

2014-2015 SHORT SIGNATURE SHEET



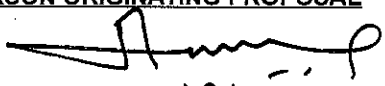
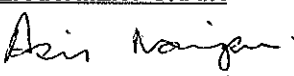
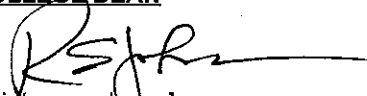
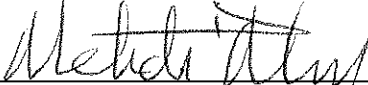
UNC CHARLOTTE

Date: 22 January 2015

Subject: New Course Proposal for ECGR 4190

Originating Department: ECE

TYPE OF PROPOSAL: UNDERGRADUATE GRADUATE _____ UNDERGRADUATE & GRADUATE _____
 (Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE FORWARDED	COMMENTS: APPROVED, APPROVED WITH REVISIONS, ETC.	SIGNATURES
			PERSON ORIGINATING PROPOSAL  [print name here:] ABA EBONG
		Approved	DEPARTMENT CHAIR  [print name here:] ASIS NASIPUARI 1/29/15
		Approved	COLLEGE CURRICULUM COMMITTEE CHAIR [print name here:]
	2/25/15	Approved	COLLEGE DEAN  [print name here:]
		Approved	GENERAL EDUCATION (if applicable; for General Education courses only) [print name here:]
		Approved	HONORS COLLEGE (if applicable; for Honors courses & programs) [print name here:]
		Approved	UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR (for undergraduate courses only)  2-24-15
		Approved	GRADUATE COUNCIL CHAIR (for graduate courses only)
			FACULTY GOVERNANCE ASSISTANT (received and processed in Academic Affairs)



UNC CHARLOTTE

SHORT FORM COURSE AND CURRICULUM PROPOSAL

*To: Dr. Mehdi Miri

From: Dr. Ryan Adams

Date: 22 January 2015

Re: New Course Proposal for ECGR 4190

SUMMARY:

The Electrical and computer Engineering Department proposes to add a new course, ECGR 4190, Science and Technology of Photovoltaics. This class will enhance the department offerings in renewable energy, a major new area of focus for the department. The class will consist of two lectures each week in which students will learn the design and modeling of high efficiency solar cells on various semiconductor materials. The economics of various solar cell structures and systems would be covered including the localized cost of electricity (LCOE) to compare in real terms, the cost of electricity from solar, to other sources of energy. This will be a 3 credit class.

FOR CONSULTATION WITH OTHER DEPARTMENTS:

1. Does the proposed change affect other departments (including additions and/or changes to degree requirements or prerequisites offered in other departments)?
 Yes X No
2. If Yes, please list the other departments affected by the proposed change:
3. Have you consulted with each department listed in item 2 regarding the proposed change?

_____ Yes _____ No

Result(s) of Consultation(s) (please attach documentation):

4. For a new course or for major modification of an existing course, include Consultation on Library Holdings.
5. For proposals involving Honors courses or programs, include written consultation with the Honors Council.

RESOURCES:

1. For a new course or revisions to an existing course, check all the statements that apply:
_____ This course will be cross listed with another course.
 There are prerequisites for this course.
_____ There are co-requisites for this course.
_____ This course is repeatable for credit.
_____ This course will affect the number of credits hours for its program.
_____ This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.
_____ This proposal will alter an agreement with a North Carolina community college.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

2. Indicate the additional resources required, if any, to implement and maintain the proposed change.

None

CREDIT HOUR (Mandatory if new and/or revised course in proposal):

Review statement and check box once completed.

- The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of a credit hour.

PROPOSED CATALOG COPY: For existing courses copy and paste the current catalog copy and use the Microsoft Word "track changes" feature (or use red text with "~~strikethrough~~" formatting for text to be deleted, and adding blue text with "underline" formatting for text to be added). For new courses, draft comprehensive catalog copy.

ECGR 4190. Science and Technology of Photovoltaics. (3) Prerequisite: ECGR 3133 with a grade of C or above, or permission of the department. Review of semiconductor properties; junctions and operating principles of solar cells; efficiency limits and losses in solar cells; solar cells and sunlight; fabrication of solar cell and modules; design of high efficiency silicon solar cells; heterojunction, thin film and other promising solar cells; photovoltaic systems and applications.

