Office of the Registrar FORM 40 REV. 7/08

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



EFD 37-05

EPARTMENT 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 r   | equest.   |   |
|--|--|---|---|
| INSTRUCTIONS: Please check the items below  1. New course with supporting doc  2. Add existing course offered at a  3. Expiration of a course  4. Change in course number  5. Change in course title  6. Change in course credit/type  PROPOSED:  Subject Abbreviation  Course Number  Long Title Fundamentals of Nanoelectronics  Short Title Fund of Nanoelectronics  Abbreviated title will be entere | uments nother campus <u>EXISTING;</u> Subject Abbreviation   | 7. Change in course 8. Change in instruct 9. Change in course 10. Change in course 11. Change in semest 12. Transfer from one | description   |
| CREDIT TYPE  1. Fixed Credit: Cr. Hrs. 2. Variable Credit Range: Minimum Cr. Hrs (Check One) To Or Maximum Cr. Hrs. 3. Equivalent Credit: Yes No ScheduleType Minutes Per Mtg Lecture 50 3   | 1. Pass/Not Pass Only 2. Satisfactory/Unsatisfactory Only 3. Repeatable    Maximum Repeatable Credit: 4. Credit by Examination 5. Special Fees  T Weeks % of Credit Offered Allocated 16 100 | 7. Variable Title 8. Honors 9. Full Time  | tion Approval Type partment     Instructor     e    |
| COURSE DESCRIPTION (INCLUDE REQUISITE Description: The development of nanotechnology properties of such nanostructures cannot be dest called for. The purpose of this course is to convenancelectronics. Requisites: ECE 30500 (may be taken concurrer  Calumet Department Head Date  Fort Wayne Department Head Date  | / has made it possible to engineer ma<br>ribed in terms of macroscopic parame<br>y the conceptual framework that unde  | eters like mobility or diffusion coeffi<br>erlies this microscopic viewpoint us   | ficient and a microscopic or atomictic viewpoint is |
| North Central Department Head  Date  Date  Date  Date  Date  Date  Date  | Indianapolis School Dean  North Central Chancellor  West Lafayette College/School Dean   | Date  Date  Date  West L.   | Malagarita Dale                                     |

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



EFD 37-05

SPARTMENT School of Electrical and Computer Engineering (EFD 37-05) **EFFECTIVE SESSION Fail 2010** INSTRUCTIONS: Please check the items below which describe the purpose of this request. New course with supporting documents Change in course attributes (department head signature only) 2. Add existing course offered at another campus 8. Change in instructional hours 3. Expiration of a course X 9. Change in course description 4 Change in course number X 10. Change in course requisites X 5. Change in course title Change in semesters offered (department head signature only) 6. Change in course credit/type Transfer from one department to another PROPOSED: **EXISTING:** TERMS OFFERED Check All That Apply: **Subject Abbreviation** Subject Abbreviation ECE X Fall Summer Spring Course Number 45300 Course Number CAMPUS(ES) INVOLVED Calumet Long Title Fundamentals of Nanoelectronics N. Central Cont Ed Tech Statewide Short Title Fund of Nanoelectronics Ft. Wayne XW. Lafayette Indianapolis Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY) **CREDIT TYPE** COURSE ATTRIBUTES: Check All That Apply 1.Fixed Credit: Cr. Hrs. 1. Pass/Not Pass Only 2.Variable Credit Range: 6. Registration Approval Type 2. Satisfactory/Unsatisfactory Only Minimum Cr. Hrs Department Instructor X (Check One) 7. Variable Title Maximum Repeatable Credit: Maximum Cr. Hrs. 8. Honors 4. Credit by Examination 3.Equivalent Credit: Yes 9. Full Time Privilege 5. Special Fees 10. Off Campus Experience ScheduleType Minutes Meetings Per Weeks % of Credit Per Mtg Week Offered Allocated **Cross-Listed Courses** Lecture 100 16 ecitation sentation aboratory ab Prep Studio Distance Clinic Experiential Research Ind. Study Pract/Observ 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 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 West Lafayette Registrar Date

