LSC Use Only
Number: ______
Submission Date: ______
Action-Date: ______

UWUCC USE Only
Number: 96-25
Submission Date: ______
Action-Date: App 3/18/97
Senate App 4/1/97

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. **CONTACT**

Contact Person Dennis Whitson Phone x4593

Department Physics

II. **PROPOSAL TYPE (Check All Appropriate Lines)**

X **COURSE** Computer Interfacing
Suggested 20 character title

____ New Course* ______
Course Number and Full Title

X Course Revision PY 355/555 Computer Interfacing
Course Number and Full Title

____ Liberal Studies Approval+ for new or existing course ______
Course Number and Full Title

____ Course Deletion ______
Course Number and Full Title

X Number and/or Title Change PY 150 Computer Applications to Physics Laboratories
Old Number and/or Full Old Title

PY 355/555 Computer Interfacing
New Number and/or Full New Title

X Course or Catalog Description Change PY 355/555 Computer Interfacing
Course Number and Full Title

____ **PROGRAM:** ____ Major ____ Minor ____ Track

____ New Program* ______
Program Name

____ Program Revision* ______
Program Name

____ Program Deletion* ______
Program Name

____ Title Change ______
Old Program Name

______
New Program Name

III. Approvals (signatures and date)

Kenneth E Hershman
Department Curriculum Committee

Richard D. Roberts
Department Chair

College Curriculum Committee

John D. Eck
College Dean

______
+Director of Liberal Studies (where applicable)

______
*Provost (where applicable)

Syllabus of Record

I. Catalog Description

PY 355 Computer Interfacing	3 credits 2 lecture hours 2 lab hours (2c-2l-3sh)

Prerequisites: CO 110

This course is designed to teach the fundamentals of interfacing the personal computer to its physical surroundings. The students will learn how to collect data and to control experiments in real time. They will learn how to use digital to analog conversion (DAC) techniques and analog to digital conversion (ADC) techniques. They will also use a graphical software package (such as LabVIEW) to design icon based interfacing tools, to learn how to use virtual instruments and to analyze data.

II. Course Objectives

1. To have the students learn the basic concepts of computer interfacing.

2. To have the students learn how to use the C language to write drivers for the A/D (Analog to Digital), D/A (Digital to Analog) card.

3. To have the students be capable of positioning mechanical objects through the use of stepping motors.

4. To have the students be capable of collecting up to eight analog signals and storing the results in digital memory through the utilization of the ADC (Analog to Digital Conversion) and the multiplexer.

5. To have the students be capable of utilizing the DAC (Digital to Analog Conversion) to drive outside experiments with an analog signal.

6. To have the students learn how to synthesize and display a waveform on the monitor and how to output that signal through the DAC.

7. To have the students learn how to design icon based interfacing tools and to learn how to use virtual instruments

8. To foster in the student the ability to work independently.

III Course Outline

Note: Each lecture is one hour and each lab is one hour.

A. Review of programming in the C Language (3 lectures and 3 labs).
1. Declaring and using variables (int, short, long, unsigned, char, float, double, etc.).
2. Functions such as sizeof(), printf(), scanf(), strlen(),
3. Character strings and formatted Input/Output.
4. Operators such as +, -, *, /, % ,++, --, >, <, >=, etc.

5. C control statements: Looping (for, while, do while) and branching (if, else, switch, etc.).
6. Arrays and pointers.
7. Bitwise operators.
8. Reading and writing files.

B. Digital Interfacing using the digital outputs and inputs of the D/A (Digital to Analog) card (4 lectures and 4 labs).
1. Turning diodes on and off and displaying characters on a seven-segment readout.
2. Controlling a stepper motor.

C. Designing timers by programming registers (1 lecture and 1 lab).

D. Analog Interfacing using the C language with NI-DAQ (National Instruments-Digital Acquisition) functions (8 lectures and 8 labs).
1. Synthesis and generation of waveforms.
2. Digital to Analog Conversion (DAC).
3. Analog to Digital Conversion (ADC).
4. Driving a RC circuit with the DAC output and collecting the output at the ADC and then displaying the result using a graphing package.

E. Introduction to LabVIEW (1 lec and 1 lab).

F. Use LabVIEW to generate selected waveforms (2 lec and 2 lab).

G. Use LabVIEW to drive a RC (Resistor-Capacitor) circuit with the DAC output and collect the output at the ADC and then use LabVIEW to display the result using its graphing capabilities (3 lectures and 3 labs).

H. Use LabVIEW to do curve fitting and data analysis (3lecture and 3 lab).

IV. Evaluation Methods

The final grade for the course will be determined as follows:

40% Tests. Four tests (three during the semester and a final) consisting of both writing programs with open book and answering questions with closed book.

50% The assigned programs. The labs will be demonstrated to work to the instructor.