ACADEMIC PLAN OF STUDY (UNDERGRADUATE ONLY): Does the proposed change impact an existing Academic Plan of Study?

- Yes. If yes, please provide updated Academic Plan of Study in template format.
 No.

STUDENT LEARNING OUTCOMES (UNDERGRADUATE & GRADUATE): Does this course or curricular change require a change in SLOs or assessment for the degree program?

- Yes. If yes, please provide updated SLOs in template format.
 No.

TEXTBOOK COSTS: It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?

- Yes. Briefly explain below.
 No. Briefly explain below.

A freely available electronic text has been adopted for this course

IMPORTANT NOTE: A Microsoft Word version of the final course and curriculum proposal should be sent to facultygovernance@uncc.edu upon approval by the Undergraduate Course and Curriculum Committee and/or Graduate Council chair.



J. Murrey Atkins Library

Consultation on Library Holdings

To: Aba Ebong
From: Jeff McAdams
Date: 10/20/14
Subject: ECGR 4190 – Photovoltaic Science and Engineering

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams Date: 10/20/14

Check One:

- 1. Holdings are superior
2. Holdings are adequate (checked)
3. Holdings are adequate only if Dept. purchases additional items.
4. Holdings are inadequate

Comments:

Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including Inspec, Compendex, Science Direct, IEEE Xplore, ENGnetBASE, Electronics & Communications Abstracts, Solid State and Superconductivity Abstracts, Optics InfoBase, Web of Science, and many others.

Table with 3 columns: LC Subject Heading, Books, Journals. Rows include Solar Cells, Photovoltaic, Solar energy storage, Semiconductors.

Handwritten signature of Jeff McAdams

Evaluator's Signature

10/20/14

Date

ECGR 4090/5090 Science & Technology of Photovoltaic



Spring 2014

Instructor

Dr. Aba Ebong

Office: EPIC 2162

Phone: 704 687 0307

Class Hour

Monday 2:00-3:15 pm

Venue

EPIC 2230

Course Website

Moodle2.unc.edu

Office Hours

Tuesdays: 10:00-12:00 am and appointments

Course Objectives

To introduce the science, technology and operating principles of various solar cells including optoelectronic properties of bulk and thin film silicon, and compound semiconductors; modeling and design factors for high efficiency solar cells, fabrication and characterization of solar cells, module fabrications and systems

Textbooks

1. The Physics of solar cells by Jenny Nelson, Imperial College Press, 2007
2. Solar Cells: Operating Principles, Technology, and Systems Applications (Prentice Hall series in solid state physical electronics) by Martin Green
3. Photovoltaic Systems Engineering (3rd Edition - 2010); Roger A. Messenger and Jerry Ventre

Exams and Grades

Final grades will be based on the following

Quizzes	4	10%
Tests	2	10%
Project	1	30%
Home work	5	10%
Final Exam	1	40%

Attendance

You are responsible for all topics, assignments and announcements given during classes

Smoking, eating and drinking

None of the above is allowed by the university during regular class meetings

Cell phones

Must be turned off during class hours. On no account should you answer a phone during class meetings.

Syllabus

1. Solar Cells and Sunlight
 - a. The vision of Photovoltaic
 - b. Physical source of sunlight, solar constant, insolation data
 - c. Direct and diffused radiation
 - d. Cost analysis of PV systems
2. Review of Semiconductor Properties
 - a. Dynamics of electrons and holes
 - b. Generation and recombination process in semiconductors.
 - c. Interaction of sunlight with semiconductor
 - d. Reflectance and absorption of light
3. Junctions and Operating Principles of Solar Cells
 - a. Homo and hetero junctions
 - b. Dark and illuminated characterization of solar cells
 - c. Internal quantum efficiency of solar cells
 - d. Equivalent circuit of solar cells
 - e. Solar cell output parameters
4. Efficiency Limits & Losses in Solar Cells
 - a. Efficiency limits for black body cells
 - b. J_{sc} losses
 - c. V_{oc} losses
 - d. FF losses
 - e. Effect of temperature on cell performance
 - f. Practically achievable efficiency limit

