PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

DEPARTMENT: School of Electrical and Computer Engineering (EFD 37-05)  EFFECTIVE SESSION: Fall 2010

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- New course with supporting documents
- Add existing course offered at another campus
- Expiration of a course
- Change in course number
- Change in course title
- Change in course credit/type
- Change in course attributes (department head signature only)
- Change in instructional hours
- Change in course description
- Change in course requisites
- Change in semesters offered (department head signature only)
- Transfer from one department to another

PROPOSED:

Subject Abbreviation: ECE
Course Number: 45300
Long Title: Fundamentals of Nanoelectronics
Short Title: Fundamentals of Nanoelectronics

ABBREVIATED TITLE WILL BE ENTERED BY THE OFFICE OF THE REGISTRAR IF OMITTED.

TERMS OFFERED:

- Summer
- Fall
- Spring

CAMPUS(ES) INVOLVED:

- Calumet
- Cont Ed
- Ft. Wayne
- Indianapolis
- Tech Statewide
- W. Lafayette

CREDIT TYPE:

1. Fixed Credit: Cr. Hrs.: 3
2. Variable Credit Range: Minimum: 3, Maximum: 5
3. Equivalent Credit: Yes

COURSE ATTRIBUTES:

- Pass/Not Pass Only
- Satisfactory/Unsatisfactory Only
- Maximum Repeatable Credit: 3
- Credit by Examination
- Special Fees

SCHEDULE TYPE:

- Lecture: 3 hours per week
- Laboratory: 3 hours per week
- Studio: 3 hours per week
- Distance: 3 hours per week
- Clinic: 3 hours per week
- Experiential: 3 hours per week
- Research: 3 hours per week
- Ind. Study: 3 hours per week
- Prac/Observ: 3 hours per week

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Description: The development of nanotechnology has made it possible to engineer materials and devices on a length scale as small as several nanometers. The properties of such nanostructures cannot be described in terms of macroscopic parameters like mobility or diffusion coefficient and a microscopic, or atomicistic, viewpoint is called for. The purpose of this course is to convey the conceptual framework that underlies this microscopic viewpoint using examples related to the emerging field of nanoelectronics.

Requisites: ECE 30500 (may be taken concurrently) and MA 26600 and MA 26500, or MA 26200.

Calumet Department Head: Date
Calumet School Dean: Date

Fort Wayne Department Head: Date
Fort Wayne School Dean: Date

Indianapolis Department Head: Date
Indianapolis School Dean: Date

North Central Department Head: Date
North Central Chancellor: Date

West Lafayette Department Head: Date
West Lafayette College/School Dean: Date

West Lafayette Registrar: Date

OFFICE OF THE REGISTRAR
PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

EFD 37-05

EFFECTIVE SESSION Fall 2010

SPARTMENT School of Electrical and Computer Engineering (EFD 37-05)

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- New course with supporting documents
- Add existing course offered at another campus
- Expiration of a course
- Change in course number
- Change in course title
- Change in course credit type
- Change in course attributes (department head signature only)
- Change in Instructional hours
- Change in course description
- Change in course requisites
- Change in semesters offered (department head signature only)
- Transfer from one department to another

PROPOSED:

Subject Abbreviation: Fundamentals of Nanoelectronics
Course Number: 45300

EXISTING:

Subject Abbreviation: ECE
Course Number: 45300

Long Title: Fundamentals of Nanoelectronics
Short Title: Fundamentals of Nanoelectronics

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

CREDIT TYPE

Fixed Credit: Cr. Hrs.
Variable Credit Range:
Minimum Cr. Hrs. (Check One) To
Maximum Cr. Hrs.
Equivalent Credit: Yes

COURSE ATTRIBUTES: Check All That Apply

- Pass/No Pass Only
- Satisfactory/Unsatisfactory Only
- Repeatable
- Maximum Repeatable Credit:
- Credit by Examination
- Special Fees
- 6. Registration Approval Type
- Department
- Instructor
- 7. Variable Title
- Honors
- 8. Full Time Privilege
- 9. Off Campus Experience