2% Problem assignments(only made for the first three weeks).

8% Objective determination of the instructor. Most of the time there will be two students per computer setup leading to the possibility that one student will do most of the work. The instructor will observe and interact with each student and thus will have a good idea of his/her progress and contribution to the work.

Grading Scale: A is 90 -> 100 %; B is 80 -> 89.9%; C is 70 -> 79.9%; D is 60 to 69.9%; F < 60%

V. Required textbooks, supplemental books and readings

NI-DAQ for Macintosh, Software Reference Manual, Version 4.5, National Instruments, 1992.

Lab-NB User Manual, National Instruments, 1991.

Wells, Lisa K., LabVIEW, Graphical Programming for Instrumentation, Student Edition User's Guide, National Instruments, 1994.

VI. Special resource requirements

Reference manual for the C language.

VII. Bibliography

Waite, Mitchell and Prata, Stephen, The Waite Group's New C Primer Plus, Second Edition, SAMS Publishing, 1993.

Perry, Greg, C by Example, The Easiest Way to Learn How to Program!, Que, 1992.

NI-DAQ for Macintosh, Software Reference Manual, Version 4.5, National Instruments, 1992.

Lab-NB User Manual, National Instruments, 1991.

Wells, Lisa K., LabVIEW, Graphical Programming for Instrumentation, Student Edition User's Guide, National Instruments, 1994.

LabVIEW 2, User Manual, National Instruments, 1992.

LabVIEW 2, Analysis VI Library Reference Manual, National Instruments, 1992.

LabVIEW 2, Data Acquisition VI Library Reference Manual, National Instruments, 1992.

Note: The only old Syllabus of record is the 1977 one that is attached. Also attached is the Syllabus for 1996.

Summary of Proposed Revisions

I. Include CO 110 as a prerequisite.

II. Change of course number from PY 150 to PY 355.

III. Introduce LabVIEW into the course.

IV. Make the course dual level.

Justification/Rationale for the Revisions

I. Include CO 110 as a prerequisite.

In the past FORTRAN was the language taught in CO 110. Starting F96 the C language is being taught in CO 110. The C language had to be taught in PY 150 since very few of the students had previous experience with it and it was necessary for the course, i.e. all the drivers are written using the C language. With CO 110 as a prerequisite I will be able to go right into a review of the C language and then into having the students write drivers in the C language.

II. Change of course number from PY 150 to PY 355.

Since CO 110 will be a prerequisite for PY 355 it seems reasonable to make it into a higher level course. Also it is being requested that the course be made into a dual level course.

III. Introduce LabVIEW into the course.

LabVIEW, or Laboratory Virtual Instrument Engineering Workbench, is a graphical programming language that has been widely adopted throughout industry, academia, and government labs as the standard for data acquisition and instrument control software. It includes all the tools necessary for data acquisition, analysis, and presentation. It uses a graphical programming language called "G" which the student can program using a block diagram method with icons that then compiles into machine code. This allows one to set up "Virtual Instruments" on the computer monitor, i.e. icons of switches, meters, etc. appear on the screen that are connected together and represent oscilloscopes, voltmeters, temperature regulators, etc. The versatility is phenomenal. This is a tool that all our graduates should have.

IV. Make the course dual level.

Very few of our graduate students come to us having had a course similar to this one, however the skills and knowledge gained from this course (see above) are becoming more and more essential to our graduates (both BS and MS) in order for them to function at a high level whether they teach, work in industry, or go to graduate school after they leave us. By making this a dual level course we would give them easy access to the material in this course.

APPENDIX-Dual Listing for Graduate Credit PY355 / 555

I. Catalog Description

PY 555 Computer Interfacing	3 credits 2 lecture hour 2 lab hours (2c-2l-3sh)

Prerequisites: Experience in writing computer programs in the C language.

This course is designed to teach the fundamentals of interfacing the personal computer to its physical surroundings. The students will learn how to collect data and to control experiments. They will learn how to use digital to analog conversion (DAC) techniques and analog to digital conversion (ADC) techniques. They will also use LabVIEW (or a similar software package) to design icon based interfacing tools and to learn how to use virtual instruments. The student will investigate the conditioning of analog and digital information using the LabVIEW capabilities. The student will complete a special project that is decided on by the instructor and the student.

II. Additional Assignments for the Graduate Student.

The last two lines in the Catalog Description above are the added assignments that the graduate student will accomplish, in addition to all that the undergraduate students do. The signal conditioning would consist of taking the FFT (Fast Fourier Transform) of data, integrating data, differentiating data, etc. LabVIEW has many capabilities for conditioning the analog or digital data. The graduate student will also complete a project such as putting together and making operational a sonic range finder or an Archimedes screw which can be used to adjust the physical position of an object. The data from the sonic range finder would be displayed as displacement vs time, velocity vs time, and acceleration vs time. The data would have to processed by LabVIEW. For the Archimedes screw a great deal of programming using icons would have to be done with LabVIEW. Other projects will be added through the years.

