- Brief review of satellite geodesy
- The legacy Global Positioning System
- The European Galileo system
- Overview of modern GNSS system
- Solving the navigation problem
- Augmentation systems
- Open source GNSS processing

Final competences

Learning objectives

- understand
 - the basic concepts of GNSS systems
 - the functioning of the legacy GPS system from satellite to receiver
 - the modernised GNSS signals and navigation messages
 - the European Galileo system
 - the processing of GNSS observations
 - the added values of augmentation systems
- be able to use open source GNSS processing software

Required knowledge

SE115

Course material

Slides (printed)

Slides (digital)

Book (loan)

References

Working methods

Ex Cathedra

Open Tasks

SE511 : Strategic Military Sensors

Titular:

GHL (Civ) Xavier Neyt (6 ECTS)

ECTS: 6

Contact hours: 22 hr(s) theory ; 40 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

Sensing platforms (UGV, UAS, airborne/spaceborne imaging)

Sensors & their specificities (EO/IR, hyperspectral imaging, range-based imaging (lidar, radar).

Advanced signal processing (Moving target Indication, Synthetic Aperture Radar,

Space-Time Adaptive Processing).

Image post-processing, principles of image compression;

Distributed Geographical Information Systems.

Final competences

I. 4. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SE

II. 4. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SE

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach

VI. 3. Acting autonomously: Practicing an attitude of lifelong learning

VII. 1. Collaborating in a multidisciplinary environment: Collaborating beyond the borders of specific disciplines to reach a common goal

Learning objectives

At the end of the course, it is expected from the student that they be able to

- assess the feasibility of remote-sensing requirements.

- choose a platform (airborne/spaceborne, orbit, scanning mechanism when applicable, timeliness) as a function of the

considered application.

- describe optical imagers and the associated data processing owing to their specificities.
- describe radar imagers, their capacities (interferometry, ...) in comparison with optical imagers.
- choose and apply geometric correction methods
- choose and apply low-level correction methods
- explain the principles of image compression methods as applied in remote sensing
- describe the challenges in combining (fusion) different images from different sensors possibly acquired at different instants
- describe the specificities of a GIS.
- present in a clear, structured and synthetic in the form of a written report the results of a practical application of the course.

Required knowledge

ES311
ES124
SE412
SE422
TN325

Course material

Book (loan)
Slides (digital)
Software
Hardware (laptop)

References

M.T. Eismann, Hyperspectral Remote Sensing, SPIE
C.Oliver and S.Quegan, Understanding Synthetic Aperture Radar Images, Artech House
P.J.Gibson and C.H.Power, Digital Image Processing and Applications, Routledge

Working methods

Ex Cathedra
Closed Tasks
Open Tasks

SM524 : Numerical and Experimental Methods applied to Continuum Mechanics

Titular:

LCL (Land) David Lecompte (6 ECTS)

ECTS: 6

Contact hours: 4 hr(s) theory ; 60 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

This course will consist of one combined numerical-experimental project in one of the following domains:

- dynamic structural behaviour
- fluid mechanics
- vibrations

The students will

- build an experimental setup
- instrument the experimental setup using relevant measurement systems to measure e.g. pressure, displacement, strain, velocity and/or accelerations
- measure, analyze and evaluate the relevant measured variables
- build a numerical model of the setup
- simulate the model behavior given the experimental initial and boundary conditions
- analyze and evaluate the relevant calculated variables
- compare and discuss the numerical and experimental output
- write a report describing the:
 - setup
 - used measurement systems
 - measurements
 - numerical model
 - simulation results
 - comparison between measured and simulated results

Final competences

- I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM
- II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM
- III. 1. Applying language and communication skills efficiently: Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these
- III. 2. Applying language and communication skills efficiently: Communicating orally his/her conclusions, knowledge, and the rationale underpinning these
- IV. 2. Thinking critically and acting scientifically: Elaborating a research question with a critical and evidence-based approach
- VI. 1. Acting autonomously: Shaping and regulating his/her own learning process in function of his/her results

Learning objectives

The student will be able to:

- build an experimental setup
- instrument the setup
- perform relevant measurements
- analyse and evaluate the measurements
- use and interpret a commercial code for the relevant problems (e.g. non-linear time-dependent finite element code, CFD code)
- discuss the relevant parameters of a numerical model

Required knowledge

ES112
ES114
ES121
ES122
ES214
ES221
ES313

Course material

Software
Slides (digital)
Notes (digital)

References

Working methods
Open Tasks

SM525 : Ageing of Systems

Titular:

GHL (Civ) Luc Rabet (3 ECTS)

ECTS: 3**Contact hours:** 18 hr(s) theory ; 12 hr(s) practice ;**Evaluation:**

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

Introduction to failure analysis of components

Overview of the different material degradation mechanisms

Elements of Fracture Mechanics

Single load fractures (shear and cleavage mode)

Residual stresses

Brittle fracture

Ductile fracture

Fatigue fracture

Wear failure

Corrosion failures

High temperature failure

Fractography

Introduction to nondestructive testing

Methodology for conducting a practical failure analysis

Final competences

I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM

II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide

Learning objectives

The student is able to:

- analyse simple material models by asking the appropriate questions;
- reproduce a theoretical reasoning by identifying the assumptions at the basis of the reasoning;
- express himself using the terminology introduced during the course;
- look up the material degradation characteristics and to interpret them in a critical way;
- make life time calculations (fatigue, creep) after having participated at the practical sessions and draw practical consequences from it ;
- link material properties to civil/military components/assemblies;
- work in small groups (2 or 3 students) on an imposed case study in the field of material degradation;
- conduct a failure analysis of simple cases using microscopy leading to the root causes of the failure;

For the nondestructive inspection part, the student will be able to understand a selected nondestructive testing method for a certain problem.

