The University Of Toledo

NEW COURSE PROPOSAL

Level (check one)

Undergraduate

Graduate

Will this course impact program requirements? If yes, a Program Modification must be completed.

Type of course (check all that apply):

Academic Skills Enhancement Writing Intensive (WAC) honors

Univ. Core: *English* *Hum* *Math* *Nat.Sciences* *Social Sciences*

Multicultural: *Diversity of US Culture* *Non-US Culture*

Transfer module: *Arts&Hum* *Engl* *Math* *Nat Sci & Phys* *Soc Sci*

(to be considered as core curriculum, question 18 must be completed)

1. College: ~~ARS~~ NSM SCS

   Department: PHYS

2. Contact Person: Steven Federman Phone: Email: steven.federman@utoledo.edu

3. Alpha/Numeric Code (Subject area - number): PHYS - 6280

4. Proposed title:

   PHOTOVOLTAIC MATERIALS AND DEVICE PHYSICS

   * Laboratory SCS

   Proposed effective term: FALL 2011

5. Planned enrollment per section: per term: 6

6. Is the course cross-listed with another academic unit? Yes ☑ No

   Is the course offered at more than one level? ☑ Yes No

   If yes to either question, please list additional Alpha/Numberic codes, and submit a separate New Course form or Course Modification form for the course(s) referenced below.

   a. PHYS - 7280 b. - c. -

   Approval of other academic unit (signature)

   Name and title

Administrative Use Only

Code:

Approved (senate or Grad Council)

Effective Date: / / **(mm/dd/yyyy)**

CIP Code:

Sub: **Prog:** **Level:**

If course is to be offered at more than one level, attatch an explanation of the different requirements that students must meet for each level. If the requirements are the same for each level, justification must be provided.

7. Credit hours: Fixed: 3 or Variable: to

8. Delivery Mode:

	Primary	Secondary	Tertiary
a. Activity Type*	Regular Lab	Lecture	
b. Minimum Credit Hours	3		
Maximum Credit Hours	3		
c. Weekly Contact Hours	4	1	

*Choices are: Lecture, Recitation, Seminar, Regular Lab, Open Lab, Studio, Clinic, Field, Independent Study, Workshop, Computer Assisted Instruction, Other

9. Terms offered: ☑ **Fall** **Spring** **Summer**

Years offered: ◉ Every Year ○ Alternate Years

10.

Are students permitted to register for more than one section during a term? ◉ No ○ Yes

May the courses be repeated for credit? ◉ No ○ Yes Maximum Hours

11.

Grading System:	Undergraduate	Gradute
	○ Normal Grading (A-F,PS/NC.PR, I)	◉ Normal Grading (A-F,PS/NC.PR, I)
	○ Passing Grade/No Credit (A-C, NC)	○ Grade Only (A-F)
	○ Credit/No Credit	○ Satisfactory/Unsatisfactory (G only)
	○ Grade Only (A-F, PR, I)	○ Audit only
	○ Audit only	○ No Grade
	○ No Grade	

12. Prerequisites (must be taken before): a. PHYS - 6140 b. PHYS - 7140 c. -

PIN (Permisson From Instructor) PDP (Permission From Department)

Co-requisites (must be taken together): a. - b. - c. -

13.

If course is to replace an existing, course(s) will be deleted, and when should that deletion occur?

	Course to be removed from inventory	Final Term to be offered (YYYYT, i.e. use 20064 for Fall'06)
a.	-	
b.	-	
c.	-	
d.	-	

14.

Catalog description (30 words Maximum)

Fabrication and characterization of solar cell materials and devices, addressing materials science and physics of substrate preparation, absorber and window deposition processes, metal contact formation, and measurement of physical properties. One four-hour lab and one-hour lecture per week.

15.

Attach a copy of a complete outline of the major topics covered. (Providing a syllabus that includes this information is acceptable.)

Syllabus:	Click here to view the Syllabus
Attachment 1	No Attachment
Attachment 2	No Attachment

16.

Where does this course fit in the University/College/Department curriculum? (Be specific by course level, if applicable). Indicate prospective demand.

This course is designed for MS-PP, PhD, and other MS students focusing in the area of photovoltaics.

17.

If the proposed course is similar to another course in the College or University, please describe the difference and provide a rationale for the duplication. (If this course duplicates material covered in another course within your department or college or in another college, attach a letter of endorsement from that area's dean and department chairperson indicating their support. Clarify the maner in which this course will differ).

18.

If the course is intended to meet a University Undergraduate **Core** requirement, complete the following and submit a course syllabus using the *template*:

Please explain how this course fulfills the general education guidelines. (*Guidelines* are available in *Faculty Senate Website*)

Course Approval:

Department Curriculum Authority:	[signature]	Date	3	14	2011	(mm/dd/yyyy)
Department Chairperson:	LSAA	Date	3	14	2011	(mm/dd/yyyy)
College Curriculum Authority:	[signature]	Date	3	17	2011	(mm/dd/yyyy)
College Dean:	Christine G. Habrecht	Date	4	19	2011	(mm/dd/yyyy)

After college approval, submit the original signed form to the Faculty Senate (UH 3320) for undergraduate-level courses; for graduate-level courses submit the original signed form to the Graduate School (UH3240). For undergraduate/graduate dual-level courses, submit the proposals to each office.