III. Criteria for Evaluation of the Student's Performance

The final grade for the course will be determined as follows:

40%	Tests. Four tests (three during the semester and a final) consisting of both writing programs with open book and answering questions with closed book.
40%	The assigned programs. The labs will be demonstrated to work to the instructor.
2%	Problem assignments (only made for the first three weeks).
18%	Special Project.

The difference here from the undergraduate is the grading on the special project.

IV. Additional Resources

There will be no additional resources required for this change.

Note: The only old Syllabus of record is the 1977 one that is attached, pg's 7 and 8. Also attached is the Syllabus for 1996, pg's 9 and 10.

Also attached are support letters from the Chairs of Departments that would be affected by these changes, pg's 11 through 14.

DEPARTMENT: Physics

COURSE TITLE: Computer Applications to Physics Laboratories

COURSE NO.: PY 150

CREDIT HOURS: 3

INSTRUCTOR: Dr. Richard Berry

1. COURSE DESCRIPTION:
   This course covers applications of the RCA 110A and Microcomputers to laboratory data acquisition. Interfaces between pulse height analyzers, signal averagers and other digital instrumentation are designed and constructed. The course will have a flexible lecture-laboratory-demonstration format with a scheduled 2 lecture/week and two 2 hour/lab per week as the nominal pattern. This will be modified to scheduled student use time when they are programming.)

2. HOW FREQUENTLY WILL THE COURSE BE OFFERED?
   No more than once per year

3. WHAT PREREQUISITES, IF ANY?
   None

4. PROPOSED TEXT AND LABORATORY MANUAL, LIBRARY MATERIALS:
   Portions of the Instruction sets supplied with the computer will be used.

5. NEW ACQUISITIONS REQUIRED:
   None

6. NEW MATERIALS AND EQUIPMENT NEEDED:
   None

7. WILL NEW STAFF BE NEEDED? IF NOT, WHY NOT?
   No, this course has been taught twice under Special Topics.

8. IS THIS AN ADDITION TO THE INSTRUCTOR'S PRESENT LOAD?
   No.

9. WHAT CHANGES IN THE INSTRUCTOR'S COURSE LOAD WILL BE MADE TO PERMIT THE INCLUSION OF THIS ASSIGNMENT?
   None

10. WHAT CHANGES IN THE PRESENT COURSE OFFERINGS MUST OCCUR TO ALLOW FOR THE ADDITION OF THIS COURSE - IN GENERAL EDUCATION AND/OR MAJOR SEQUENCE?
    None

11. WHAT ACADEMIC NEED DOES THIS COURSE FULFILL?
    Students are increasingly more interested in laboratory applications of the computer and there are too many students to teach them one at a time in a casual manner. The only solution is a formal course with credit because it does take a lot of a student's time to learn how data acquisition is actually managed in a real time environment.

12. HAVE THERE BEEN SPECIFIC REQUESTS FOR THIS COURSE?
    Yes

Course PY 150

13. HOW WOULD THIS COURSE INTEGRATE WITH THE EXISTING DEPARTMENTAL PROGRAM?
It is an elective

14. DOES THIS COURSE INTEGRATE WITH THE EXISTING DEPARTMENTAL PROGRAM?
Yes

15. HAVE YOU EXAMINED THE CATALOG TO SEE IF A SIMILAR COURSE IS OFFERED ELSEWHERE IN THE UNIVERSITY
Yes, no other course of this type is offered at I.U.P.

16. WILL THIS COURSE BE SELF-CONTAINED OR WILL IT NECESSITATE ADDITIONAL COORDINATE AND/OR COROLLARY COURSES?
It is self-contained.

17. IS THIS COURSE CURRENTLY BEING OFFERED AT ANY OTHER UNIVERSITY?

Yes, using different resources as are available at other universities.

18. ARE YOU AWARE OF ANY OBJECTIONS TO THE COURSE?
No, except for possible effects on teaching load.

19. ADDITIONAL INFORMATION FOR THE COMMITTEES:
This course will contain a brief functional review of the computers and a short discussion of programming. Students will be encouraged to acquire an adequate background by taking Computer Science courses before enrolling.

8/21/96

SYLLABUS

COMPUTER APPLICATIONS TO PHYSICS 3 CREDITS
PHYSICS 150

Description:

This course is designed to teach the fundamentals of interfacing the personal computer to its physical surroundings. The students will learn to program in the C language in order to collect data and to control experiments: They will learn how to use digital to analog conversion (DAC) techniques and analog to digital conversion (ADC) techniques.

Objectives:

(1) To have the students learn the basic concepts of computer interfacing.

