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| |  | | --- | | **Course Information** |  |  |  | | --- | --- | | Course title | Bioelectronics Circuit Design | | Semester | 110-1 | | Designated for | COLLEGE OF ELECTRICAL ENGINEERING AND COMPUTER SCIENCE  GRADUATE INSTITUTE OF ELECTRICAL ENGINEERING | | Instructor | [JUN-CHAU CHIEN](https://nol2.aca.ntu.edu.tw/nol/coursesearch/teacher.php?op=s2&td=901209) | | Curriculum Number | EEE5058 | | Curriculum Identity Number | 943 U0600 | | Credits | 3.0 | | **Course Syllabus** | | | **Please respect the intellectual property rights of others and do not copy any of the course information without permission** | | | Course Description | This course covers essential topics for electronics in bioinstrumentation, biomedical devices, and biosensors. | | Course Objective | The students will learn (1) the signal transduction mechanisms in different types of biosensors, (2) understand how to define system specifications based on sensor requirements including dynamic range, noise analysis, linearity, power consumption, and (3) design complete signal conditioning circuits with various low-noise and low-power circuit techniques such as current re-use, correlated-double-sampling (CD), and chopping stabilization. Topics include biopotential measurements of ECG and/or neural action potentials, current readout interface circuits for electrochemical and optical sensors, charged-based readout using FET- transistors, magnetic sensors, and emerging topics in powering, wireless communication, microfluidics, electrochemistry, DNA-based sensor, COVID-19 detection, and etc. We will cover gm/Id design methodology for the amplifiers, CMOS chip layout techniques, fundamental of analog-to-digital converters (ADC), successive-approximation register (SAR) ADC, high-resolution oversampling ADC, and various simulation techniques. | | References | 參考書目: 1. Gray, Hurst, Lewis, Meyer, Analysis and Design of Analog Integrated Circuits, 5th Edition, John Wiley & Sons, 2009. 2. B. Razavi, Design of Analog CMOS Integrated Circuits, 1st Edition, McGraw Hill, 2001. 3. Carusone, Johns, Martin, Analog Integrated Circuit Design, 2nd Edition, John Wiley & Sons, 2012. 4. Pavan, Schreier and, Temes, Understanding delta-sigma data converters, 2nd Edition, Wiley, 2017. 5. Various materials to be distributed throughout the course. |  |  | | --- | | **Progress** |  |  |  |  | | --- | --- | --- | | Week | Date | Topic | | Week 1 | 9/27 | Course introduction | | Week 2 | 10/4 | Signal conditioning and biopotential physiology. | | Week 3 | 10/11 | Holiday | | Week 4 | 10/18 | Amplifier design, feedback review | | Week 5 | 10/25 | Noise analysis and low-noise techniques | | Week 6 | 11/01 | ADC fundamentals and SAR-ADC introduction and design | | Week 7 | 11/08 | Oversampling concepts and Delta-Sigma modulator introduction | | Week 8 | 11/15 | Midterm | | Week 9 | 11/22 | Introduction of affinity biosensor | | Week 10 | 11/29 | Electrochemistry, current interface circuits, and charge-based readout circuits | | Week 11 | 12/06 | Optical sensing and magnetic sensing | | Week 12 | 12/13 | Oscillator-based sensors | | Week 13 | 12/20 | Microfluidics | | Week 14 | 12/27 | Energy harvesting and power management design | | Week 15 | 1/03 | Wireless communication for bioelectronics | | Week 16 | 1/10 | Final | |

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