Programme of Microelettronica (Microelectronics)		
• Code**: I2E002** • type of course unit **: compulsory** • level of course unit **: second cycle** • year of study **: first,** semester**: second**		
Number of ECTS credits: 4 (workload is 90 hours; 1 credit = 25/30 hours)		
Teacher: Prof. Giuseppe FERRI		
1	**Course objectives**	The course is aimed to the study and comprehension of analog microelectronic technology, circuits and systems. Students should learn basic analog microelectronics blocks and techniques.
2	**Course content and Learning outcomes (Dublin descriptors)**	**Topics of the module include (programme):** Textbook index: Chapter 1 MOS transistor 1.1 Introduction 1.2 The MOS transistors: band structure in solids 1.3 Operation and fundamental equations 1.4 The threshold voltage 1.5 Mutual Characteristic 1.6 Output characteristic 1.7 Small Signal equivalent Circuit 1.8 Transconductance 1.9 output conductance 1:10 resistances seen from the terminals 1:11 Parasitics 1:12 Noise 1:13 Comparison MOS- BJT Chapter 2 The main analog voltage blocks 2.1 Introduction 2.2 key features of the operational amplifiers 2.3 stability of the amplifiers 2.4 single transistor amplifiers 2.5 output stages 2.6 Current mirrors 2.7 Other current references 2.8 voltage generators 2.9 Transconductance amplifiers (OTA): simple, symmetrical, Miller OTA 2:10 noise considerations 2:11 fully differential OTA 2:12 " folded cascode " OTA 2.13 multi-stage OTA and its frequency compensation Chapter 3 Low-voltage low-power design 3.1 Introduction and design considerations 3.2 Classification of "low voltage" CMOS circuits 3.3 electrical properties of MOS in "low- voltage" applications 3.4 Low voltage input stages. 3.5 Low voltage output stages 3.6 Introduction to " low power" design 3.6.1 "Low- power" limitations and practical solutions 3.6.2 Adaptive biasing circuits Chapter 4 The " current-mode " approach: CCII 4.1 Introduction 4.2 Theory 4.3 The feedback current-mode approach : new blocks 4.4 First and second generation current conveyors topologies 4.5 : CCII applications: amplifiers, converters, impedance simulators, capacitance multipliers, oscillators, filters, multi-input multi-output CCIIs Chapter 5 Circuits and interfaces for sensor applications 5.1 Introduction 5.2 Classification of sensors 5.3 resistive,capacitive and thermal sensors 5.4 sensor interfaces and " smart systems" 5.4.1 interfaces for resistive sensors 5.4.2 interfaces for capacitive sensors 5.4.3 Interfaces for temperature sensors 5.5 Application of the lock-in amplifier in sensor interface. Chapter 6 Switched capacitors (SC) and switched OpAmp (SOA) 6.1 Introduction 6.2 Switched capacitors 6.3 Switched Op-Amp 6.4 Case study example Chapter 7 Techniques of offset and noise reduction in CMOS amplifiers 7.1 Introduction 7.2 errors (accuracy) in amplifiers 7.3 static compensation techniques 7.4 dynamic compensation techniques 7.4.1 auto-zero technique (AZ) 7.4.2 chopper circuits

		(CHC) 7.4.3 Dynamic element matching (DEM) Chapter 8 Techniques of signal from noise recovering: the lock-in amplifier Appendix CMOS process and layout integrated circuits A.1 Introduction A.2 Implementation of monocrystalline silicon wafers (CZ method) A.3 processes based on silicon A.4 lithography A.5 manufacturing process for NMOS gate A.6 CMOS technology A.7 the silicon on insulator (SOI) process A.8 Layout A.9 latch-up On successful completion of this module, the student should acquire profound knowledge and design capabilities of analog microelectronic circuits.
3	**Prerequisites and learning activities**	The student must know the basic elements of analog electronic circuits
4	**Teaching methods and language**	Lectures, team work (in Labs) with final report, exercises, home work (project) Language: Italian Ref. : Text books and lectures
5	**Assessment methods and criteria**	Oral exam with project discussion