(2) To have the students learn the C language to the level needed for computer interfacing.

(3) To have the students learn the basics of the use of the digital input and output.

(4) To have the students capable of positioning mechanical objects through the use of stepping motors and the digital input and output.

(5) To have the students capable of utilizing the DAC (Digital to Analog Converter) to drive outside experiments with an analog signal.

(6) To have the students capable of collecting a analog signal and storing the results in digital memory through the utilization of the ADC (Analog to Digital Converter).

(7) To have the students learn how to synthesize and display a waveform on the monitor and how to output that signal through the DAC.

(8) To have the students learn how to digitally store an analog signal that changes with time and then to plot the changing signal vs. time.

Procedures:

(1) Classroom time is used for lecture presentations and for going over difficulties that the students have run into during the lab.

(2) Students work outside of class on preparations for their labs.

(3) A weekly 2-hr lab is devoted to "hands-on" applications of interfacing techniques.

Grading:

The course grade is determined by problem assignments (8%), in-class tests (40%), the successful completion of the assigned programs and labs (44%), and the objective determination of the instructor (8%).

Course Outline:

I. Programming in the C Language.

(a) Declaring and using variables (int, short, long, unsigned, char, float, double, etc.).

(b) Functions such as sizeof(), printf(), scanf(), strlen(),

(c) Character strings and formatted Input/Output.

(d) Operators such as +, -, *, /, % ,++, --, >, <, >=, etc.

(e) C control statements: Looping (for, while, do while) and branching (if, else, etc.).

(f) Arrays and pointers.

(g) Bitwise operators.

(h) Reading and writing files.

II. Digital Interfacing using the digital output of the D/A card.

(a) Turning diodes on and off and displaying characters on a seven-segment readout.

(b) Using interrupts to initiate an action.

(c) Controlling a stepper motor.

III. Analog Interfacing using the C language with NI-DAQ functions.

(a) Synthesis and generation of waveforms.

(b) Digital to Analog Conversion (DAC).

(c) Analog to Digital Conversion (ADC).

IV. Charging and discharging a capacitor in a RC circuit using the DAC output and then collecting the changing voltage using the ADC input. The voltage will be plotted vs. time using Cricket Graph.

October 15, 1996

TO: Dr. Dennis Whitson

FROM: Dr. Pothen Varughese, Chair
Department of Chemistry

Pothen Varughese

SUBJECT: Changes in PY 150 (Interfacing Course)

The Chemistry Department supports the changes you proposed to make in the PY 150 course. We believe that the Applied Physics majors who choose the chemistry track will benefit from these changes and it does not in any way affect any of the course offerings of the Chemistry Department. In fact, some of our chemistry majors may be advised to take PY 150 as an elective. If it is made a dual level course, chemistry graduate students may also be interested in taking this as an elective. This will be an appropriate course for our analytical chemistry majors who needs computer interfacing experience in their graduate program.

jas

BIOLOGY DEPT.

Indiana, Pennsylvania 15705

October 14, 1996

TO: Dr. Dennis Whitson
Physics Department

FROM: Dr. Robert Prezant, Chair

RE: Change in PY 150 (Interfacing Course)

I support the proposed changes for PY 150. The changes are logical and will help Applied Physics students progress through and beyond the program. The requirement of CO 110 as a prerequisite is mandatory in order to have appropriate computer language skills; the added curriculum makes it appropriate to increase the course level from 100 to 300 level; and finally, with the added requirements for graduate students as outlined in the proposal, the dual listing makes perfect sense. The latter will increase the students preparation for additional graduate work (at the Ph.D. level) or employability of the M.S. students emerging from this program.

la

23 October 1996

To: Dennis Whitson
Physics Department

From: Jim Wolfe, chair
Computer Science Dept. Curriculum Committee

Subject: Changes to PY 150

The Computer Science Department is pleased to support the proposed revision of PY 150 to become PY 355. We see the created dependence on CO 110 as a prerequisite as a benefit to both departments. Physics students will benefit by being assured of a complete introduction to C++ in the process of developing problem solving skills in CO 110. The Computer Interfacing course will benefit by having only to note the few language differences in input and output between C and C++, rather than having to introduce the whole C language.

The CO 110 course may benefit by having a few extra Physics students, although most students who were taking PY 150 were already taking CO 110. The Computer Science department benefits by satisfying the computer science needs of Physics students (and perhaps attracting a few more students to our minor program) while providing an updated core course for our majors. We do not expect any significant increase in teaching load because of this course revision.

DATE: October 22, 1996

TO: Dr. Dennis Whitson, Physics Department

FROM: Dr. Frank W. Hall, Chair FWHall
Geoscience Department

RE: Changes in PY 150 (Interfacing Course)

The Geoscience Department supports the changes in the attached information.