Required knowledge

ES113

ES214

ES321

Course material

Book (loan)

Slides (printed)

Slides (digital)

Articles

References

Mechanical Metallurgy, George E. DIETER, 3rd Edition, McGraw Hill
Fatigue of Materials, S. SURESH, 2nd Edition , Cambridge University Press

ASM Handbook "Non destructive evaluation and quality control" Vol 17, American Society of Materials International

Working methods

Ex Cathedra

Demonstration
Teaching Conversation
Open Tasks

SM526 : Mechanical Systems Integration

Titular:

CDC (Civ) Eric Colon (3 ECTS)

ECTS: 3

Contact hours: 16 hr(s) theory ; 14 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

In this course several classical production techniques (turning, milling, drilling, grinding,...) are described. Modern machining techniques as additive manufacturing is also covered.

Table of contents:

- General information on mechanical design
- Tolerances, fits and surface quality
- Machining Basics
- Milling
- Turning
- Additive manufacturing

Final competences

I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM

II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

V. 1. Working with people as an individual or in a group: Adapting to individual human behavior and group dynamics

Learning objectives

- The student applies the main basic assumptions and notions of the theory and solves problems by exploiting production processes in mechanical design
- The student critically analyzes publications and standardization in the field of mechanical production and exploits them in a mini-project
- The student makes 'simple' calculations of a production process in mechanical design
- The student is able to design solutions to a problem, develop and relate sources and concepts in mechanical design
- The student is able to analyse and defend his/her solutions to the problem

Required knowledge

ES125

SM315

Course material

Notes (digital)

Slides (digital)

Software

References

Working methods

Ex Cathedra

Demonstration

Open Tasks

SM527 : Autonomous Systems

Titular:

CDC (Civ) Eric Colon (3 ECTS)

ECTS: 3

Contact hours: 16 hr(s) theory ; 14 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

At the end of the course, students are expected to have demonstrable knowledge and insight in the following aspects of unmanned and remotely piloted platforms (land/air/sea):

- Kinematics and actuation of mobile platforms
- Perception of the environment, obstacle avoidance and motion planning
- Control of individual and of group of platforms
- Applications of autonomous systems
- Safety and regulation

Final competences

I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM

II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

V. 1. Working with people as an individual or in a group: Adapting to individual human behavior and group dynamics

Learning objectives

At the end of the course, students are expected to be able to:

- Explain the characteristics and capabilities of typical autonomous systems

- Select a platform adapted to the operational requirements of typical missions
- Design the control loop of typical autonomous platforms
- Implement control algorithm on simulated autonomous systems
- Present the results of the group project during the oral exam

Required knowledge

DS425

Course material

Slides (digital)

Articles

Software

References

•Chapters from Handbook of Robotics 2nd Edition Springer ISBN: 978-3-319-32550-7

•Introduction to Autonomous Mobile Robots 2nd Edition The MIT Press ISBN: 978-0-262-01535-6

Working methods

Ex Cathedra

Closed Tasks

Open Tasks

SM531 : Land Vehicle Performance and Stability

Titular:

LCL (Land) Kristof Harri (6 ECTS)

ECTS: 6

Contact hours: 32 hr(s) theory ; 32 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral, written

Content

1. Vehicle design and mobility

--> classification, mobility requirements, geometry, safety, vehicle design

2. Mechanics of tires

- Tire terminology

- Rim characteristics

- Tire characteristics

- On-road longitudinal tire dynamics

- Off-road longitudinal tire dynamics

- Lateral tire dynamics

- Interaction between longitudinal and lateral forces

- Vertical properties of tires

3. Propulsion

- On road vehicle propulsion

- Off road vehicle propulsion

- Prime movers

- Power transmission (gearbox, differential, ASR)

4. Braking

- Braking performance

- Braking stability

- Brake proportioning

- ABS, EBD,...

5. Suspensions

- Axle kinematics

- The most common suspensions

- Bounce and pitch motion

- Vehicle roll

- Vertical dynamics

- 6. Vehicle handling
 - Low speed steering
 - High speed steering
 - ESC

Final competences

- I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM
- II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM
- III. 2. Applying language and communication skills efficiently: Communicating orally his/her conclusions, knowledge, and the rationale underpinning these
- IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach
- IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach
- IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach
- VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide

Learning objectives

At the end of the course, the students are expected to:

- Define and understand the working principle of the different components of a vehicle;
- Interpret the influence of different parameters (tires, geometry, kinematics,...) on vehicle mobility;
- Determine and interpret the vehicle performances taking into account the mobility requirements and the vehicle specifications;
- Question the requirement file for the acquisition of a new vehicle taking into account the mobility aspects and the vehicle performance;
- Report and defend solutions to different vehicle dynamics problems;
- Evaluate, as a manager, the technical problems on vehicles and to give a solution in principal;
- Judge and develop operational requirements with respect to vehicle mobility;
- Solve (elementary) problems related to vehicle propulsion;
- Solve (elementary) problems related to vehicle performance;
- Solve (elementary) problems related to vehicle stability.

