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I – PROGRAM DESCRIPTION

The graduate program in Materials Science is designed to provide advanced competence in interdisciplinary materials-related fields of study through didactic coursework and directed research activities. The program only admits students into the Ph.D. program but offers a Masters of Science as well as a Doctor of Philosophy degree. The following regulations describe the requirements for M.S. and Ph.D. degrees in Materials Science and policies for student advising, guidance and performance review. This information is intended to supplement and expand upon the regulations of the Vanderbilt Graduate School and the School of Engineering. However, specific research paths, expectations, and other requirements may be imposed by and are at the discretion of the research adviser.

The acronyms IGPMS (Interdisciplinary Graduate Program in Materials Science) and IMS (Interdisciplinary Materials Science) have both been used to identify the program. IMS is the acronym used in the course catalog to identify courses specific to the program.

II – ADMISSION CRITERIA

- Satisfactory completion of appropriate coursework in an undergraduate science or engineering program demonstrating proficiency.
- Students must take the verbal, quantitative and analytic portions of the Graduate Record Examination (GRE) for admission.
- Students for whom English is not the primary language must take the Test of English as a Foreign Language (TOEFL) examination. The Test of Written English (TWE) is also recommended.

In addition, the selection committee may consider additional information such as a personal statement, letters of recommendation, caliber of previous schools, etc.

III – STUDENT GUIDANCE, ADVISING AND COMMITTEES

Temporary Adviser. For students entering the IMS program without an adviser (most matriculates), the director of IMS will act as a temporary adviser. Students will sign up for classes based on recommendations of the director and the program administrator. In cases, where the student has already identified an adviser, course selection will be made in cooperation between the adviser and program administrator.

Thesis Adviser. By the end of the first academic year, the student will identify two thesis/project advisers. The selection is by mutual consent of the advisers and student. Each adviser must be associated with the Materials Program and have primary appointments in different departments.

Advisory Committee. The student, with the advice of the IMS director, will select additional members of the faculty to serve on the advisory committee. The advisory committee will oversee administration of the preliminary examination, and consists of at least five (including the two co-advisers) faculty members, representing three departments. At least three must be members of the Graduate Faculty, and at least three must be affiliated with the Materials Program at Vanderbilt.
**Ph.D. Committee.** The Graduate School appoints a committee of at least five members to oversee all Ph.D. qualifying examinations, dissertation research and final examinations. The requirement for this committee is the same as the advisory committee, where a committee consists of five faculty members, representing at least three departments and at least three members from the Materials Program faculty. The student’s advisor will nominate this committee and forward the nomination to the Director of the IMS program.

**TA vs. RA.** Normally students are admitted with a teaching assistantship (TA), which means they work for the materials program as a grader, lab instructor or in some other teaching role. The salary and responsibilities are set by the program. This is the mechanism the program uses to fund students before they join a research group. A TA appointment, however, is not indefinite. Students are expected to find a research adviser who agrees to provide the student’s salary as a research assistantship (RA) in return for conducting research within a research group. The salary and expectations are determined by the faculty adviser.

### IV – DEGREE REQUIREMENTS

**Ph.D. Degree Requirements.** The interdisciplinary Ph.D. degree in Materials Science requires a total of 72 hours with a minimum of 24 hours of formal coursework, of which 12 hours will be from the materials science core. Students must complete each course with a grade of B or higher. The materials science core courses must be taken in the first semester in which the course is available. The core consists of the following courses:

- **MSE 310** Atomic Arrangements of Solids
- **PHYS 223** Thermodynamics (advanced option: PHYS 341 or PHYS 355)
- **PHYS 254** Physics of Condensed Matter (advanced option: PHYS 354)

plus one of the following:

- **CHEM 350A** Chemistry of Inorganic Materials
- **CHEM 350B** Chemistry of Biological Materials
- **CHEM 235** Macromolecular Chemistry: Polymers, Dendrimers and Surface Modifications

The remainder of the 72 hours can be taken as dissertation research, coursework, or transfer credit (if applicable). Performance in dissertation research does not affect the student’s GPA.

**M.S. Degree Requirements.** The interdisciplinary M.S. degree requires a minimum of 24 semester hours (beyond the Baccalaureate) of formal course work plus a thesis signed by two faculty members. The semester hours will include at least three of the four core program courses.
A. RESEARCH ROTATIONS

First year students will participate in a series of three research rotations. Each research rotation will last 10 weeks with the expectation that approximately 9 hours per week should be devoted to working with the particular research group. Since the semesters are almost 15 weeks in length, the second rotation would span the end of the fall and the beginning of the spring semesters. A report summarizing the research conducted during the rotation will be submitted upon completion of each 10-week rotation. The report should be written as if the work were to be submitted to an appropriate conference related to the field of study.

