APPLICATION FOR NEW COURSE

1. Submitted by College of Engineering Date 11/22/05

   Department/Division offering course Electrical and Computer Engineering

2. Proposed designation and Bulletin description of this course

   a. Prefix and Number EE 570 b. Title* Fundamentals of Nanoelectronic Devices and Materials

   *NOTE: If the title is longer than 24 characters (including spaces), write A sensible title (not exceeding 24 characters) for use on transcripts Fund.of Nano.Devices and Materi

   c. Lecture/Discussion hours per week 3 d. Laboratory hours per week

   e. Studio hours per week f. Credits 3

   g. Course description

   Energy bands in crystals; heterostructures; quantum wells and low dimensional systems; the two-dimensional electron gas and MODFET; transmission in nanostructures; current topics in nanoscale devices.

   h. Prerequisites (if any) EE 360 and engineering standing, or consent of instructor.

   i. May be repeated to a maximum of (if applicable)

4. To be cross-listed as MSE ME/~~GME~~ 570
   Prefix and Number

   Signature, Chairman, cross-listing department Dept. Kelly 5/31/09

5. Effective Date Spring ~~2006~~ 2010 (semester and year)

   Approved by ME faculty 2/22/06

6. Course to be offered ☐ Fall ☑ Spring ☐ Summer

7. Will the course be offered each year? (Explain if not annually) ☑ Yes ☐ No

8. Why is this course needed?

   This course is needed because the electronics industry and the engineering nanoelectronics industry needs graduates with knowledge taught in this course.

9. a. By whom will the course be taught? Dr. Vijay Singh

   b. Are facilities for teaching the course now available? If not, what plans have been made for providing them? ☑ Yes ☐ No

APPLICATION FOR NEW COURSE

10. What enrollment may be reasonably anticipated? 15

11. Will this course serve students in the Department primarily? ☑ Yes ☐ No

Will it be of service to a significant number of students outside the Department? ☑ Yes ☐ No
If so, explain.

Will the course serve as a University Studies Program course? ☐ Yes ☑ No

If yes, under what Area?

12. Check the category most applicable to this course

- ☐ traditional; offered in corresponding departments elsewhere;
- ☑ relatively new, now being widely established
- ☐ not yet to be found in many (or any) other universities

13. Is this course applicable to the requirements for at least one degree or certificate at the University of Kentucky? ☑ Yes ☐ No

14. Is this course part of a proposed new program: ☐ Yes ☑ No
If yes, which?

15. Will adding this course change the degree requirements in one or more programs?* ☐ Yes ☑ No
If yes, explain the change(s) below

16. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

17. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has been consulted. ☐

18. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate students in assignments, grading criteria, and grading scales. ☑

19. Within the Department, who should be contacted for further information about the proposed course?

Name Dr. Vijay Singh Phone Extension 257-3243

*NOTE: Approval of this course will constitute approval of the program change unless other program modifications are proposed.

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Signatures of Approval:

Department Chair 21-0 in Favor	11/22/05 Date
Dean of the College	12-11-09 Date
	1-20-09 Date of Notice to the Faculty
*Undergraduate Council	4/28/2010 Date
	Date
Brian A... 2010.07.28 08:41:16 -04'00' *Graduate Council	Date
*Academic Council for the Medical Center	Date
*Senate Council (Chair)	Date of Notice to University Senate

*If applicable, as provided by the Rules of the University Senate

ACTION OTHER THAN APPROVAL

SYLLABUS

EE 570- Fundamentals of Nanoelectronic Devices and Materials

Department of Electrical and Computer Engineering, University of Kentucky

Instructor: Dr. Vijay P. Singh

Office: 467 D Anderson Hall

E-mail: vsingh@engr.uky.edu

Web: http://www.engr.uky.edu/~vsingh

EE570 URL:

Office hours:

Meeting Time and Place:

Textbook: "The Physics of Low-Dimensional Semiconductors", J. H. Davies
Cambridge University Press, 1998, ISBN 0-521-48148-1, QC611.8.L68039

Grading Policy:

Grade for the undergraduate students will be based on:

Homework Assignments	15%
Quizzes	40%
Final Exam	15%
Project I	30%

Grade for the graduate students will be based on:

Homework Assignments	15%
Quizzes	40%
Final Exam	15%
Project I	15%
Project II (Advanced Project)	15%

- Homework will be assigned almost every week. For full credit, problem solutions must show a clear systemic method for arriving at the correct solution. Points will be taken off for incorrect solutions or work that is difficult to follow.

- Failure to take an exam during the assigned class period will result in a grade of zero for that test. In such a case, student should see the instructor to explain the circumstances.
- The student is responsible for all business conducted during any scheduled class period. Any revision to the test dates, homework assignments, etc. will be announced during the class period.
- The detected use of unethical tactics on a quiz, test, or homework will result in an E for the course. This includes copying another person's work, or making your work available for others to copy. Appropriate actions will be taken in accordance with the university policies on cheating and plagiarism.
- The student is expected to read the text and is responsible for all material in the reading assignments. The sections of the text should be read prior to the class meetings covering the material.

Course Topics

I. Foundations: Wave mechanics and the Schrodinger Equation; Free Particles; Bound Particles; Charge and current densities.

II. Energy Bands in Crystalline Materials:
Band Structure in One Dimension; Electron Motion; Density of States; Band Structure; Crystal Structure and Band Structure in common Semiconductors; Measurement of Band Gap.

III. Heterostructures: General properties of heterostructures; Growth of heterostructures; Band engineering; Quantum wells, Superlattices and Silicon-Germanium heterostructures; Quantum dots and wires; Optical confinement

IV. Quantum Wells and Low Dimensional Systems: Infinitely deep potential well; Square Well of Finite Depth; Two and Three Dimensional Potential Wells.

V. The Two- Dimensional Electron Gas and MODFET: Band Diagram of MODFET; Current-Voltage Characteristics and Threshold Voltage in MODFET

VI. Transmission in nanostructures: Tunneling; Tunneling in heterostructures;Transmission matrices (T- matrices); Resonant tunneling; Tunneling transport; Current and conductance in one dimension; Current in two and three dimensions; Quantized conductance in nanostructures.

VII. Current Topics in Nanoscale Devices: Solar cells, display devices, sensors and other devices of interest.

Student Learning Outcomes

Upon completion of the course, the student will have:

1. The basic understanding of the behaviour of electrons in semiconductor crystals, Schrodinger equation; energy levels and bands and charge and current densities
2. The basic understanding of heterostructures; band engineering; quantum wells, superlattices and quantum dots and wires.
3. The basic understanding of electron transport in nanostructures, tunneling; resonant tunneling and quantized conductance in nanostructures.

Homework policy: Homework will generally be assigned each week. The homework assignments will be distributed in the Class and/or Web. The homework is to be turned in at the *beginning* of the class period. No late homework will be accepted.

Attendance: If a student is to be absent from class for an extended period of time (two classes or more), the Instructor must be notified in advance, if possible, or by the second class of the absence.

Final Exam: Any student having a legal conflict on that exam day will need to notify the instructor *no later* than the last week of classes. Anyone failing to notify the instructor before this time will have to take the exam during the scheduled time.

Grading Assignment will be based on your final score for the course based on the homework, midterm exams, project and final exam, as outlined above. The letter grade assignment will then be calculated according to the table below.

(a) For Undergraduate Students:

Final Grade/Composite Score	Letter Grade
86-100 %	A
46-85%	B,C,D
Below 45%	E

(b) For Graduate Students:

Final Grade/Composite Score	Letter Grade
86-100 %	A
55-85%	B,C
Below 55%	E