Required knowledge

ES112
ES114
ES121
ES122
SM315
EP324

Course material

Notes (printed)
Notes (digital)
Slides (digital)

References

Several books on vehicle dynamics

Working methods

Ex Cathedra
Demonstration
Closed Tasks
Open Tasks

SM532 : Land Vehicle Technology

Titular:

LCL (Land) Kristof Harri (3 ECTS)

ECTS: 3

Contact hours: 15 hr(s) theory ; 15 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

Based on the specs of a 'new purchased' vehicle following aspects will be studied

- Engine modeling
- Vehicle performance on soft soil
- Obstacle crossing
- Maneuverability
- Gradeability
- The drive line of a 4x4 vehicle
- Start-up devices
- Differentials

Final competences

I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM

II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach

Learning objectives

At the end of the course, the students are expected to:

- Interpret the influence of some aspects of the driving line on vehicle mobility;
- Question the requirement file for the acquisition of a new vehicle with respect to mobility;
- Report and defend the choice of different driveline systems with respect to mobility;
- Evaluate, as a manager, the technical problems on vehicles and to give a solution in principal;
- Judge and develop operational requirements with respect to vehicle mobility;
- Clarify the military vehicle technology on vehicles of the land component;

Required knowledge

SM531

Course material

Slides (digital)
Articles

References

Working methods

Teaching Conversation
Open Tasks

SM541 : Performance and Stability of Fixed Wing Aircraft

Titular:

COL (Air) Elmar Recker (4 ECTS)

ECTS: 4

Contact hours: 26 hr(s) theory ; 14 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 0

Daily work: amount oral evaluations: 0

Weight daily work: 0

Weight exam: 40

Type of exam: written

Content

1. Aircraft Performance

1.1. Performance parameters: Conventions, Forces, Fundamental parameters, Governing equations

1.2. Steady flight: Symmetric flight, Parameters affecting performance curves, Climbing performance, Descending performance

1.3 Accelerated flight: Accelerated straight level flight, Load factor, Turning flight, Accelerated climbs, Total energy, Flight envelope, Takeoff, Landing

2. Aircraft Stability:

2.1. Static stability and control

2.2. Equations of motion

2.3. Stability derivatives

2.4. Dynamic stability

2.5. Control response

2.6. Introduction to enhanced stability

Final competences

I. 4. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SE

II. 4. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SE

Learning objectives

At the end of the course, students are expected to evaluate a particular design in terms of:

- Performance,
- Stability.

At the end of the course, students are expected to solve problems related to

- Performance,
- Stability.

Required knowledge

ES114

ES312

EP543

Course material

Hardware (laptop)

Notes (printed)

Notes (digital)

References

Asselin Mario; An introduction to Aircraft Performance

Corke Thomas; Design of Aircraft

Cumpsty Nicholas; Jet propulsion

John D. Anderson Jr. Introduction to flight. McGraw Hill, third edition, 1989

Barnes W. McCormick. Aerodynamics, aeronautics and flight mechanics, John Wiley, 1979

Bernard Etkin and Lloyd Duff Reid. Dynamics of flight. Stability and control. John Wiley, third edition, 1996

Working methods

Ex Cathedra

Closed Tasks

Open Tasks

SM542 : Air Vehicle Technology

Titular:

LCL (Land) Benoît Marinus (2 ECTS)

ECTS: 2

Contact hours: 12 hr(s) theory ; 6 hr(s) practice ; 6 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 6

Weight exam: 14

Type of exam: Oral

Content

1. Wings, high-lift devices, and control surfaces,
2. Aeroelasticity (wing divergence and aileron reversal),
3. Fuselage aerodynamics and structure,
4. Fan/Propeller/Rotor aerodynamics and structure,
4. On-board systems (ECS, APU/EPU, hydraulic system, electric system, fuel system,...),
5. Supersonic flight.

Final competences

- I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM
- II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM
- III. 2. Applying language and communication skills efficiently: Communicating orally his/her conclusions, knowledge, and the rationale underpinning these
- IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach
- VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide
- VI. 3. Acting autonomously: Practicing an attitude of lifelong learning
- VII. 1. Collaborating in a multidisciplinary environment: Collaborating beyond the borders of specific disciplines to reach a common goal

Learning objectives

At the end of the course, students are expected to evaluate a particular design in terms of:

- Wings, high-lift devices, and control surfaces,

- Aeroelasticity (wing divergence and aileron reversal),
- Fuselage aerodynamics and structure,
- Fan/Propeller/Rotor aerodynamics and structure,
- On-board systems (ECS, APU/EPU, hydraulic system, electric system, fuel system,...),
- Effects of Supersonic flight.

At the end of the course, students are expected to solve problems related to

- Wings, high-lift devices, and control surfaces,
- Aeroelasticity (wing divergence and aileron reversal),
- Fuselage aerodynamics and structure,
- On-board systems (ECS, APU/EPU, hydraulic system, electric system, fuel system,...),
- Effects of Supersonic flight.

Required knowledge

TP413

EP324

ES312

EP522

SM526

ES321

ES214

Course material

Notes (printed)

Notes (digital)

Slides (digital)

References

- Raymer, D. P. Aircraft Design: a conceptual approach. AIAA, Reston (USA), 2006.

- Wright, J., and Cooper, J. Aeroelasticity and Loads. John Wiley & Sons, Ltd, Chichester (England), 2007.

