Last update: 25-01-2018

295904 - FGED - Green Functions and Linear Differential Equations: Diffusive Problems, Static Inverters

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering

Teaching unit: 749 - MAT - Department of Mathematics

Academic year: 2017

Degree: BACHELOR'S DEGREE IN MATERIALS ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL ELECTRONICS AND AUTOMATIC CONTROL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN ELECTRICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN MECHANICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)

ECTS credits: 6 Teaching languages: Catalan, Spanish

Teaching staff

Coordinator: Encinas Bachiller, Andres Marcos

Others: Carmona Mejias, Angeles
Jiménez Jiménez, M. José

Opening hours

Timetable: Each teacher will determine the timetable when the course start.

Prior skills

It is advisable to have passed the subject of Càlcul Numèric i Equacions Diferencials

Degree competences to which the subject contributes

Specific:

CEB-01. Solve mathematical problems that may arise in engineering. Apply knowledge of linear algebra; geometry; differential geometry; differential and integral calculus; differential equations and partial differential equations; numerical methods; numerical algorithms; statistics and optimisation.

Generical:

CG-03. (ENG) Conocimiento en materias básicas y tecnológicas, que les capacite para el aprendizaje de nuevos métodos y teorías y les dote de versatilidad para adaptarse a nuevas situaciones.

CG-04. (ENG) Capacidad de resolver problemas con iniciativa, toma de decisiones, creatividad, razonamiento crítico y de comunicar y transmitir conocimientos, habilidades y destrezas en el campo de la Ingeniería Industrial.

Transversal:

01 EIN N3. ENTREPRENEURSHIP AND INNOVATION - Level 3. Using knowledge and strategic skills to set up and manage projects. Applying systemic solutions to complex problems. Devising and managing innovation in organizations.

07 AAT N3. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.

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Teaching methodology

-2 hour lectures (approximately): the teacher will describe basic concepts and materials, will give examples and will propose exercises.
- 1 hour (approximately) of the weekly class time will be devoted to solving problems proposed both in class and in the course ' s ancillary material. Students are required to actively participate in these classes.
- 1 hour, students will be carrying out complementary activities at computer classroom

Learning objectives of the subject

The objective of this course is to present the concept of solving a linear differential equation of one or several variables under concentrated actions, and how to use this type of solutions to obtain the response to distributed actions. Also, we will focus on the problem of obtaining the coefficients of the equations involved from the knowledge of the corresponding Green function. We will study actual problems of interest in all the degrees taught in the EEBE, which include static problems, diffusive and undulatory problems.

Study load

Total learning time: 150h	Theory classes:	45h	30.00%
	Practical classes:	0h	0.00%
	Laboratory classes:	15h	10.00%
	Guided activities:	90h	60.00%

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Content

Green function for initial value problems in one dimension

Learning time: 25h

Theory classes: 5h
Practical classes: 2h 30m
Laboratory classes: 2h 30m
Self study : 15h

Description:
Obtaining the Green function. Concentrated actions Dirac Delta. Distributed actions. Lagrange formula. Construction of the Green function for first, second and fourth order equations. Recovery of the physical system coefficients from the Green function.

Specific objectives:
Construction of Green's function in compartmental problems. Construction of the response function in RC, RL, RLC circuits and in oscillators.

title english

Learning time: 50h

Theory classes: 10h
Practical classes: 5h
Laboratory classes: 5h
Self study : 30h

Description:
Boundary value problems of second and fourth order. Obtaining the Green function. Reciprocity principle of Betti - Maxwell. Recovery of the physical system coefficients from the Green function. Eigenvalues of self-adjoint boundary problem ¿¿and Mercer's Theorem.

Specific objectives:
Construction of Green's function in problems of transverse bending of ropes and beams, and longitudinal bars. Calculation of vibration frequencies and associated harmonics.

Vectorial Calculus and Green's formulae

Learning time: 25h

Theory classes: 5h
Practical classes: 2h 30m
Laboratory classes: 2h 30m
Self study : 15h

Description:
Divergence theorem and integration by parts. Classification of second order linear EDPs. Maximum principle. Boundary value problems and uniqueness of solutions.

Specific objectives:
To identify the problems related to static, diffusive and wave phenomena. Physical interpretation of different boundary conditions.

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Green's functions for problems in several variables	Learning time: 50h Theory classes: 10h Practical classes: 5h Laboratory classes: 5h Self study : 30h

Description:
Problems in rectangular domains. Method of separation of variables. Concentrated actions in the domain and the boundary. Green's function and resolvent kernels.

Specific objectives:
Construction of the Green function in heat diffusion problems of bars. Construction of the Green function in problems of transverse vibrations of ropes and beams, and longitudinal bars. Calculation of vibration frequencies and associated harmonics. Calculation of the function of Green in rectangles.

Qualification system

The Grade is calculated through continuous assessment through the presentation of work, exercises and laboratory practices.
Problems: 25%
Jobs: 50%
Laboratory: 25%

Bibliography

Basic:

D. G. Duffy. Green ' s Functions with Applications. Chapman & Hall/CRC, 2001.

R. Haberman. Ecuaciones en Derivadas Parciales, con series de Fourier y Problemas de Contorno. Prentice Hall, 2003.

Marcellán, F., Casasus, L., Zarzo, A.. Ecuaciones diferenciales problemas lineales y aplicaciones. McGraw-Hill, 1991.

P. K. Kythe. Green ' s Functions and Linear Differential Equations: Theory, Applications and Computation. Chapman & Hall/CRC, 2011.

I. Peral. Primer curso de ecuaciones en derivadas parciales. Addison-Wesley, 1995.