

Year 2024-25



Istituto Europeo di Design

Private Licensed Centre

TEACHING GUIDE FOR
**Scientific Fundamentals
of Design**

Foundation Course – IED Madrid Diploma Programme

Total Design

Updated on: 1st September 2024

Foundation Course – IED Madrid Diploma Programme.

Subject: Scientific Fundamentals of Design.

1. SUBJECT/COURSE IDENTIFIERS

Type	Basic learning
Nature	Theoretical-practical course
Specialty/Itinerary/style/tool	Total Design
Subject/Field	Science applied to design
Teaching/course period	1st Semester
Number of credits	4 ECTS
Department	Didactic/Educational department
Priority/ prerequisites	Without priority
Language/s in which the course is taught	English

2. TEACHER IN CHARGE OF THE SUBJECT

Surname & Name	E-Mail
Camacho Castro, Nuria	

3. LIST OF LECTURERS AND GROUPS THEY TEACH

Surname & Name	E-Mail	Groups

4. COMPETENCIES/SKILLS

Cross-sectoral skills
CT2 Collecting meaningful information, analysing, synthesising and managing it accordingly.
CT3 Problem solving and decision making to meet the goals of the work/project being performed.
CT8 Developing reasoned and critical ideas and arguments.
CT13 Pursuit of excellence and quality in their professional activity.
CT14 Mastering research methodology in the generation/creation of projects, ideas and viable solutions.

General skills

CG4 Having a scientific vision of the perception and behaviours of form, matter, space, movement, and colour.

CG5 Acting as mediators between technology and art, ideas and purposes, culture and commerce.

CG10 Adapting to changes and to the industrial technological evolution.

CG15 Knowing the processes and materials, knowing how to coordinate one's own intervention with other professionals, according to sequences and degrees of compatibility.

CG18 Optimizing the use of the resources needed to achieve the planned objectives.

CG19 Showing critical capacity and knowing how to propose research strategies.

5. LEARNING ACHIEVEMENTS

- Knowing how to modify and calculate the mathematical parameters necessary for the development of a design proposal.
- Knowing how to correctly apply the concept of scale in the development of prototypes and graphic documents necessary to produce the design.
- Knowing how to manage the different types of harmonic relationships that are established between the various parts of a design and its whole.
- Learning the ability to know the nature of the materials used in product design, and the properties required of them.
- Understanding and interpreting the technical information offered by the manufacturers of materials, and learning to apply said information correctly when selecting the most suitable ones for each individual design proposal.
- Understanding the difference between mechanical energy and that of the electromagnetic spectrum. And, recognising the parameters that define the different waves that are integrated in the latter, especially those corresponding to visible light.
- Knowing how to identify and solve the basic fundamentals of matter, energy and wave.

6. CONTENTS

Section (if applicable)	Topic/repertoire
I. INTRODUCTION	Topic 1. Science in Design
II. MATHEMATICS OF SHAPE/FORM	Topic 2. Reason/Purpose & similarity 2.1 Similarity relationships. 2.2 Scales.

	<p>Topic 3. Theory of proportion</p> <p>3.1 Human measures and proportions.</p> <p>3.2 Classical proportions, dynamic proportions, the divine proportion.</p> <p>3.3 The Japanese Ken.</p>
	<p>Topic 4. Form/Shape generation</p> <p>4.1 Symmetry.</p> <p>4.2 Movement on the plane.</p> <p>4.3 Polygons and polyhedral. Curves and surfaces.</p> <p>4.4 Fractals.</p>
<p>III. MATERIALS. PHYSICS AND CHEMISTRY APPLIED TO DESIGN</p>	<p>Topic 5. Structure of matter</p> <p>5.1 Matter, mass, and energy.</p> <p>5.2 Atoms and molecules.</p> <p>5.3 Links /Bonds.</p>
	<p>Topic 6. Properties required of materials</p> <p>v6.1 Mechanical, physical, chemical, and technological.</p>
	<p>Topic 7. Selection of materials in design</p> <p>7.1 Tests.</p> <p>7.2 Criteria.</p>
<p>IV. ENERGY</p>	<p>Topic 8. Energy Transmission</p> <p>8.1 Parameters of waves.</p> <p>8.2 Mechanical waves: sound.</p> <p>8.3 Electromagnetic waves.</p>
	<p>Topic 9. The Visible Spectrum</p> <p>9.1 Energy range.</p> <p>9.2 Colour.</p> <p>9.3 Mixes.</p>
	<p>Topic 10. Natural and artificial light</p> <p>10.1 Types of spectra.</p> <p>10.2 Light sources.</p> <p>10.3 Effects on bodies. Shadows.</p> <p>10.4 Transmission of light. Properties.</p>

