ECTS – Arkusz przedmiotu (Course sheet)

Responsible(s) for the course

Prof. dr hab. inż. Władysław Dąbrowski
Dr inż. Piotr Wiącek
Dr inż. Tomasz Fiutowski

M7060 Electronics II

area-oriented

code; course name

M7060 Electronics II

area and degree of studies; specialization

Medical Physics – undergraduate (B.Sc.) level

semester, type of classes, #of hours, ECTS points

semester: VII; total hours: 75, lecture: 30, seminar: 15, laboratorium laboratory: 30,
ECTS: 6

Course Web page

(personal Web pages of the teachers

http://novell.ftj.agh.edu.pl/~dabrowsk/
http://novell.ftj.agh.edu.pl/~wiacek/
http://fatcat.ftj.agh.edu.pl/~fiutowski/

Course objectives

To acquaint students with selected problems and electronic circuits used in biological research and in medical imaging.

Course content

4 Noise sources in amplifiers. Noise optimisation of instrumentation amplifiers. – 2 h.
5 Interferences in electronic circuits. Grounding and shielding. – 2 h.
6 Ramo’s theorem. Detector as a signal current source. Semiconductor detectors. Current pulses from semiconductor detectors. – 2 h.
7 Position-sensitive semiconductor detectors in applications to medical imaging. – 2 h.
8 Charge Coupled Devices (CCD) – principle of operation and applications to radiation detection. – 2 h.
10 Extraction of signals from position-sensitive detectors. – 2 h.
12 Noise filtering and pulse shaping. Optimisation of signal-to-noise ratio. – 2 h.
13 Computer aided analysis of electronic circuits – SPICE. – 2 h.
14 CMOS technology and Application Specific Integrated Circuits. – 2 h.
Application Specific Integrated Circuits for electrical stimulation and recording signals from neurons. – 2 h.
15 Application Specific Integrated Circuits for readout of position-sensitive detectors in applications to medical imaging. – 2 h.

Content of classes, laboratories, projects and/or seminars

Seminar – 15 h
Comparison of parameters of selected instrumentation amplifiers.
Comparison of parameters of selected analogue-to-digital converters of different types.
Noise phenomena in semiconductor devices.
Noise sources in amplifiers.
Charge sharing effects in silicon strip detectors.
"Medipix" pixel detector.
Position-sensitive semiconductor detectors in applications to medical imaging.
Application of Charge Coupled Devices (CCD) to medical imaging.
Photomultipliers – structure and principle of operation.
Optimisation of a charge sensitive preamplifier with MOSFET input transistor.
Campbell-Francis’ theorem. Pulse rate meters.
Models of MOSFETs in the SPICE simulator.
Basic steps of the CMOS technological process.
Application Specific Integrated Circuits for electrical stimulation and recording signals from neurons.
Application Specific Integrated Circuits for readout of position-sensitive detectors.
Laboratory – 30 h.
Measurements and analysis of noise in instrumentation amplifiers.
Design of an amplifier for recoding of continuous signal from a photodiode
Characteristics and applications of an avalanche photodiode.
Electronic chain for processing of signals from semiconductor detectors.
Readout chain of a scintillator detector.
Circuits for extraction of timing information from radiation detectors.
Coincidence circuits
Parameterisation of a multichannel system for readout of a silicon strip detector.

Course summary

Bibliography

4. P. Horowitz, W. Hill, Sztuka elektroniki Cz. 1 i Cz. i, Warszawa, Wydawnictwa Komunikacji i Łączności, 2003

Conditions for receiving credit
1) final exam
2) continuous assessment (seminar, laboratory) with positive final grade

Rules to determine the final grade
Straight mean of all grades received.

Key words