Università degli Studi della Basilicata
Scuola di Ingegneria

COURSE: MATHEMATICAL ANALYSIS (CALCULUS I)

TEACHER: ELISABETTA BARLETTA

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Language ITALIAN

| ECTS: 12 | n. of hours: 120 | Academic year: 2015/2016 | Campus: POTENZA | Semester: I & II |
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TOPICS
Sequences of real numbers and series. Functions of one real variable and their limits. Infinities and infinitesimals. Continuous functions. Uniform continuity. Differentiability of a function. Rolle's, Langrange's and Cauchy's theorems. de L'Hôspital's theorems. Taylor's formula and representations of its reminder. Mac Laurin's formula. Mac Laurin's expansion of elementary functions. Indefinite integration. Riemann integral. Improper integrals. Relation between improper integrals and numeric series. First order differential equations. Higher order differential equations with constant coefficients.. Complex numbers.

TEACHING METHODS (please tick one or more options)
X Theoretical lessons
X Tutorials in classroom
□ Tutorials in laboratory
□ Project works
□ Technical visits
Other activities (please specify) _____

TEXTBOOKS
E. Giusti, Analisi Matematica I, Bollati Boringhieri, 2002.

E. Giusti, Esercizi e Complementi di Analisi Matematica, vol. I, Bollati Boringhieri, 1991.

S. Salsa, A. Squellati, Esercizi di Matematica, vol. I, Zanichelli, 2001.

R.A. Adams, Calcolo differenziale 1, Casa Editrice Ambrosiana, 2007.

ON-LINE EDUCATIONAL MATERIAL
web address:

LEARNING OUTCOMES
Developing a good knowledge of the basic mathematical language together with abilities of differentiable and integral calculus in one real variable. The aim is to provide a tool for comprehending successive lessons in mathematics, physics and engineering.

REQUIREMENTS
Elementary algebra, analytic geometry in the plane and trigonometry.

EVALUATION METHODS (please tick one or more options)
□ Intermediate verifications
X Written examination
□ Discussion of a project work
□ Practical test
X Oral examination
Other methods (please specify) _____

DETAILED CONTENT

**1 - Sequences and series of real numbers:** The field of real numbers with the Euclidean topology. Convergent sequences. Divergent sequences. Monotone sequences. Cauchy sequences. Operations with limits of sequences. Sequences and topology of **R** . Numerical series with nonnegative terms. Convergence criteria for numerical series. Absolutely convergent series.

**2 - Functions in one real variable:** The domain, the range and the graph of a function. Composition of functions; inverse of a function. Extremes of a function. Monotone functions. Limits of a function. Relation between the sign of the limit and the sign of the function. Operations with limits of functions. Some remarkable limits. One-sided limits. Limits of monotone functions. Infinities and infinitesimals.

**3 - Continuous functions:** Definition of a continuous function. Discontinuity points. Theorem on the permanece of the sign of a continuous function. Continuous functions on sets. The statement of intermediate value theorem. Weierstrass theorem. Uniform continuity. Cantor's theorem. Continuous invertible functions.

**4- Differentiability of a function:** Derivative of a function. Relation between the differentiability and the continuity of a function. Differentiation rules. Rolle's Theorem. Lagrange's (or mean value) Theorem. Cauchy's Theorem. Determination of local and global extremes of a function in one real variable.

**5 - Consequences of infinitesiaml calculus:** Limits of a function in one real variable and de l'Hôspital Theorems. Higher-order derivatives. $C^k$ and $C^\infty$ functions. Convex (concave) functions. Some properties of differentiable convex (concave) functions. Determination of the graph of a function in one real variable.

**6 - Taylor's formula of a function:** Taylor's polynomial of a funtion. Taylor' expansion. Representations of the Taylor's reminder. Relation between Taylor's formula and the local extreme points of a function. Mac Laurin's formula. Mac Laurin's expansion of elementary functions.

**7 - Integration of a function: P**rimitive of a function. Determination of the primitives of elementary functions. The formulae of the integration by parts and by substitution. Integration of rational functions. Abelian integrals. Trigonometric integrals. Integration of binomial differentials. Riemann integral. Integral mean value theorem. Fundamental theorem of calculus. Integrals and Taylor's reminder. Mac Laurin's formula for the functions $\log(1-x)$, $\arctan x$ , $\arcsin x$.

**8 - Improper Integrals:** Convergence criteria for improper integrals. Euler integral of the first and second kind. Improper integrals and numeric series.

**9 - Complex numbers:** The construction of the complex field **C**. Polar form of a complex number. The n-th power and the rational power of a complex number. as a metric space. Sequences and series of complex numbers. Complex logarithm and complex power of a complex number .

**10 - Differential equations:** First order ordinary differential equations (ODEs). Separation of variables. Linear first order ODEs. Bernoulli's ODE. Riccati's ODE. Equations of the form $y' = f((ax+by+c)/(a'x+b'y+c'))$. Manfredi's ODE. Higher order ODEs with constant coefficients.

EXAMINATION SESSIONS (EXPECTED)
Tuesday, February 2, 2016; Friday, Aprile 15, 2016; Tuesday, July 5, 2016; Tuesday, September 20, 2016; Friday, November11, 2016.

SEMINARS BY EXTERNAL EXPERTS YES □ NO X

FURTHER INFORMATION