7. STUDENTS WORK TIME PLAN/SCHEDULE

Type of Activity	Total hours
Type of Activity	35,5 hours
Theoretical activities	32 hours
Practical activities	4,5 hours
Other mandatory training activities (conferences, seminars, etc.)	24 hours
Tests	24 hours
Student's total working hours	120 hours

8. METHODOLOGY

Theoretical-practical activities	<p>Lectures where the teacher will introduce the theoretical concepts and their analysis, supported by documentaries, audiovisuals and other necessary ICTs. During the lecture, the student will be able to ask questions to solve any doubts that may arise.</p> <p>Each session will include activities that encourage students' personal reflection on their work, as well as reaching conclusions regarding what has been learnt. And all along, favouring functional learning which will enable students to put the knowledge into practice.</p>
Other mandatory training activities (conferences, seminars, etc.)	<p>Students will have the fashion workshop, digital tools, modelling, Fab Lab and other laboratories, as supporting tools for the completion of projects and exercises, with the support of specialized teachers.</p> <p>Likewise, students will receive support sessions for practical classes in which - through a participation method based on self-evaluation and debate - students can solve doubts and make progress with their project and exercises with the help of a guidance tutor.</p>

9. EVALUATION AND GRADING CRITERIA AND INSTRUMENTS

Work to be assessed:

1. Students will be able to modify and calculate the mathematical parameters required for the development of a design proposal.
2. Knowing how to correctly apply the concept of scale in the development of prototypes and graphic documents required for the design.
3. Knowing how to manage the different types of harmonic relationships that are established between the different parts of a design and its whole.
4. Developing the ability to know/see the nature of the materials used in product design, and the properties required of them.

5. Knowing how to interpret the technical information offered by the manufacturers of materials, and how to correctly apply said information when selecting the most suitable materials for each design proposal.
6. Understanding the difference between mechanical energy and electromagnetic spectrum energy. Also, knowing the parameters that define the different waves that are integrated in the electromagnetic spectrum, especially those corresponding to visible light.
7. Knowing how to identify and solve the fundamentals of matter, energy and wave

The evaluation assessment must be designed and planned in a manner that integrates it within the teaching/learning training activities.

The assessment of students learning ought to be continuous, personalized and integrative:

- Continuous: in that it is integrated into the teaching-learning process and consequently is not limited by dates or specific situations.
- Personalised: since it must take into account the capacities, skills and the student's attitude. Special attention will be paid to the student's participation in work groups.
- Integrative: in that it requires taking into account the general capacities established for each stage, this will be done through the objectives in the different units and areas. .

Students' learning will be assessed in relation to the achievement of the educational objectives that are specified in the course syllabus, and associated to the general and specific objectives, taking as an immediate reference the evaluation criteria established for each learning area.

To assess students learning process we need to:

- Evaluate their curricular competence (abilities and aptitudes).
- Assess the factors that hinder or facilitate good learning.
- Encourage self-evaluation and co-evaluation of students amongst themselves, as a source of critical analysis of their results, to allow for changes in attitude and for their improvement.
- Value the learning context in which the student develops.