Schedule/Type

Lecture
Lab Prep
Experiential
Ind. Study
Pract/Obser

Meeting Per Week
16

% of Credit Allocated
100

TERMS OFFERED: Check All That Apply

Summer
Fall
Spring

CAMPUS(ES) INVOLVED

Calumet
Cont Ed
Fl. Wayne
Indianapolis
N. Central
Tech Statewide
W. Lafayette

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Description: The development of nanotechnology has made it possible to engineer materials and devices on a length scale as small as several nanometers. The properties of such nanostructures cannot be described in terms of macroscopic parameters like mobility or diffusion coefficient and a microscopic, or atomistic, viewpoint is called for. The purpose of this course is to convey the conceptual framework that underlies this microscopic viewpoint using examples related to the emerging field of nanoelectronics.

Requisites: ECE 30500 (may be taken concurrently) and MA 28600 and MA 28500 or MA 28200.

Calumet Department Head Date
Calumet School Dean Date

Fort Wayne Department Head Date
Fort Wayne School Dean Date

Indianapolis Department Head Date
Indianapolis School Dean Date

North Central Department Head Date
North Central Chancellor Date

West Lafayette Department Head Date
West Lafayette College/School Dean Date

OFFICE OF THE REGISTRAR
**PURDUE UNIVERSITY**
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

**DEPARTMENT** School of Electrical and Computer Engineering (EFD 37-05)  EFFECTIVE SESSION Fall 2010

**INSTRUCTIONS:** Please check the items below which describe the purpose of this request.

- [ ] New course with supporting documents
- [ ] Add existing course offered at another campus
- [x] Change of topic
- [ ] Change in course number
- [x] Change in course title
- [ ] Change in course credit/type
- [ ] Change in course attributes (department head signature only)
- [x] Change in instructional hours
- [x] Change in course description
- [ ] Change in course requisites
- [ ] Change in semesters offered (department head signature only)
- [ ] Transfer from one department to another

**PROPOSED:**
- Subject Abbreviation: ECE
- Course Number: 45300
- Long Title: Fundamentals of Nanoelectronics
- Short Title: Fundamentals of Nanoelectronics

**EXISTING:**
- Subject Abbreviation: 
- Course Number: 
- Long Title: Fundamentals of Nanoelectronics
- Short Title: Fundamentals of Nanoelectronics

Abbreviated title will be entered by the Office of the Registrar if omitted. (20 CHARACTERS ONLY)

**TERMS OFFERED:** Check All That Apply:
- [ ] Summer
- [x] Fall
- [ ] Spring

**CAMPUS(ES) INVOLVED:**
- Calumet
- Cont Ed
- Ft. Wayne
- Indianapolis
- N. Central
- Tech Statewide
- W. Lafayette

**CREDIT TYPE**
1. Fixed Credit: Cr. Hrs.
2. Variable Credit Range:
   - Minimum Cr. Hrs.
   - Maximum Cr. Hrs.
   - Equivalent Credit: Yes [ ] No [ ]

**COURSE ATTRIBUTES:** Check All That Apply
1. Pass/Not Pass Only
2. Satisfactory/Unsatisfactory Only
3. Repeatable
4. Maximum Repeatable Credit:
5. Credit by Examination
6. Registration Approval Type
   - Department [x]
   - Instructor [ ]
7. Variable Title
8. Honors
9. Full Time Privilege
10. Off Campus Experience

**COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):**
Description: The development of nanotechnology has made it possible to engineer materials and devices on a length scale as small as several nanometers. The properties of such nanostructures cannot be described in terms of macroscopic parameters like mobility or diffusion coefficient and a microscopic, or atomistic, viewpoint is called for. The purpose of this course is to convey the conceptual framework that underlies this microscopic viewpoint using examples related to the emerging field of nanoelectronics.

Requisites: ECE 30500 (may be taken concurrently) and MA 26800 and MA 26500 or MA 26200.