Working methods

Teaching Conversation

Class Discussion

Open Tasks

SM544 : Performance and Stability of Rotary Wing Aircraft

Titular:

COL (Air) Elmar Recker (3 ECTS)

ECTS: 3

Contact hours: 18 hr(s) theory ; 12 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 0

Daily work: amount oral evaluations: 0

Weight daily work: 0

Weight exam: 30

Type of exam: written

Content

The hovering helicopter, Factors affecting hover, The vertical flight, Momentum theory of forward flight, The blade element method in forward flight, Performance estimates, Performance characteristics, Rotor flapping characteristics, Trim and static stability, Main rotor design considerations, Airfoils for rotor blades, Anti-torque systems, Empennages and wings, Preliminary design, Other configurations, Helicopter noise, Helicopter vibration, Helicopter accidents

Final competences

I. 4. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SE

II. 4. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SE

Learning objectives

At the end of the course, students are expected to evaluate a particular design in terms of:

- Performance,
- Static Stability.

At the end of the course, students are expected to solve problems related to

- Performance,
- Static Stability.

Required knowledge

ES114

ES312

EP543

Course material

Hardware (laptop)

Notes (printed)

Notes (digital)

References

Prouty R.W., Helicopter performance, stability and control, Krieger Publishing Company Inc., 2002

Prouty R.W., Helicopter aerodynamics, Volume 1, Eagle eye solutions, 2009

Prouty R.W., Helicopter aerodynamics, Volume 2, Eagle eye solutions, 2009

Working methods

Ex Cathedra

Closed Tasks

Open Tasks

SM551 : Ship Stability and Performance

Titular:

LCL (Land) Bart Janssens (6 ECTS)

ECTS: 6

Contact hours: 22 hr(s) theory ; 36 hr(s) practice ; 8 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

1. Static Stability

- Stability of the floating body
- Stability of the intact ship
- Stability computations
- Stability curves
- Moving, loading and unloading weights
- The problem of mobile cargo
- Hull damage
- Grounding
- Docking
- The inclining experiment
- Stability regulations

2. Dynamic stability

- Modeling waves
- Ship motions
- Damping installations
- Seakeeping experiments

3. Ship resistance

- The towing tank experiment
- Numerical approximation

Final competences

I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM

II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM

Learning objectives

This course aims to teach the students about the theory of static and dynamic ship stability, so they are aware of and able to compute the influence of changes to a ship's configuration.

Furthermore, the factors influencing the resistance force are studied.

At the end of the course, students are expected to have demonstrable knowledge and insight in:

1. the static stability of
 - the intact ship
 - the intact ship after loading, unloading and moving weights
 - the damaged ship
 - the grounded ship
2. Experimental determination of the static stability characteristics
3. Stability regulations and their verification
4. Interaction with waves
5. Dynamic stability aspects
6. The resistance force

Student will be able to:

Compute the stability properties of a ship, both using the stability curves and based on the

ship shape ;

Compute changes in the stability due to modifications or damage ;

Experimentally determine and analyse the stability characteristics on a model ship ;

Obtain ship resistance using numerical simulation and / or experiments ;

Compute, analyse and evaluate the main characteristics of the dynamic stability ;

Apply the knowledge from this course to the writing and verification of specifications for

modification or procurement of ships ;

Report in written and oral form and with criticism about his findings concerning ship stability and resistance ;

Conduct elementary research and acquire knowledge independently concerning recent developments and trends.

Required knowledge

ES125

ES312

EP324

Course material

Notes (digital)
Slides (digital)
Software

References

Hervieu R, Statique du navire, 1986
Devauchelle P, Dynamique du navire, 1986
Library MECA-Marine

Working methods

Ex Cathedra
Demonstration
Closed Tasks

SM552 : Naval Ship Technology

Titular:

LCL (Land) Benoît Marinus (3 ECTS)

ECTS: 3

Contact hours: 15 hr(s) theory ; 14 hr(s) practice ; 8 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

Theory: spiral of a ship's design

- Requirements
- Functionality analysis
- Types of platforms
- Displacement
- Hullform
- Stability
- Seakeeping
- Propulsive power
- Structure - Beam girder approximation
- Armament
- Crew
- Overall plan
- Zoning
- Auxiliaries
- Regulatory Implications
- Vulnerability and signatures

Practice: realization of a preliminary design/sizing project of a group of systems of a ship.

Visit: visiting a shipyard is the embodiment of all topics in this course and allows to gain insight in the complexity of a ship.

Guided questions & answers sessions

Quick assessments (graded)

Open task consisting in a limited design exercise with data collection and analysis (graded written report ---daily work--- and oral presentation with defense ---oral exam---)

Final competences

I. 8. Understanding of extensive subject matter in the field of Engineering and Military Sciences: SM

- II. 8. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: SM
- V. 1. Working with people as an individual or in a group: Adapting to individual human behavior and group dynamics
- IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach
- VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide
- VI. 3. Acting autonomously: Practicing an attitude of lifelong learning
- VII. 1. Collaborating in a multidisciplinary environment: Collaborating beyond the borders of specific disciplines to reach a common goal

Learning objectives

At the end of the course, students are expected to

- make the preliminary design/sizing of a subsystem according to ANEP-77,
- evaluate the impact on displacement, stability, and hull girder strength,
- describe the impact on seakeeping, crew, plan, zoning, vulnerability and signatures.

