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 Turboshaft 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

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 relevane 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:
GHL (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:
GHL (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

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, Syntetic Aperture Radar,
Space-Time Adaptive Processing).
Image post-processing, princples 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 experimantal 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 Hanbook 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: Coventions, 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

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

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 evaluatethe 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

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 weaponeering 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, "Weaponeering. Conventional Weapon System Effectiveness", AIAA, 2004

Working methods

Ex Cathedra
Demonstration
Teaching Conversation
Closed Tasks