Faculty Senate Undergrad. Curriculum Comm.:		Date	/	/		(mm/dd/yyyy)
Faculty Senate Core Curriculum Comm :		Date	/	/		(mm/dd/yyyy)
Graduate Council :		Date	/	/		(mm/dd/yyyy)
Office of the Provost :		Date	/	/		(mm/dd/yyyy)
Registrar's Office:		Date	/	/		(mm/dd/yyyy)

New Course Description and Syllabus: "Photovoltaic Materials and Device Physics Laboratory"

PHYS 6280/7280 (proposed course numbers) -- PHOTOVOLTAIC MATERIALS AND DEVICE PHYSICS LABORATORY

[3 hours] Fabrication and characterization of solar cell materials and devices, addressing materials science and physics of substrate preparation, absorber and window deposition processes, metal contact formation, and measurement of physical properties. One four-hour lab and one-hour lecture per week. Prerequisite: PHYS 6140/7140

Example Syllabus

Photovoltaic Materials and Device Physics Laboratory provides hands-on experience with the processes and techniques used to fabricate and characterize solar cells. The requirements to produce efficient and stable photovoltaic devices are exacting and extensive, and each step may require substantial characterization and trials to confirm the desired material, film, and interface properties. Students will assemble into small teams to address specific steps in the process, including assessment of substrate and transparent conductor properties, deposition of semiconductor absorber and window layers, deposition of metal contact layer, and characterization of these layers' properties. Teams will work toward functional devices, which will be characterized using current-voltage and quantum efficiency techniques, and stability testing such as light-soaking and environmental exposure testing.

Students will maintain careful and legible laboratory notebooks, which will be submitted periodically during the course. Notebooks will also provide invaluable reference during preparation of lab reports, which will constitute a significant fraction of the course grade. Reports should include: an appropriate introduction describing previous steps and the foundation of the report's content; details on materials, apparatuses' purpose and function, and experimental setups; the measurements made and data acquired; data analysis including error and uncertainty analysis; and conclusions/status. Reports should be written carefully and in a professional style to describe the details and implications of the laboratory experiments and results, include all appropriate references, feature carefully-prepared figures and tables with labels and captions, and feature graphs with axes labeled (with units!) and annotations as appropriate (labeling peaks and other features). When operating within teams involving undergraduate students, graduate students will take a leadership role in planning and coordinating characterization studies, transfer detailed knowledge to the undergraduates, and lead the preparation/delivery of the summary presentation.

An example timeline follows:

Week 1	Data acquisition, analysis, report writing	Week 12-13	Device characterization and testing
Week 2-4	Rapid solar cell fabrication and characterization	Week 14-15	Review, revise, and improve results
Week 5-9	Thin film depositions, characterization	Week 16	Final reports, presentations
Week 10-11	Thin film device completion	Follow-up	Course revision and feedback

PHYS 4580 – MOLECULAR AND CONDENSED MATTER LABORATORY (title revised)
(description revised)
[3 hours] Experiments in molecular and condensed matter physics. Measurements and analysis based on techniques such as film thickness and surface morphology, X-ray diffraction, optical absorption, four-point probe and Hall measurements. One four-hour lab and one-hour lecture per week. May be offered as writing intensive. Prerequisite: PHYS 3320

Example Syllabus

Molecular and Condensed Matter Physics Laboratory provides hands-on simulated research experience to develop experimental skills associated with understanding the physics of materials and of property characterization measurements. Some experiments may focus on understanding the requirements to produce efficient and stable photovoltaic devices, enabling students to learn about the key steps in solar cell processing through analytical measurement and characterization of these materials. Experimental techniques may include those listed in the table below.

Students will maintain careful and legible notes in their lab notebooks, submitted at intervals during the semester for feedback on content, style, and techniques; notebooks will also provide invaluable reference during preparation of lab reports on an every-two-weeks interval. These laboratory reports will constitute a significant fraction of the course grade, and should include: an appropriate introduction describing previous steps and the foundation of the report's content; details on materials, apparatuses' purpose and function, and experimental setups; the measurements made and data acquired; data analysis including error and uncertainty analysis; and conclusions/status. Reports should be written carefully and in a professional style to describe the details and implications of the laboratory experiments and results, include all appropriate references, feature carefully-prepared figures and tables with labels and captions, and feature graphs with axes labeled (with units!) and annotations as appropriate (labeling peaks and other features).

This course may involve close interaction with graduate students taking PHYS 6280/7280 who will be working on the fabrication and characterization of thin film solar cells. Undergraduates would work with graduate students to assist them with the measurements necessary to understand, assess, and revise the materials and processes involved in thin film solar cell fabrication and testing.

Example experiments/measurements:

Week 1	Data acquisition, analysis, report writing	Week 12-13	Current-voltage and quantum efficiency characterization;
Week 2-4	Optical characterization, evaporation of metals, electrical characterization, nanomaterial properties	Week 14-15	Light-soaking effects; stability measurements; exposure testing and UV
Week 5-9	X-ray diffraction, surface morphology, film thickness, Hall mobility	Week 16	Final reports, presentations
Week 10-11	Thin film device completion	Follow-up	Course revision and feedback