Required knowledge

SM551
SM525
SM526
ES125
TP424
EP324
EP522

Course material

Notes (printed)
Notes (digital)
Slides (digital)

References

"Practical ship design", D.G. Watson, Elsevier, 1998

Working methods

Teaching Conversation
Class Discussion
Open Tasks

TN423 : Networks and Security Awareness

Titular:

MAJ (Air) Thibault Debatty (7 ECTS)

ECTS: 7

Contact hours: 48 hr(s) theory ; 16 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 23

Weight exam: 47

Type of exam: Oral

Content

- * Introduction to networking and OSI model
- * Protocols (Layer 1 -> Layer 7)
- * Introduction to routing
- * security : introduction
- * security threats
- * security controls: filters, crypto
- * detection of security incidents
- * OSINT

Final competences

I. 5. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TN

II. 5. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TN

Learning objectives

- * explain the interaction between network protocols
- * explain the role and working of network protocols
- * analyze a new protocol and compare it with seen technologies
- * explain the different security concepts and threats
- * explain which security controls can protect (or not) against threats
- * explain how we can detect security incidents

Required knowledge

Course material

Slides (digital)

Notes (digital)

References

Working methods

Ex Cathedra

Closed Tasks

Demonstration

Teaching Conversation

TN512 : Distributed Information Systems

Titular:

GHL (Civ) Wim Mees (6 ECTS)

ECTS: 6

Contact hours: 30 hr(s) theory ; 30 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

The course covers a broad overview of modern distributed information systems, from design concepts and architectures all the way down to implementation approaches.

There are the topics that will be covered:

- application layer overlay topologies
- data modeling and management
- interoperability
- middlewares
- virtualization and cloud technologies
- continuous integration and continuous delivery (CI/CD)
- DevOps
- Internet of Things (IoT)

Final competences

I. 5. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TN

II. 5. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TN

Learning objectives

At the end of the course the students will be able to understand how distributed information systems are designed and implemented, and the tradeoffs that are to be made.

Required knowledge

TN423

Course material

Slides (digital)

References

Working methods
Ex Cathedra

TN513 : Information Networks

Titular:

MAJ (Air) Thibault Debatty (6 ECTS)

ECTS: 6

Contact hours: 25 hr(s) theory ; 35 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: written

Content

This course is the follow-up of TN423. It has 2 parts. The first part focuses on advanced networking technologies:

- * link aggregation

- * STP

- * IPv6

- * VoIP

- * SDN

Students will have to apply these technologies in a real setup.

Then, the security part of the course will focus on the forensics analysis of a security incident:

- * OS principles

- * Windows internals and windows forensics

- * Linux forensics

- * Memory forensics

For this part, the students must perform the forensics analysis of a security incident, to discover the activity of a user from a set of evidences (disk dump, memory dump,...)

Final competences

I. 5. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TN

II. 5. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TN

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

Learning objectives

- * Explain the technologies seen in class

- * Be able to apply seen protocols and techniques in a real setup
- * Perform the forensics analysis of a security incident, discover user activity and make recommendations

Required knowledge

TN423

Course material

Slides (digital)

References

Working methods

Ex Cathedra

Closed Tasks

Open Tasks

Demonstration

Teaching Conversation

TN514 : Advanced Wireless Communication Systems

Titular:

MAJ (Land) Mathias Becquaert (6 ECTS)

ECTS: 6

Contact hours: 36 hr(s) theory ; 25 hr(s) practice ; 4 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 1

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

The course gives an overview of the theory and practice behind many of today's communications systems in the domain of source coding, channel coding and modulation techniques. The course introduces the architecture and technology of telecommunication systems at a block diagram level with an accent on radio transmitters/receivers and wireless communication networks.

The following topics are covered:

- Introduction to Information Theory.
- Source coding, including Vocoders.
- Forward Error Coding: linear codes, cyclic codes (BCH, RS), convolutional codes, turbo codes, LDPC codes.
- Software Defined Radio (SDR) technology.
- Noise performance and linearity of radio transmitter and receiver.
- Digital modulation schemes, including Spread spectrum techniques and Orthogonal Frequency Division Multiplexing (OFDM).
- Optimal digital receivers for band limited signals in an AWGN channel.
- Carrier and symbol synchronisation.
- Multiple-Input Multiple-Output techniques.
- Wireless cellular communication systems.

Final competences

I. 5. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TN

II. 5. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TN

III. 2. Applying language and communication skills efficiently:
Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

VI. 3. Acting autonomously: Practicing an attitude of lifelong learning

Learning objectives

After finishing the course, students must be able to:

- evaluate/write technical specifications on telecommunication equipment,
- discuss technical issue regarding source and channel coding with colleagues,
- explain the structure of modern radio transmitter and receiver and the role of each building block,
- evaluate/compare technical data sheets and noise performance of radio transmitter and receiver,
- discuss technical issue regarding wireless communication with colleagues,
- explain the structure of a Software Defined Radio,
- implement a simple waveform on a SDR platform,
- explain the structure of a cellular communication network.

Required knowledge

ES222

ES311

TN325

Course material

Notes (printed)

Slides (printed)

Software

Hardware (laptop)

References

Recommended textbooks (not mandatory for the course):

- John G. PROAKIS, Digital Communication, Mc Graw-Hill, 2008.
- Sklar B., Digital Communications, Fundamentals and Applications, Prentice Hall, 2001.

