

SUBJECT TEACHING GUIDE

G616 - BROAD MATHEMATICS

Degree in Mining Resources Engineering
First Degree in Mining Resources Engineering

Academic year 2024-2025

| 1. IDENTIFYING DATA | | | | | |
|----------------------------------|--|------------------|--------------------|------------------|--|
| Degree | Degree in Mining Resources Engineering First Degree in Mining Resources Engineering | | | Type and Year | Compulsory. Year 2 Compulsory. Year 2 |
| Faculty | School of Mines and Energy Engineering | | | | |
| Discipline | Subject Area: Advanced Basic Training Module: Training in Common with the Mining Branch | | | | |
| Course unit title and code | G616 - BROAD MATHEMATICS | | | | |
| Number of ECTS credits allocated | 6 | Term | Semester based (2) | | |
| Web | | | | | |
| Language of instruction | Spanish | English Friendly | Yes | Mode of delivery | Face-to-face |

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|------------------|--|--|--|--|--|
| Department | DPTO. MATEMATICA APLICADA Y CIENCIAS DE LA COMPUTACION | | | | |
| Name of lecturer | DIEGO RUIZ ANTOLIN | | | | |
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| Office | E.T.S. de Ingenieros Industriales y de Telecomunicación. Planta: - 5. DESPACHO (S5016) | | | | |
| Other lecturers | PAULA CAMUS BRAÑA | | | | |

3.1 LEARNING OUTCOMES

- Critically analyse the characteristics of a population from a sample. Apply the fundamental properties of the punctual estimators and confidence intervals.
- Manage the concept of multiple integral of Riemann and its application to problems of Physics and Engineering. Use symbolic calculus software to solve problems of calculation of volumes, areas, centers of gravity.
- Apply the Fourier analysis and express a function by a series of trigonometric functions.
- Classify and solve some types of first-order differential equations.
- Solve differential equations of second order, linear and constant coefficients, homogeneous and not homogeneous. Use of the Laplace transform.
- Know some second order partial differential equations.
- Use of specific software for the resolution of different problems.
- To analyse the importance of quality control and the quality control programmes
- To use symbolic calculus software to solve calculus problems about volume, area and gravity center

4. OBJECTIVES

- Familiarize the students in the required statistical tools to apply inference studies from a sample.
- Introduce students to statistical quality control and its applications.
- Know how to sketch curves, surfaces and volumes, in three-dimensional space, defined by implicit or parametric equations, in rectangular, polar or cylindrical coordinates.
- Know how to express a curve as a vector function of a variable and calculate its length from its differential.
- Learn to calculate curvilinear integrals, double and triple integrals of curves, surfaces and volumes, respectively, in order to obtain geometric or physical characterizations. Example: calculation of work of a force, mass of a rod, areas, volumes, geometric center and center of mass.
- Know the theory and applications of Fourier Analysis.
- Learn to solve simple differential equations of first and second order by analytical and numerical methods.
- Know the modeling through differential equations of different processes in physics, engineering, economics, biology. Solve these equations and represent and analyze the solution.
- Know some equation in partial derivatives of second order.
- Deepening into the use of specific software as a basic tool for calculus and statistical analysis.

