

ICGEE Curriculum available for 2011/2012 Academic Year

Nanoelectronics

Module Title:	Nanoelectronics
Module Status:	Available, to be delivered second term 2011/2012

Generic Module Information:

Name of module owner/lecturer?	Dr. Giorgos Fagas and Dr. Aidan Quinn
Delivery mode: e.g. on-site, on-line, mixed-mode. For on-site specify contact hours per week	<p>For Cork located students: On- site 1.5 hour per week of lectures combined with 2 tutorial sessions.</p> <p>For students from other locations: live web streaming using AV facility, 1.5 hour lectures per week in real time with recordings and other relevant materials available via ICGEE VLE.</p>
Duration of the module:	1 semester: 16 lectures. 90 minutes each.
Assessment methods and weightings where relevant:	Continuous assessment and written final exam.
Pass standard:	40%
Penalties for late submission of continuous assessment work:	Where work is submitted up to and including 7 days late, 10% of the total marks available shall be deducted from the mark achieved. Where work is submitted up to and including 14 days late, 20% of the total marks available shall be deducted from the mark achieved. Work submitted 15 days late or more shall be assigned a mark of zero.
Number of ECTS or institutional credits assigned to the module:	5 ECTS
Course Content or Syllabus (Optional):	<ul style="list-style-type: none"> • From microelectronics to Nanoelectronics, challenges and objectives and overview/examples of measured effects; Primary quantum mechanics; Top-down nanofabrication:CMOS scaling, multi-gate transistors, junctionless transistors; • Electronic structure of confined systems: application to nanoscale structures (e.g. Si nanowires, graphene, nanotubes); • Bottom-up synthesis, directed assembly and electrical contacting of nanoscale building blocks:nanowires, nanotubes, graphene, nanocrystals; • Quantum transport: elementary theory and effects (e.g. conductance quantisation and fluctuations, coherent and single-electron tunnelling); • Principles of nanoelectronic devices (e.g. multigate FET, Junctionless FET, SET); • Device operation and performance (benchmarking bottom-up vs top-down)
Learning Outcomes	<p>On successful completion of this module, students should be able to:</p> <ul style="list-style-type: none"> • Illustrate key electronic structure and quantum transport properties of low-dimensional systems using analytical methods and basic numerical computations (e.g. in MATLAB).

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	<ul style="list-style-type: none"> • Analyse the operating principles of nanoscale electronic devices and interpret measured device data, with particular reference to novel non-planar silicon devices (multi-gate transistors, junctionless transistors), nanowire devices, graphene devices, molecular electronic devices. • Compare and contrast candidate device performance based on fundamental limitations and their (ultimate) potential for high-volume manufacturing. • Recognise the near- and medium-term scaling challenges associated with continued miniaturisation in conventional "top-down" semiconductor technology at and below the 22nm node. • Summarise the benefits and challenges associated with bottom-up fabrication of nanostructures for future applications in electronics.
Recommended Text (to be confirmed)	<ul style="list-style-type: none"> • Fundamentals of Nanoelectronics by George W. Hanson (Prentice Hall, international edition 2007) • Introduction to Nanoscience by Stuart Lindsay (Oxford University Press, 2009)
Supplementary Texts	<ul style="list-style-type: none"> • <u>The Physics of Low-dimensional Semiconductors: An Introduction</u> by <u>J. H. Davies</u> (Cambridge University Press, 1997) • <u>Quantum Nanoelectronics: An Introduction to Electronic Nanotechnology and Quantum Computing</u> by Edward L. Wolf (Wiley-VCH, 2009)