9.1. EVALUATION/ASSESSMENT TOOLS

Theoretical-practical activities	<p>Paying active attention and understanding teachers' explanations.</p> <p>Having the initiative to participate with their own opinions and constructive criticism.</p> <p>Punctuality and quality in the research process during the follow-up of exercises in tutorials.</p>
Practical activities	<p>Projects and tasks based fundamentally on the perception and experimentation of the concepts explained in the classroom will be assessed.</p> <p>Students will be encouraged to develop a specific project where they will develop exercises associated to the subject.</p>
Other mandatory training activities (conferences, seminars, etc.)	<p>Active attendance to workshops, seminars, exhibitions, conferences or webinars sharing thoughts, reflections and knowledge in the classroom with the group.</p>

9.2. EVALUATION CRITERIA

<p>Theoretical-practical activities</p>	<p>Punctuality and quality throughout the research process, in the follow-up of the exercises during tutorials. Active attention and understanding during explanations. Showing initiative to contribute with your own opinions and constructive criticism. The weekly assessment of the practical cases will deal with:</p> <ul style="list-style-type: none"> • Correct practical use of the tools shown in the classroom. • Careful performance • Cared-for ideas/conceptualisation • Contributions • Punctuality: handing-in projects on time. <p>When handing-in projects, the following parameters will be assessed:</p> <ul style="list-style-type: none"> • Punctuality: handing-in projects on time. • Practical use of the knowledge acquired in the classroom. • Visual presentation • Oral presentation • Communication tools put into use. • Contributions. <p>Teachers will value punctuality, the research process, and contributions made during the follow-up of the exercises in tutorials.</p>
<p>Other mandatory training activities (conferences, seminars, etc.)</p>	<p>Teachers shall value how students apply the knowledge acquired in workshops, seminars, exhibitions, conferences or webinars, to the tasks and projects in the course.</p>

9.3. GRADING CRITERIA

1. The evaluation system to be used in the subject/course is adapted to the continuous evaluation model.
2. In the continuous evaluation system, class attendance is compulsory, and students must comply with a percentage of activity in the presence of the teacher, which is estimated to be 80%.
3. If the student does not meet the criteria for continuous evaluation, they will be graded in a evaluation process with a loss of continuous evaluation - they will present the projects requested during the course and a specific test for this call, and, their corresponding relative weights are shown in section 9.3.1 and 9.3.2 of this guide.
4. In any case, the student will take an extraordinary exam, the structure, evaluation instrument and grading criteria for said exam is explained in section 9.3.3 of this guide.
5. In order to pass the subject/course, the student must meet the requirements of the weighting of the evaluation instruments defined in points 9.3.1, 9.3.2 and 9.3.3.3.

9.3.1. Assessment tools for the weighting of grades in the continuous assessment process

Tools	Weighting of grades
Weekly practical-work presentation	30%
Project development and follow-up	60%
Critical and well-argued participation in debates, tutorials and workshops	10%
Total	100%

9.3.2. Assessment tools for the weighting of grades in the evaluation process following a loss of continuous assessment/evaluation

Tools	Weighting of grades
Presentation of the exercises and final project.	60%
Presentation of the specific test for the evaluation in case of a loss of continuous evaluation.	40%
Total	100%

9.3.3. Assessment tools for the weighting of grades in the extraordinary evaluation process

Tools	Weighting of grades
Presentation of practical exercises and Final Project	60%
Presentation of the specific test for the extraordinary evaluation	40%
Total	100%

9.3.4. Weighting of grades in the evaluation process for students with a disability

When the evaluation tools are adapted for this purpose, all the different types of disability must be taken into account

Tools	Weighting of grades
These shall be determined taking different types of disability into consideration	
Total	100%