| 6. SUBJECT PROGRAM | |
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| CONTENTS | |
| 1 | <p>BLOCK 1. CONFIDENCE INTERVALS AND QUALITY CONTROL.</p> <p>TOPIC 1. INFERENCE AND HYPOTHESIS TESTING: Point estimation. Confidence intervals for proportions, means, and variances. Introduction to hypothesis testing.</p> <p>TOPIC 2: LINEAR REGRESSION;</p> <p>TOPIC 3. QUALITY CONTROL: Introduction. Control charts for measurements and attributes.</p> |
| 2 | <p>BLOCK 2. INTEGRAL CALCULUS</p> <p>TOPIC 3. CURVES AND SURFACES: Curves in the plane. Surfaces. Some important surfaces. Normal vector and tangent plane to a surface. Parametric equations of a curve on a surface.</p> <p>TOPIC 4. DOUBLE AND TRIPLE INTEGRALS: Concept of double integral. Class of integrable functions and properties. Mean Value Theorem. Calculation of double integrals. Change of variables in double integrals. Calculation of volumes. Triple integrals. Calculation of triple integrals. Change of variables in triple integrals. Applications to problems in Engineering Physics.</p> <p>TOPIC 5. VECTOR FIELD THEORY: Scalar and vector fields. Differential operators. Divergence and curl of a vector field. Line integrals. Circulation of a vector. Work done by a force. Path-independent integrals. Calculation of potential function. Surface area. Surface integrals. Flux of a field through a surface. Integral theorems. Applications.</p> |
| 3 | <p>BLOCK III. FOURIER ANALYSIS</p> <p>TOPIC 6. FOURIER SERIES AND TRANSFORMS: Systems of orthogonal functions. Approximation of a function by the sum of terms from an orthogonal system. Trigonometric or Fourier series. General procedure for expanding a function into a Fourier series. Fourier transforms. Definition and properties. Application of the above to problems in Physics and Engineering.</p> |
| 4 | <p>BLOCK IV. DIFFERENTIAL EQUATIONS</p> <p>TOPIC 7. FIRST-ORDER DIFFERENTIAL EQUATIONS: Introduction. General solution. Particular solution. Analytical methods (separation of variables, exact equations, linear equations). Integrating factor. Applications to problems in Physics and Engineering. Numerical solution of initial value problems. Euler's method. Runge-Kutta method.</p> <p>TOPIC 8. ORDINARY DIFFERENTIAL EQUATIONS</p> <p>SECOND-ORDER LINEAR EQUATIONS: Initial value problems for second-order ODEs. General solution of the homogeneous equation with constant coefficients, non-homogeneous equations with constant coefficients. Solution methods. Variation of parameters. Method of undetermined coefficients. Numerical solution of initial value problems (generalization of Euler's method), numerical solution of boundary value problems (finite difference method). Systems of linear first-order differential equations.</p> <p>TOPIC 9: INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS: Introduction to partial differential equations.</p> |

7. ASSESSMENT METHODS AND CRITERIA

| Description | Type | Final Eval. | Reassessn | % |
|---|-----------------------|-------------|-----------|---------------|
| Computer Lab sessions | Laboratory evaluation | No | No | 16,00 |
| Continuous evaluation tests | Written exam | No | Yes | 24,00 |
| Written exam 1 | Written exam | Yes | Yes | 30,00 |
| Written exam 2 | Written exam | Yes | Yes | 30,00 |
| TOTAL | | | | 100,00 |
| Observations | | | | |
| In the case of not exceeding the minimum grades, the global numerical grade will be the lowest value between 4.9 and the weighted average of all the evaluation items, as indicated in the Regulation of the UC Evaluation Processes, article 35. Only for duly justified causes (e.g. health restrictions) the evaluation tests may be organized remotely, with prior authorization from the Faculty's Board. | | | | |
| Observations for part-time students | | | | |
| Those students enrolled part-time who request it at the beginning of the term, will have the option of doing the laboratory practices individually, in a flexible schedule that adapts to their needs. In addition, the part of the grade corresponding to the continuous evaluation tests will be included in the grade of the exam of the regular exam, thus taking into account the impossibility of regular attendance throughout the term. | | | | |

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Luceño, A.; González, F.J. 2004. "Métodos estadísticos para medir, describir y controlar la variabilidad". Santander : Servicio de Publicaciones de la Universidad de Cantabria. ISBN: 84-8102-375-2.
<http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=127136>

Marsden, J.E.; Tromba, A.J. 1998. "Cálculo Vectorial". Wilmington, Delaware: Addison-Wesley Iberoamericana. ISBN: 0-201-04604-0
<http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=27894>

Larson, R.; Hostetler, R.P.; Edwards, B.H. 2006. "Cálculo". México: McGraw-Hill. ISBN: 970-10-5274-9
<http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=235642>

Simmons, G.F.; Robertson, J.S. 1993. "Ecuaciones diferenciales: con aplicaciones y notas históricas". McGraw-Hill. ISBN: 84-481-0045-X
<http://catalogo.unican.es/cgi-bin/abnetopac/?TITN=81598>

O'Neil PV. 1994. "Matemáticas avanzadas para la Ingeniería". 3ª Edición. Cecsca