The Senate of Michigan Technological University

PROPOSAL 1-88

DOCTOR OF PHILOSOPHY IN APPLIED PHYSICS

BACKGROUND:

In June 1987, the State Academic Officers expressed support for the proposed Doctor of Philosophy Degree in Applied Physics at MTU. Prior to submitting the proposal to the State Academic Officers, motions to grant planning permission for the proposed degree were approved by the Faculty Senate on February 19, 1987 (Proposal 5-87, following procedures outlined in Senate Proposals 10-70 and 7-78) and by the MTU Board of Control on March 20, 1987. The final proposal must now receive approval by the Senate and then the Board of Control prior to implementation. The Senate Curricular Policy Committee voted on September 22, 1987 to recommend that the Senate approve the proposed program.

PROPOSAL:

The Senate of Michigan Technological University recommends the establishment of the program offering the Doctor of Philosophy in Applied Physics.

PROGRAM DESCRIPTION:

Introduction:

The Physics Department is proposing a Ph.D. degree in Applied Physics to strengthen and develop its overall program. The Ph.D. degree is considered the standard terminal degree in Physics.

A 1986 National Research Council survey, titled Physics Through the 1990's, predicts a critical shortage of physicists in the next ten years which will severely impede research in the United States. The particular need for training and research in scientific computation has been emphasized by a 1984 National Science Foundation Advisory Committee for Advanced Scientific Computing.

This proposed program is consistent with the MTU 2005 report which emphasizes the need for an increased graduate program and research effort. The Ph.D. degree program will enhance the Physics Department's ability to attract high quality faculty and graduate students, which will also in turn benefit the undergraduate instructional program.

Admission:

Applicants to the program are expected to have an M.S. degree in Physics (or the equivalent course work and research experience (with thesis). Applicants with a 3.0 GPA or better will be

given the highest consideration; it is expected that foreign applicants with TOEFL scores below 550 would rarely be admitted.

Students who wish to pursue a Ph.D. in Applied Physics under an MTU faculty member in a "cognate" area outside the Physics department, and who have an M.S. degree in the appropriate area, must obtain special permission of the Head, Department of Physics, the Head of the cognate department, and the proposed thesis advisor, before applying for the program. Approval must be in writing, and the student and the advisor must include a description of the research topic(s) to be studied, and the means by which the student is to be funded (including contingency plans if support is from an outside source needing renewal during the degree period).

Course of Study:

Students are expected to take the following courses as part of their Ph.D. program: Advanced Theory of Solids, Mathematical Physics (Group Theory), Advanced Quantum Mechanics (if theoretical), Applications of Parallel Processing in Physics (if computational), Advanced Experimental Methods (if experimental).

Course work for students from a "cognate" area is determined by the Thesis Advisory Committee (TAC) subject to the approval of the Physics Graduate Studies Committee (PGSC). Generally, some selected courses from Physics would be part of the student's course of study.

Upon entrance, the student is assigned an advisor by the PGSC which retains responsibility for the student's program until the TAC is formed. Formation of the TAC generally occurs in the first or second quarter following entrance, and is done by the student who selects the thesis advisor (with the help of PGSC, if necessary). Then, the student and the advisor recommends (to the PGC) two other graduate faculty members. If accepted by the PGSC, the three faulty members (at least one from Physics) become the TAC. From this point on, the TAC bears full responsibility for the student's course work and research.

The first departmental exam encountered by students is the qualifying (or comprehensive) exam which is given each spring, and is to be taken in the first spring following entry into the program (unless entry occurs in the winter or spring quarter; then the exam may be delayed until the following year). The exam is written and 6 hours in length, and tests physics skills in mechanics, electricity and magnetism, quantum mechanics, and mathematical physics (mostly). The Qualifying Examination Committee (QEC) is chosen by the PGSC and the TAC, who gives as well as grades the exam. Three grades are possible: pass, pass with condition (given in writing), or fail. Students required to retake the exam (fail, certain conditional passes) must do so the next time the exam is given. Students not passing on this occasion will be dismissed. For students in "cognate" areas, the QEC and the exam will involve faculty and questions from the "cognate" area as well as selected areas of physics.

Within six months of successful passage of the qualifying exam, the preliminary exam is taken. This exam outlines the proposed research, and indicates the student's state of current knowledge in the research area. It is given and graded by the TAC and one additional faculty member appointed by the PGSC. The exam must be passed within two months after first being taken. The remaining requirements (final exam, preparation of the thesis, residence and grade requirements) are as specified in MTU's catalog.

Research Areas:

Applied physics is the practical application of fundamental concepts and theories of physics. Research in "pure" physics, on the other hand, may or may not have a practical application in mind.

Certain disciplines, which are nearly entirely "pure" in nature are excluded from the umbrella of the proposed degree; these include high energy particle physics (we have no faculty in these areas presently, and intend to hire none).

On the other hand, we have many faculty active in computational and experimental areas, as well as some theoretical computational and experimental areas, as well as some theoretical areas (e.g. condensed matter) who are doing practical research. Examples include: (in condensed matter physics) stability of energetic solids non-invasive, non-destructive studies of materials, studies of turbulence associated with jet engines, surface studies of ice-cement interfaces, defects in metals; (in atomic and molecular physics) transport and delivery of natural gas, behavior and design of polymers; (physical properties of snow), identification of vehicles, vehicle design; (biometeorology) effect of temperature, humidity on insect behavior. The new program is tailored so that any of the current Physics faculty, who are members of the graduate faculty, may direct Ph.D. level research in any of their current specialties.

Funding Support:

Currently the department has about $1,000,000 of external funding each year. This supports 15 Graduate Research Assistantships, various equipment purchases needed to maintain and upgrade laboratories, supplies (including computer time), and provides some summer support to funded faculty. The available funds (including support from the State of Michigan) are already sufficient to maintain a graduate student population of 25-30. Any further expansion of the program would be funded through the development of additional external funding sources (i.e. no additional funding is needed from the University).

Resources:

The Physics Department now supervises students from the Physics of Solids option of the Metallurgical Engineering Department's Ph.D. program. Thus, the personnel (including graduate students), the equipment, and the library resources necessary for a Physics Ph.D. program are already in place. No new faculty will be needed to institute this program and no new equipment will be necessary. Three new doctoral-level courses, which will be taught by the current faculty, have been added. No other changes in curriculum will be necessary to initiate the proposed program.

Adopted by Senate: 23 September 1987
Supported by Administration: YES
BOC Approval: 20 November 1987