10. TIME PLAN FOR THE CONTENTS, TEACHING METHODOLOGY AND EVALUATIONS

Session	CONTENTS, CONNECTED TEACHING METHODOLOGY, AND EVALUATION TOOLS		Total hours presence-based	Total hours not presence-based
Session 1	TOPIC 1: The Science in Design			
	Theoretical-practical activities	Clase magistral, que desarrollará el temario concreto de la sección (<i>Conceptos básicos</i>). El docente exhibirá documentos e imágenes, y los analizará usando las TICs necesarias.	2,5 hours	
	Evaluation	Proactive attitude in the classroom.		
Session 2	TOPIC 2: Reason/Purpose and similarity			
	Theoretical-practical activities	Master class, which will develop the specific topic of the section (similarity and scale ratios). The teacher will display documents and images and will analyse them using the required ICTs.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises. Start the project in the Thematic Block II.		2 hours
	Other learning activities	Attendance to the workshop.	2 hours	
	Evaluation	Proactive attitude in the classroom.		
Session 3	TOPIC 3: Theory of proportion			
	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Human measurements and proportions, classical proportions, etc.). The teacher will display documents and images and will analyse them using the required ICTs.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises. Start the project in the Thematic Block II.		2 hours
	Other learning activities	Attendance to the workshop.	2 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the workshop. Corrections to the case-study. Follow-up of the project in the Thematic Block II.		

TOPIC 4: Form/shape generation				
Session 4	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Symmetries, movements on the plane, geometric shapes, fractals, etc.). The teacher will display documents and images and will analyse them using the required ICTs.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises.		4 hours
	Other learning activities	Attendance to the workshop.	2 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the workshop. Corrections to the case-study. Follow-up of the project in the Thematic Block II.		

Project Block II				
Session 5	Theoretical-practical activities	Explanation of the project markings/amendments.	1,5 hours	
	Practical activities	Presentation of the Block II project "Mathematics of Form".	1 hour	
	Other learning activities	Attendance to the workshop.	4 hours	
	Evaluation	Presentation of Project I.		

TOPIC 5: Structure of matter				
Session 6	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Matter, mass). The teacher will display documents and images and will analyse them using the required ICTs.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises. Starting the project within thematic block III.		2 hours
	Other learning activities	Attendance to the workshop.	2 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the workshop. Corrections to the case-study.		

TOPIC 6: Properties required of the materials				
Session 7	Theoretical-practical activities	Master class, which will develop the specific topic of the section (mechanical, physical, chemical and technological properties.). The teacher will display documents and images and will analyse them using the required ICTs. Compulsory tutorial.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises. Developing the project within block III.		2 hours
	Other learning activities	Previously arranged visit to an exhibition or seminar.	4 hours	
	Evaluation	Proactive attitude in the classroom. Corrections to the case-study. Follow-up of the project in Block III.		

TOPIC 7: Selecting design materials				
Session 8 y 9	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Trials and criteria.). The teacher will display documents and images and will analyse them using the required ICTs. Compulsory tutorial.	5 hours	
	Practical activities	Producing a case-study. Students will put into practice what they have learnt through a series of set exercises. Developing the project within block III.		4 hours
	Other learning activities	Attendance to the workshop.	4 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the exhibition or seminar. Corrections to the case-study. Follow-up of the project in Block III.		

Project Block III				
Session 10	Theoretical-practical activities	Feedback explanations of the project marking.	1,5 hours	
	Practical activities	Presentation of the project within thematic block III.	1 hour	
	Other learning activities	Attendance to the workshop.	4 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences. Presentation of the project in Block III. "Materials".		

TOPIC 8: Energy transmission				
Session 11 y 12	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Waves: sound, light). The teacher will display documents and images and will analyse them using the required ICTs.	5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises.		2 hours
	Other learning activities	Attendance to the workshop.	4 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the workshop. Corrections to the case-study.		

TOPIC 9: The visible spectrum				
Session 13	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Energy, colour, blends/mixes). The teacher will display documents and images and will analyse them using the required ICTs.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises.		2 hours
	Other learning activities	Attendance to the workshop.	2 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the workshop. Corrections to the case-study. Follow-up of the project in Block IV.		