**Signature Lines:**
- Calumet Department Head: 
- Calumet School Dean: 
- Fort Wayne Department Head: 
- Fort Wayne School Dean: 
- Indianapolis Department Head: 
- Indianapolis School Dean: 
- North Central Department Head: 
- North Central Chancellor: 
- West Lafayette Department Head: 
- West Lafayette College/School Dean: 
- West Lafayette Registrar: 

**OFFICE OF THE REGISTRAR**
TO: The Faculty of the College of Engineering  
FROM: The Faculty of the School of Electrical and Computer Engineering  
RE: ECE 453 Changes in Course Title, Description, and Requisites

The faculty of the School of Electrical and Computer Engineering has approved the following changes of the undergraduate level course, ECE 453. This action is now submitted to the Engineering Faculty with a recommendation for approval.

From: ECE 453 Introduction to Nanoelectronics

Sem. 1, Class 3, Cr. 3  
Prerequisite: ECE 305  
Corequisite: ECE 311. Authorized equivalent courses or consent of instructor may be used in satisfying course pre- and co-requisites.

Introduction to the operating principles of a new class of quantum devices made possible by revolutionary semiconductor fabrication techniques. Quantum concepts are emphasized and specific device examples given.

To: ECE 453 Fundamentals of Nanoelectronics

Sem. 1, Class 3, Cr. 3.  
Prerequisite: ECE 305 (may be taken concurrently) and [[MA 266 and MA 265] or MA 262]

The development of nanotechnology has made it possible to engineer materials and devices on a length scale as small as several nanometers. The properties of such nanostructures cannot be described in terms of macroscopic parameters like mobility or diffusion coefficient and a microscopic, or atomistic, viewpoint is called for. The purpose of this course is to convey the conceptual framework that underlies this microscopic viewpoint using examples related to the emerging field of nanoelectronics.

Reason: The course title, description, and requisites have been changed to reflect the updated content of the course.

M. J. T. Smith, Head  
School of Electrical and Computer Engineering

APPROVED FOR THE FACULTY OF THE SCHOOLS OF ENGINEERING BY THE ENGINEERING CURRICULUM COMMITTEE

ECC Minutes 2/11/09
Date 2/11/09
Chairman ECC R Copia
ECE 453  Fundamentals of Nanoelectronics

Required Text(s): Class notes

Recommended Reference(s):


Lecture Outline:

Weeks 1 through 5
1. An atomistic view of electrical resistance
2. Schrodinger equation
   Hydrogen atom, Method of finite differences
3. Self-consistent field / Coulomb blockade
   One-electron versus the many-electron picture
   HW#1, 2, 3, Exam I

Weeks 6 through 10
4. Basis functions
   Converting a differential equation to a matrix equation
5. Bandstructure
   Toy examples, general result, common semiconductors
6. Subbands
   Quantum wells, wires, dots and nanotubes
   Density of states, minimum resistance of a quantum wire
   HW#4, 5, 6, Exam II

Weeks 11 through 15
7. Capacitance: Quantum versus electrostatic
8. Level broadening
   Self-energy, Local density of states, Lifetime, Golden rule
   What constitutes a “contact”?
9. Current-voltage characteristics
   Coherent transport, Transmission, Green’s function method
   HW# 7, 8, 9

Exam III (Finals week)
Course outcomes:

1. Ability to perform simple analysis of nanoelectronic devices.
2. Ability to calculate the density of states in nanoelectronic devices.
3. Ability to perform in-depth analysis of nanoelectronic devices.

Assessment Method for Course Outcomes:

Exams I, II and III respectively.
ECE 453  Fundamentals of Nanoelectronics

Required Text(s): Class notes

Recommended Reference(s):


Lecture Outline:

**Weeks 1 through 5**
1. An atomistic view of electrical resistance
2. Schrodinger equation
   - Hydrogen atom, Method of finite differences
3. Self-consistent field / Coulomb blockade
   - One-electron versus the many-electron picture
   - HW#1, 2, 3, Exam I

**Weeks 6 through 10**
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   - Converting a differential equation to a matrix equation
5. Bandstructure
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   - HW#4, 5, 6, Exam II

**Weeks 11 through 15**
7. Capacitance: Quantum versus electrostatic
8. Level broadening
   - Self-energy, Local density of states, Lifetime, Golden rule
   - What constitutes a “contact”?
9. Current-voltage characteristics
   - Coherent transport, Transmission, Green’s function method
   - HW# 7, 8, 9

Exam III (Finals week)