Working methods

Ex Cathedra

Demonstration

Closed Tasks

TN515 : Communication Subsystems

Titular:

MAJ (Land) Mathias Becquaert (6 ECTS)

ECTS: 6

Contact hours: 30 hr(s) theory ; 30 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

The course gives an overview of the theory and practice of the three key subsystems of today's communication systems, namely the transmission line, the antenna and the propagation channel.

For each of the subsystems the course introduces the principle of operation, defines the parameters characterizing its functioning and performances with special attention to their respective advantages and drawbacks in definite applications, in particular those related to defence and security.

The following topics are covered :

- General theory of transmission line
- Conductive transmission lines
- Dielectric transmission lines
- Radiation from elementary sources
- Transmitting antenna
- Receiving antenna
- General equation of a radiolink
- Aperture antennas
- Array antennas
- Propagation modes of a radiowave
- Large scale and small scale fading

Final competences

I. 5. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TN

II. 5. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TN

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:
Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

VI. 3. Acting autonomously: Practicing an attitude of lifelong learning

Learning objectives

Have an overview of the transmission means used in communication systems.

Be able to evaluate/write technical specifications on the transmission and radiation parts of a telecommunication system.

Be able to discuss technical issue regarding these aspects with colleagues.

Explain the functioning and the performance parameters of antennas and cables.

Evaluate technical data sheets and performances of the conductive or dielectric lines used in communication systems and networks.

Explain the structure of a point-to-point radiolink.

Evaluate the link budget of a radiocommunication.

Realize a radiolink at short distance and experiment on its different components

Explain the technical issues of a radiolink by direct wave, groundwave and skywave and the interaction between wave and environment.

Present the results of applying the theory on a series of lab measurements in a clear, structured manner in the form of a written report.

Required knowledge

ES112

ES121

ES124

ES213

TN325

Course material

Slides (printed)

Slides (digital)

Software

References

Herbert Neff, Basic Electromagnetic Fields (Harper and Row)

Constantin Balanis, Antenna Theory (Wiley)

Working methods

Ex Cathedra

Demonstration
Closed Tasks
Open Tasks

TP413 : Cabin Environment of Military Platforms

Titular:

LCL (Land) Bart Janssens (3 ECTS)

ECTS: 3

Contact hours: 15 hr(s) theory ; 18 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

1. Comfort requirements
2. Thermodynamics of moist air
3. Heat transfer
4. Cabin energy balance
5. Ventilation
6. Air quality and filtration

Final competences

I. 6. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TP

II. 6. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TP

Learning objectives

- Define and estimate properties of moist air
- Model the static and (simplified) dynamic thermal heat transfer
- Solve an energy balance in the presence of different modes of heat transfer
- Being able to calculate the necessary ventilation needs in order to obtain thermal comfort conditions
- estimate friction losses in ventilation systems
- Analyze a complete vehicle ventilation system

Required knowledge

ES312

Course material

Slides (digital)
Notes (digital)

References

ASHRAE fundamentals handbook

Working methods

Ex Cathedra
Demonstration
Closed Tasks
Open Tasks

TP424 : Ballistic Impact and Protection: Fundamentals

Titular:

LCL IMM (Land) Frederik Coghe (3 ECTS)

ECTS: 3

Contact hours: 16 hr(s) theory ; 14 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

The course TP424 addresses the field of terminal ballistics from both a practical and a theoretical point of view. This includes an overview of the different ballistic threats present on the modern battlefield, modelling approaches to evaluate the effects of these threats, next to introducing basic protective schemes based on the aforementioned models.

The level of ambition of this course is not aimed at the development of new weapon systems or ballistic protection systems but more at acquiring the skills to evaluate the feasibility of weapon systems or ballistic protection concepts from a technical point of view.

Based on "first principle" approaches this course will provide the necessary tools to validate weapon system and ballistic protection concepts. A number of modelling approaches in this field will be investigated in more detail both by desktop calculations and/or simulations using finite element software.

Final competences

I. 6. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TP

II. 6. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TP

Learning objectives

After finishing this course, the student should have obtained the necessary skills to:

- Give a reasoned vision on the technology used for weapon systems and ballistic protection for military systems;

- Choose and apply a suitable method and/or model to solve a problem in this field, after critically assessing the actual problem to solve;
- Link the contents of this course to the content of the other courses in the field of ballistics regarding threats and ballistic protection.

Required knowledge

ES114
ES125
ES211
ES214
WS225
ES321
WA411

Course material

Notes (digital)
Slides (digital)
Book (loan)

References

Rosenberg & Dekel, "Terminal Ballistics", 2012,
<https://www.springer.com/gp/book/9783642445125>.

Working methods

Ex Cathedra
Closed Tasks
Open Tasks

TP516 : Cyber Defense

Titular:

GHL (Civ) Wim Mees (6 ECTS)

ECTS: 6

Contact hours: 30 hr(s) theory ; 30 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

The course attempts to cover all aspects of how cybersecurity is to be managed in an organization, from identifying what needs to be done all the way to making sure that we stay protected.

This involves the following topics:

- modeling business processes and information flows
- threat modeling
- risk assessment and risk management
- security policies
- network architecture patterns
- using cryptography
- software development
- certification
- cyber resilience
- cyber situation awareness and operational planning
- cyber threat intelligence
- governance standards (ISO27000, NIST CSF)
- best practices
- education and training

Final competences

I. 6. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TP

II. 6. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TP

Learning objectives

The students will be able to design a cybersecurity solution that is adapted to the specific needs of an organization, taking into account

cyber threat intelligence, and ensuring the security level is maintained over time.