TOPIC 10: Natural and artificial light				
Session 14	Theoretical-practical activities	Master class, which will develop the specific topic of the section (Types of spectrum, shadows, transmissions, etc.). The teacher will display documents and images and will analyse them using the required ICTs.	2,5 hours	
	Practical activities	Students will put into practice what they have learnt through a series of set exercises.		4 hours
	Other learning activities	Attendance to the workshop.	2 hours	
	Evaluation	Proactive attitude in the classroom, sharing knowledge, experiences, and tools provided through attendance to the workshop. Corrections to the case-study. Follow-up of the project in Block IV.		

Session 15	Evaluation: Ordinary Call			
	Practical activities	Continuous Evaluation: Project & result evaluation Evaluation following a loss of continuous evaluation/assessment: the evaluation will be based on projects and results, as well as the specific test.	2,5 hours	
	Evaluation			

Session 16	Comments on the Final Results			
	Evaluation	Evaluation, comments & information on the Project and exercise results.	2,5 hours	

11. TEACHING RESOURCES AND MATERIALS

11.1. General Bibliography

Title	Fundamentos del diseño - (English edition title: "Principles of Design")
Author	Wong, Wucius
Publisher	Editorial Gustavo Gili S.A., Barcelona

Title	Biomímesis (English edition title: "Biomimicry")
Author	Janine M., Benyus
Publisher	Tusquets, 2012

Title	Engineered Biomimicry (original edition)
Author	Lakhtakia, Akhlesh (ed) ; Martín-Palma, Raúl J. (ed)
Publisher	Elsevier, 2013

Title	Biomimicry resource handbook (original edition)
Author	Baumeister, Dayna; Tocke, Rose; Dwyer, Jamie ; Ritter, Sherry; Benyus, Janine M.
Publisher	Biomimicry, 2013

Title	Historia de la ciencia (original edition)
Author	Sánchez Ron et al.
Publisher	Editorial Austral. Colección ciencia y humanidades

Title	Fundamentos geométricos del diseño en ingeniería (original edition)
Author	Alberca, M. Prieto
Publisher	Aula documental de investigación

Title	La rebelión de las formas. O cómo perseverar cuando la incertidumbre aprieta (original edition)
Author	Wagensberg , J.
Publisher	Tusquets ediciones, 2007, 3º edición.

Title	¿Cómo nacen los objetos? Apuntes para una metodología proyectual. - (English edition title: " How are objects born? ")
Author	Munari, Bruno
Publisher	Editorial Gustavo Gili S.A., Barcelona

Title	Arte y percepción visual - (English edition title: " Art and visual perception: A psychology of the creative eye ")
Author	Arnheim, Rudolf ; Balseiro, María Luisa
Publisher	Alianza, 1979

11.2. Additional Bibliography

Title	Una breve historia de casi todo - (English edition title: " A short history of nearly everything ")
Author	Bryson, Bill
Publisher	RBA Editores

Title	La nueva mente del Emperador - (English edition title: " The Emperor's new mind ")
Author	Penrose, Roger
Publisher	Grijalbo Mondadori, 1996

Title	Seven Experiments that could Change the World
Author	Sheldrake, Rupert
Publisher	Park Street press

Title	Notebooks I y II
Author	Leonardo
Publisher	Dover

Title	La nueva vision - (English edition title: " The New Vision: Fundamentals of Design: Painting Sculpture Architecture ", 1938.)
Author	Moholy-Nagy
Publisher	Infinito

Title	Punto y línea sobre el plano - (English edition title: " Kandinsky: Point and Line to Plane: Bauhausbucher ")
Author	Kandinsky
Publisher	Labor

Title	Sobre el crecimiento y la forma (English edition title: " On Growth and Form: The Complete Revised Edition ", 1992.
Author	Thompson, D'Arcy
Publisher	Cambridge University Press

Title	Paul Klee notebooks vol. 1 (" The thinking eye ") & vol. 2 (" The nature of nature ")
Author	Klee, Paul. Spiller, Jürg (editor)
Publisher	Lund Humphries

11.3. Websites of interest

<http://www.materialconnexion.com>

<http://www.materio.com>

<https://www.inventables.com/>