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



EFD 37-05

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

| INSTRUCTIONS: Please check the ite  | ms below which describe the purpose of  | this request.  |  |
|---|---|--|--|
| 3. Expiration of a course 4. Change in course numb                                  | ered at another campus  | 8. Change in instruct  9. Change in course  10. Change in course                     | e description<br>e requisites  |
| l == **   |   | ( <del>)</del>   | sters offered (department head signature only)   |
|   | ••  | 12. Transfer from one  | e department to another  |
| PROPOSED:   | EXISTING:   |  | TERMS OFFERED  |
| Subject Abbreviation  | Subject Abbreviati  | ion ECE  | Check All That Apply:  |
| Course Number   | Course Number   | 45300  | CAMPUS(ES) INVOLVED  |
| Long Title Fundamentals of Nanoele  | ctronics  |  | Calumet N. Central Cont Ed Tech Statewide  |
| Short Title Fund of Nanoelectronics   |   |  | Ft. Wayne XW. Lafayette  |
| Abbreviated title will b  | e entered by the Office of the Registrar if   | f omitted. (30 CHARACTERS ONLY)  | — Indianapolis   |
| CREDIT TYPE   |   | COURSE ATTRIBUTES: Check   | All That Apply   |
| 1.Fixed Credit: Cr. Hrs.  2.Variable Credit Range:                                  | 1. Pass/Not Pass Only   | 6. Registra  | ation Approval Type  |
| Minimum Cr. Hrs   | 2. Satisfactory/Unsatisfactory C  |  | partment 🔀 Instructor  |
| (Check One) To 07   | 3. Repeatable   | 7. Varlable Tit  |  |
| Maximum Cr. Hrs.  | Maximum Repeatable Credit   | U. 1101003   |  |
| 3.Equivalent Credit: Yes No   | 4. Credit by Examination 5. Special Fees  | 9. Full Time   |  |
| ScheduleType Minutes Mee  | elings Per Weeks % of Credit  | 10. Off Car  | npus Experience  |
| Per Mtg   | Week Offered Allocated  |  | Cross-Listed Courses   |
| Lecture 50 3  | 16 100  |  |  |
| sentation   |   |  | .  |
| Laboratory  |   |  |  |
| Lab Prep  |   |  |  |
| Studio  |   |  |  |
| Distance  |   |  |  |
| Clinic  |   |  |  |
| Experiential  |   |  |  |
| Research  | Mariana   |  |  |
| Ind. Study Pract/Observ   |   |  |  |
| COURSE DESCRIPTION (INCLUDE REC   | UNOTES (DESTRUCTIONS).  |  |  |
| Description: The development of nanotec<br>properties of such nanostructures cannot | chnology has made it possible to enginee<br>be described in terms of macroscopic pa<br>o convey the conceptual framework that | arameters like mobility or diffusion coef<br>underlies this microscopic viewpoint us | ale as small as several nanometers. The ficient and a microscopic, or atomistic, viewpoint is sing examples related to the emerging field of |
| Calumet Department Head   | Date Calumet School Dean  | Date   |  |
| Fort Wayne Department Head  | Date Fort Wayne School Dean   | Date   |  |
| ndianapolis Department Head   | Date Indianapolis School Dean   | Date   |  |
| North Central Department Head   | Date North Central Chancellor   | Date 12/10   |  |
| Vest Lawyette Department Head   | Date West Lafayette College/School Dea  | an Date West i   | Lafayette Registrar Date   |
|   | •   | 7100((   | rougherra Legistrar Data   |

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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** 

Date

Chairman ECC

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## ECE 453 Fundamentals of Nanoelectronics

Required Text(s): Class notes

#### Recommended Reference(s):

1. S. Datta, Quantum Transport: Atom to Transistor, Cambridge University Press (2005), ISBN 0-521-63145-9.

2. MatLab: Student Version, Current Edition, The MathWorks, Inc.

#### 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):

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HW#4, 5, 6, Exam II

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