Required knowledge

TN423

TN512

Course material

Slides (digital)

References

Working methods

Ex Cathedra

TP521 : Ballistic Impact and Protection: Applications

Titular:

LCL IMM (Land) Frederik Coghe (3 ECTS)

ECTS: 3

Contact hours: 16 hr(s) theory ; 14 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

The course TP521 is a continuation of the concepts taught in the course TP424, applying and extending the content of the latter to applications specifically for the battlefield. The course will include state-of-the-art concepts and methods for the design and evaluation of platform and vehicle armour systems and personal armour systems (body armour). The importance of ballistic protection as part of a complete system will also be illustrated using the 'survivability onion' concept, and by illustrating trade-offs that can be made linked to ballistic protection (reactive armour, active armour, threat detection, damage mitigation). Due to the shift in threat scenario as encountered in current operations, an important part of the course will also be devoted to the effects of blast loadings on both vehicle and personal armour systems, and how these systems are designed in order to mitigate both ballistic and blast effects.

The level of ambition of this course is not aimed at the development of new ballistic protection systems but more at acquiring the skills to evaluate the feasibility of ballistic protection concepts from a technical point of view.

Based on 'first principle' approaches this course will provide the necessary tools to validate ballistic protection concepts. A number of modelling approaches in this field will be investigated in more detail both by desktop calculations and/or simulations using finite element software.

Final competences

- I. 6. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TP
- II. 6. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TP
- IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach
- III. 1. Applying language and communication skills efficiently: Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these
- III. 2. Applying language and communication skills efficiently: Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

Learning objectives

After finishing this course, the student should have obtained the necessary skills to:

- Give a reasoned vision on the technology used for ballistic protection regarding military systems;
- Choose and apply a suitable method and/or model to solve a problem in this field, after critically assessing the actual problem to solve;
- Link the contents of this course to the content of the other courses in the field of ballistics regarding threats and ballistic protection.

Required knowledge

TP424

Course material

Notes (digital)
Slides (digital)
Book (loan)

References

Rosenberg & Dekel, "Terminal Ballistics", 2012,
<https://www.springer.com/gp/book/9783642445125>

Working methods

Ex Cathedra
Closed Tasks
Open Tasks

TP523 : Effects of Explosions on Structures

Titular:

LCL (Land) David Lecompte (3 ECTS)

ECTS: 3

Contact hours: 16 hr(s) theory ; 14 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: written

Content

General classification of explosions

Shock wave characterisation for non-confined explosions

Study of shock wave propagation and reflection

Use of scaling laws for model evaluation

Blast loading of structures

Dynamic behaviour of construction materials

Resistance function for steel and reinforced concrete beams and columns

Single degree of freedom modeling

Blast load calculation of structures based on Technical Manual UFC 3-340-02

Final competences

I. 6. Understanding of extensive subject matter in the field of Engineering and Military Sciences: TP

II. 6. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: TP

IV. 1. Thinking critically and acting scientifically: Gathering information with a critical and evidence-based approach

VI. 3. Acting autonomously: Practicing an attitude of lifelong learning

Learning objectives

At the end of this course the student will be able to:

1. analyse, calculate and evaluate the loading on a simple structure due to an explosion

2. analyse, calculate and evaluate the dynamic deformation of a blast loaded structural member

- 3 consult, explain and exploit existing norms and guidelines with respect to the study of the effects of explosions in general
- 4 analyse and evaluate the vulnerability of an existing structure and propose mitigation and protection measures

Required knowledge

ES112
ES113
ES114
ES121
ES122
ES214
ES321

Course material

Slides (digital)
Notes (digital)

References

1. FEMA, Reference Manual to mitigate potential terrorist attacks against buildings, US Federal Emergency Management Agency (FEMA), 2011.
2. HINMAN, Blast safety of the building envelope, Hinman Consulting Engineers, website van de Whole Building Design Guide WBDG, National Institute of Building Sciences, USA.
3. Technical Manual UFC 3-340-02

Working methods

Ex Cathedra
Demonstration
Closed Tasks

WA411 : Design Principles and Evaluation of Armament and Ammunition

Titular:

LCL IMM (Land) Frederik Coghe (8 ECTS)

ECTS: 8

Contact hours: 46 hr(s) theory ; 30 hr(s) practice ; 8 hr(s) visit

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 26

Weight exam: 54

Type of exam: Oral

Content

The course WA411 limits itself to the classical gun systems, i.e. excluding rockets, missiles and electrical systems. It covers small, medium and large calibre gun systems, next to kinetic energy non-lethal weapons.

The level of ambition of this course is not aimed at the development of new weapon systems but more at acquiring the skills to follow-up weapon system projects and evaluate their feasibility from a technical point of view.

Based on "first principle" approaches this course will provide the necessary tools to validate weapon systems projects and/or concepts. A number of weapon system concepts will be investigated in more detail both by desktop calculations and laboratory sessions in the Laboratory of the Department ABAL.

The course will be concluded by a one-day visit to the relevant Belgian industry.

Final competences

I. 7. Understanding of extensive subject matter in the field of

Engineering and Military Sciences: WS

II. 7. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: WS

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

Learning objectives

After finishing this course, the student should have obtained the necessary skills to:

- Give a reasoned vision on the technology used for armament regarding regular gun systems ;
- Choose and apply a suitable method and/or model to solve a problem in this field, after critically assessing the actual problem to solve ;
- Link the contents of this course to the content of the other courses in the field of ballistics regarding regular gun systems.