5. Fabrication of solar cell and modules
 - a. Promising PV Si materials
 - b. Fabrication of baseline Si solar cell
 - c. Fabrication of advanced Si solar cells
 - d. Construction of solar cell module
6. Design of high efficiency Si Solar Cells
 - a. Surface recombination velocity & spectral response consideration
 - b. Heavy doping effects, junction depth, emitter doping profile consideration
 - c. Substrate doping, thickness & diffused length consideration
 - d. Grid, BSF, ARC designs
 - e. Texturing & Light trapping
7. Hetero junction, thin film & other promising solar cells
 - a. GaAs solar cells
 - b. Amorphous Si thin-film solar cells
 - c. Polycrystalline thin-film CdTe & CuInSe₂ cells
 - d. Multi junction solar cells
 - e. Concentrator solar cells
 - f. Organic solar cells
8. PV Systems & applications
 - a. Stand alone PV systems
 - b. Utility interactive PV systems
 - c. Modeling & design of PV systems
 - d. Building integrated PV

Academic Dishonesty

All the provisions of the University code of academic integrity apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid.

Please read the discourse on cheating and ECGR 4090/5090 on the web page. For homework and projects, while discussion is allowed, direct copying is not and students must turn in individual submissions. Realize that mastery of the material in the homework and assignments will be essential for a good performance on the quizzes and exams!

All UNC Charlotte students have the responsibility to be familiar with and to observe the requirements of The UNC Charlotte Code of Student Academic Integrity (see the Catalog). This Code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials (such as Library books on reserve), and complicity in academic dishonesty (helping others to violate the Code). Any further specific requirements or permission regarding academic integrity in this course will be stated by the instructor, and are also binding on the students in this course. Students who violate the Code can be punished to the extent of being permanently expelled from UNC Charlotte and having this fact recorded on their official transcripts. The normal penalty is zero credit on the work involving dishonesty and further substantial reduction of the course grade. In almost all cases, the course grade is reduced to "F." If you do not have a copy of the Code, you can obtain one from the Dean of Students Office or access it online at www.legal.uncc.edu/policies/ps-105.html. Standards of academic integrity will be enforced in this course. Students are expected to report cases of academic dishonesty they become aware of to the course instructor who is responsible for dealing with them.

Course Calendar

Refer to the web page: <http://www.registrar.uncc.edu/calendar.htm> for the academic calendar.

Instructor and Student Conduct

Syllabus Revisions: The standards and requirements set forth in this syllabus may be modified at any time by the course instructor. Notice of such changes will be by announcement in class and/or by email to your UNCC email address.

Disability Services/Special Needs: If you have a documented disability and require accommodation in this course, contact the Disability Services office, located in Fretwell building, room 230. Phone 704/687.4355 (voice/TDD). Information about available services can be found at: <http://www.ds.uncc.edu>. Students in this course seeking accommodations to disabilities must first consult with the Office of Disability Services and follow the instructions of that office for obtaining accommodations. Please initiate this process and inform me during the first two weeks of class.

Diversity: UNC Charlotte strives to create an academic climate in which the dignity of all individuals is respected and maintained. Therefore, we celebrate diversity that includes, but is not limited to ability/disability, age, culture, ethnicity, gender, language, race, religion, sexual orientation, and socioeconomic status.

Sexual Harassment: All students are required to abide by the UNC Charlotte Sexual Harassment Policy (<http://www.legal.uncc.edu/policies/ps-61.html>) and the policy on Responsible Use of University Computing and Electronic Communication Resources (<http://www.legal.uncc.edu/policies/ps66.html>). Sexual harassment, as defined in the UNC Charlotte Sexual Harassment Policy, is prohibited, even when carried out through computers or other electronic communications systems, including course-based chat rooms or message boards.

Religious Accommodations for Students: UNC Charlotte Policy #134 in part states: Students who, acting in accordance with this Policy, miss classes, examinations or other assignments because of a religious practice or belief must be provided with a reasonable alternative opportunity to complete such academic responsibilities. It is the obligation of students to provide faculty with reasonable notice of the dates of religious observances on which they will be absent by submitting a Request for Religious Accommodation Form to their instructor prior to the census date for enrollment for a given semester. The census date for each semester (typically the tenth day of instruction) can be found in UNC Charlotte's academic calendar. A student who submits a Request for Religious Accommodation Form after the census date must show good cause for the late submission, and the late submission itself may be taken into account in determining whether the student has a religious practice or belief requiring accommodation and whether granting the request would create undue hardship. (<http://legal.uncc.edu/policies/ps-134.html>). Read the policy webpage for specific details and the form.