IGPMS Research Rotation Report Requirements.

(1) **Format.** The report should be 2 to 4 single-spaced pages in length (including figures and tables) formatted as a double column article with appropriate single column header: title, author list (you as first author along with any students that helped with your training and your advisers), author affiliations, date and short abstract (~200 words). Use 11 or 12 point size in a Roman font.

(2) **Content.** Typical sections include:

(a) **Introduction.** What is the genesis of your topic and the purpose of the research? How will this research advance science and technology; what potential benefit could it have for society? What scientific question are you trying to answer? Place your work in the context of what has already been done. Include a few key literature references with a bibliography list at the end of the report.

(b) **Methods and Theory.** Not all reports will include both methods and theory. What experimental or computational methods did you use?

If you worked in two laboratories, clearly indicate what you did in each one. Describe the procedures and the strengths and limitations of the techniques.

(c) **Results and Discussion.** This section should summarize any experimental data or modeling results. Figures with figure captions should be described using text in this section. Contrary to typical article submissions, please provide clear attribution or delineation of work between you and your collaborators. What part of the work was performed by others in the research group?

(d) **Conclusions, Acknowledgements, and References.** The conclusions section should not be merely a restatement or summary of results. Instead, think about what claims you can make about your system that were not known before the work was done. How does your work change the way technology will be developed?
Style. Make sure the report tells a compelling story. Every good scientific article clearly explains in the introduction a scientific question to be answered in the article and places the question into context of what the community already knows. The methods or theory section then describes how the effort attempts to address the question posed in the introduction. Finally, the results and discussion provides the answer to your question with a logical development of ideas. Because every story is different, feel free to modify the structure of your report to best tell the story.

B. PH.D. PRELIMINARY EXAMINATION

To proceed with study for the PhD degree in the materials science program, a student must demonstrate proficiency in the fundamentals of materials science and potential for conducting high-quality original research by fulfilling the following two requirements.

1. Students must earn a grade of B or better in each of the four core courses. Students who fail to receive at least a B in any of the core courses will be required to repeat each course in which a B was not earned. If a student fails to receive a B (or better) in a course that is being repeated, that student will be terminated from the program. For purposes of repeating coursework, enrollment is considered an attempt.

2. Students must pass an exam administered by the Advisory Committee that consists of a) submission of an area paper to the Advisory Committee at least one week prior to the oral component, b) oral presentation in a program seminar format of the work contained in the paper, and c) defense of the work presented and examination. The format and extent of the area paper are at the discretion of the advisers, but the expectation is that the paper will describe original research efforts conducted so far and should be written as if the work were to be submitted for publication in a refereed journal. The presentation will be based on the research included in the area paper, but the examination is not limited to those fields of study or technology. Students should be prepared to address questions related to a) the core course work already completed, b) any other materials-related course work already completed, c) work conducted during research rotations, or d) research conducted in the student’s research group. The examination can encompass areas both directly and indirectly related to the paper.

The test should be administered after the student’s second academic semester and before the last day of classes of their third academic semester. Failure to sit for the exam before the end of their third semester will result in an automatic “U” for that semester. For students who have transferred from another graduate institution, scheduling of the exam will be established on an individual basis, but the test must be taken within 12 months of beginning studies at Vanderbilt. If a student fails any component of the exam, the Advisory Committee can grant the student a second chance. If a second chance is granted, the second test, which will have the same format, must be retaken within 3 months. A second failure will result in termination from the Ph.D. program.
C. QUALIFYING EXAMINATION

The Qualifying Examination will be given in accordance with the regulations of the Graduate School and administered by the Ph.D. committee. It will consist of a written dissertation proposal, an oral presentation of the proposal, and defense of the proposal. The oral segment may include an examination of concepts both directly and indirectly related to the dissertation proposal. Students should complete the Qualifying Examination after 24 graduate hours and within 42 months of beginning graduate study in the IGPMS. The examination can be taken a maximum of two times. For students with any other prior graduate work, the timeline for Ph.D. qualifying exam can be established on an individual basis.

In the oral qualifying examination, the student should

- demonstrate competency with fundamentals in the areas that required remedial action as a result of the preliminary examination,
- demonstrate in-depth knowledge of subject matter related to the dissertation project, and
- present a written proposal containing a reasonable research plan and some demonstration of original work in the area of the dissertation to the Ph.D. committee two weeks prior to the examination.