Required knowledge

ES114
ES125
ES211
ES321
WS225
WA326

Course material

Notes (digital)
Slides (digital)

References

N/A

Working methods

Ex Cathedra
Demonstration
Closed Tasks
Open Tasks

WA421 : Guided Weapons

Titular:

COL (Land) Johan Gallant (6 ECTS)

ECTS: 6

Contact hours: 28 hr(s) theory ; 38 hr(s) practice ;

Evaluation:

Daily work: amount written evaluations: 2

Daily work: amount oral evaluations: 0

Weight daily work: 20

Weight exam: 40

Type of exam: Oral

Content

In the first part of the course (2 Hr theory, 20 Hr practical work) different practical aspects of rocket propulsion are addressed in the form of laboratory sessions: processing of extruded rocket propellant, burning rate law determination in closed vessel, life firing tests, study of sensitivity to mechanical and electrical stimuli and determination of the heat of explosion, and safety aspects related to deflagration-to-detonation transition and the insensitive munition concept.

In the second part of the course (26 Hr theory, 18 Hr practical work), the four main components of a guided weapon are discussed : guidance, control, propulsion and warhead. The emphasis is on guidance and control, where mathematical models are developed. The trajectory models (2DOF to 6DOF models), combined with the guidance models, lead to launch and intercept envelopes and the definition of avoidance techniques. The chapter on guidance methods presents technical solutions for guidance problems, based on available sensors and guidance laws. In the chapter on control methods, the technical solutions for the control problem are compared. The chapters on propulsion and warhead are limited to comments on the selection of engines and warhead as a function of the requirements.

Final competences

I. 7. Understanding of extensive subject matter in the field of Engineering and Military Sciences: WS

II. 7. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: WS

IV. 4. Thinking critically and acting scientifically: Deciding on the grounds of critical thinking and an evidence-based approach

- V. 1. Working with people as an individual or in a group: Adapting to individual human behavior and group dynamics
- VI. 2. Acting autonomously: Gathering and interpreting relevant information from the different disciplines to devise a sound judgment, solve a complex problem, and/or decide

Learning objectives

By the end of the course, students will be able to:

- evaluate the performance of a propulsion system,
- explain the working principles of guided weapons,
- compare the guidance, control and propulsion methods,
- see the connection between the different functions of tactical guided weapons,
- evaluate the performance of a guided weapon,
- create simulation models of the guidance, control and propulsion functions.

Required knowledge

WS225
WA314
ES322
WA326
SE412

Course material

Notes (printed)
Software
Hardware (laptop)
Slides (printed)
Notes (digital)
Slides (digital)

References

- P. Zarchan, Tactical and Strategic Missile Guidance, Ed. 6, AIAA, 2012
- E.L. Fleeman, Tactical Missile Design, Ed. 2, AIAA, 2006
- G.M. Siouris, Missile Guidance and Control Systems, Springer, 2004
- A. Davenas, Solid Rocket Propulsion Technology, Pergamon Press, 1993
- N. Kubota, Propellants and Explosives, Thermochemical Aspects of Combustion, Wiley-VCH, 2002.
- G.P. Sutton and O. Biblarz, Rocket Propulsion Elements, John Wiley & Sons Inc., 7th Ed., 2001
- Y.M. Timnat, Chemical Propulsion, Academic Press, 1987
- J. Carleone, Tactical Missile Warheads, Volume 155, AIAA, 1993

Working methods

Ex Cathedra

Demonstration

Open Tasks

WS533 : Fire Control

Titular:

COL (Land) Johan Gallant (3 ECTS)

ECTS: 3**Contact hours:** 11 hr(s) theory ; 22 hr(s) practice ;**Evaluation:**

Daily work: amount written evaluations: 1

Daily work: amount oral evaluations: 0

Weight daily work: 10

Weight exam: 20

Type of exam: Oral

Content

Trajectory modeling is applied in order to create practical Fire Control Systems.

After defining general principles, different aspects such as aiming techniques and weaponing are analyzed for direct and indirect fire applications.

Specific weapon systems requiring dedicated solutions are then studied.

Final competences

I. 7. Understanding of extensive subject matter in the field of Engineering and Military Sciences: WS

II. 7. Applying relevant and valid information to devise arguments, solve complex problems, formulate recommendations, and/or make decisions in the field of Engineering and Military Sciences: WS

III. 1. Applying language and communication skills efficiently:

Communicating in writing his/her conclusions, knowledge, and the rationale underpinning these

III. 2. Applying language and communication skills efficiently:

Communicating orally his/her conclusions, knowledge, and the rationale underpinning these

IV. 3. Thinking critically and acting scientifically: Formulating a judgment on the grounds of critical thinking and an evidence-based approach

Learning objectives

By the end of the course, students will be able to:

- give a reasoned vision (orally or/and in written) about the basic working principles of the aiming and laying of unguided weapons for different operational settings,

- demonstrate (orally or/and in written through software development and/or small laboratory demonstration) some of the fire control principles,
- link the contents of this course to the content of the other courses in the field of ballistics.

Required knowledge

CL116
WS225
ES313
WA326
TP424

Course material

Notes (printed)
Notes (digital)
Slides (printed)
Slides (digital)

References

Morris DRIELS, "Weaponneering. Conventional Weapon System Effectiveness", AIAA, 2004

Working methods

Ex Cathedra
Demonstration
Teaching Conversation
Closed Tasks