The formal request for appointment to the qualifying examination committee must be received by the Graduate School at least two weeks prior to the date of the examination. Forms for this request are available in the program office.

D. FINAL PUBLIC ORAL EXAMINATION

The final public oral examination is an oral defense of the student’s thesis presented before the Ph.D. committee and the public in accordance with the Graduate School requirements. The student must pass the oral and the dissertation must be approved by the committee. These two requirements do not have to be concurrent. The student can take the oral examination a maximum of two times. The dissertation is considered approved once it has been signed by all committee members.

In general, the final oral examination will be conducted in two parts. The first part consists of a public presentation of the thesis followed by questions from the gallery. The second part will be in the form of a question period attended by the Ph.D. committee and invited faculty only.

The student shall submit, no later than two weeks before the end of the final exam period of the term in which the student expects to graduate, two approved copies of the thesis to the Graduate School office, one to the program office and one to each of the thesis advisers. Approval requires at least five signatures on the thesis title page of members of the Ph.D. committee. The candidate shall also furnish an abstract of the thesis, not to exceed 250 words in length, to the Graduate School office.
E. Other regulations and information

**Transfer Students.** All questions pertaining to transfer students are to be decided in accordance with the policies published in the current edition of The Bulletin of Vanderbilt University.

**Materials Science Minor Degree Requirements.** To qualify for a “materials minor” within a Ph.D. program of another discipline, completion of twelve hours of the core program courses will be required; within an M.S. degree program, six hours of the core program courses will be required. It is expected that the students’ research will be materials oriented and that the students will have the opportunity to use the facilities and resources of the Interdisciplinary Graduate Program in Materials Science. These students will receive a “certificate of recognition” from the program signifying their fulfillment of the materials science minor.

**Registration.** Students are required to register for the fall and spring semesters, even if all course and semester hour requirements have been met, unless an approved leave of absence has been secured from the Dean of the Graduate School. Responsibility to maintain this registration rests with the students; student status in the Graduate School ceases with failure to register.

**Student Performance.** All graduate students must maintain at least a 3.0 overall average. A student is considered on probation following a semester in which the grade average falls below 3.0. If the 3.0 average is not regained at the end of the probationary semester the student will be withdrawn from the Ph.D. program. S/U grades are given every semester for all research courses (369, 379, 399) if a student receives two consecutive U grades or an accumulation of three U grades it will result in dismissal from the program.

**Time Limits.** All requirements for the Ph.D. degree must be completed within four years of passing the preliminary examination and within two years of passing the qualifying examination.

**Financial Aid.** In the first year, financial aid is provided to all IGPMS students in the form of a teaching assistantship (TA), which includes a salary, tuition, health insurance and fees. TAs should expect to spend 20 hr/wk on teaching duties. By the end of the second semester, students are expected to have identified a research adviser who can continue financial support. Students who fail to secure funding after one year will be withdrawn from the program. Continuation of support and level of support depends at all times on the students satisfactorily fulfilling all assigned responsibilities, registering for all advised course work, making satisfactory progress toward the degree, and the availability of financial resources. Students will not be supported for more than 6 years.

**Seminar Attendance.** All IMS graduate students are required to attend all VINSE colloquia.

**Office Space.** First year students will be assigned offices in Olin Hall by Mechanical Engineering where they can maintain office hours while teaching, all IMS students will move to office space within their selected research group once determined.

**Additional Employment.** All students receiving aid agree to hold no other employment during the period for which aid is given. Students cannot accept extra jobs for pay within or outside the University unless prior approval is given by the Ph.D. adviser and the IMS Director. Supplementation may be allowed for University work related to training, but it must have prior approval.
V – SUGGESTED TIMELINE

FIRST YEAR

- Complete at least three of the required four core courses (Schedules may allow students to complete all courses in one year, however, allowing for scheduling problems, completion over 3 semesters is permitted)
- Complete three research group rotations
- Join a research group by May and begin research as soon as possible
- Participate in all required seminars and graduate student meetings

SECOND YEAR

- Complete core coursework
- Complete elective coursework
- Complete the preliminary examination requirement by December (third academic semester)
- Participate in all required seminars and graduate student meetings

THIRD YEAR

- Continue research as a major effort
- Participate in all required seminars and graduate student meetings
- Select and appoint students Ph.D. committee in consultation with thesis advisor
- Complete the Ph.D. qualifying examination requirement by March*

FOURTH YEAR

- Participate in all required seminars and graduate student meetings
- Write and defend dissertation

*Deadlines are approximate