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SUBSTANTIVE DEGREE PROGRAM PROPOSAL
TITLE PAGE

NAME OF INSTITUTION:
The University of Texas at Dallas

NAME OF PROPOSED PROGRAM:
Materials Science and Engineering (Ph.D. and M. S.)

Display how proposed program(s) would appear on the Coordinating Board inventory, include Texas CIP code designation(s).

Materials Science and Engineering, Ph.D.	**CIP Code: 14.1801.00**
Materials Science and Engineering, M. S.	**CIP Code: 14.1801.00**

How would name(s) of program(s) appear on student diplomas?
Doctor of Philosophy in Materials Science and Engineering
Master of Science in Materials Science and Engineering

How would name(s) of program(s) appear on student transcripts?
Materials Science and Engineering Ph.D.
Materials Science and Engineering M. S.

Administrative Unit(s) responsible for the program(s):
Erik Jonsson School of Engineering and Computer Science

Proposed date for implementation of program:
2005-2006

Person to be contacted for further information about proposed program(s):

Name: **C. R. Helms** Title: **Dean**

Phone: **972-883-2974**

Signatures:

______________________________________ ___________________
Campus Chief Executive Officer Date

______________________________________ ___________________
System Chief Executive Officer Date

(As appropriate)
Governing Board approval date:____

SCHOOL OF ENGINEERING AND COMPUTER SCIENCE
THE UNIVERSITY OF TEXAS AT DALLAS

Proposal for Graduate Programs in:

MATERIALS SCIENCE AND ENGINEERING

Executive Summary

The University of Texas at Dallas, as a joint effort between the Erik Jonsson School of Engineering and Computer Science and the School of Natural Sciences and Mathematics, proposes a graduate program in Materials Science and Engineering offering the Doctor of Philosophy and Master of Science degrees. Consistent with the overall mission of U. T. Dallas, the program will provide highly trained graduates in Materials Science and Engineering to the region, the state, and the country. The University has a unique opportunity to build on existing, strong faculty and students working in the areas of biology, chemistry, engineering, nanoscience, and physics to develop a nationally recognized program that will help Texas industry and universities become more successful in an increasingly competitive field.

The optimal use of materials has always been a key aspect of a civilization's technology and, consequently, its standard of living. Currently, it is recognized nationally that advanced materials will help drive global, and especially U.S., economic growth in the 21st century. A study published by the National Academy Press concludes:

> **This study of materials science and engineering has produced a picture of remarkable contrasts. On the one hand, the study has revealed a field of great vitality—rapidly emerging scientific discoveries, stunning new capabilities for understanding and prediction, and applications that are essential for the health of every U.S. industry. On the other hand, several troubling developments have come to light. Despite growing opportunities in the field, a shortage of educated personnel is foreseen. Limitations on resources are constraining progress. And our national effort needs greater focus and coordination in order to meet the challenge of international competition. (Materials Science and Engineering for the 1990s: Maintaining Competitiveness in the Age of Materials, NATIONAL ACADEMY PRESS, Washington, D.C. 1989)**

In the Dallas area there is a large unmet demand for high quality materials scientists and engineers. It is estimated that Texas Instruments alone hires approximately 300 engineers each year for materials science related activities. Dr. Hans Stork, Senior Vice President and Chief Technical Officer of Texas Instruments writes in support of this proposal, "The future success of Texas Instruments depends on our ability to hire a highly trained work force, and a critical area of expertise now and in the future will be Materials Science and Engineering. Each new generation of semiconductor device engineering depends more on advanced materials than any other generation in the past. We need students trained in the fundamentals of electronic materials and processing in order to remain competitive." Additionally, there are numerous other microelectronics

corporations, a significant aerospace and defense contractor, and a growing advanced chemical and biomedical segment, all of which require materials scientists and engineers who hold master's and Ph.D. degrees. Bruce Snider, Director of Engineering, Technology and Quality at Raytheon writes in support of this proposal, "Although Raytheon is known as a major defense electronics firm, the material sciences play an important role in the success of our electro-optics and phased array radar systems which utilize ceramics, composites, polymers, coatings, adhesives, electronic materials, metals, and castings, only to name a few." Local economic data indicates that approximately 600-1000 new Materials Science and Engineering related jobs are generated annually in the DFW area. (Data from the National Academy report suggests that this number could be as high as 4,200 for the state of Texas.) On the other hand, data from the American Society of Engineering Education (ASEE) shows that a total of 991 graduate degrees in metallurgy and materials were awarded nationally in 2003. This total has been approximately the same for over a decade.

Materials Science and Engineering is a significant part of the growth of graduate scientific research at U. T. Dallas. In August 2003, the State of Texas committed $50 million in Texas Enterprise Funds for The University of Texas at Dallas as part of a government-university-industry project to place the next Texas Instruments manufacturing plant in Richardson, Texas. This proposal to offer Ph.D. and M. S. degrees in Materials Science and Engineering is part of this economic development plan, and the graduates of the Materials Science and Engineering program will play a key role in the economic competitiveness of not only the Texas Instruments facility, but also the Dallas-Fort Worth region, Texas, and the nation. Internally to U. T. Dallas, this program strategically fits with existing centers of excellence in electrical engineering, chemistry, nanoscience, and biology. In particular, Materials Science and Engineering has been encouraged in recent reports from important external experts such as the Washington Advisory Group.

The interdisciplinary Materials Science and Engineering program at UTD will emphasize teaching and research in the following areas: 1) nanostructured materials, 2) electronic, optical and magnetic materials, 3) biomimetic materials, 4) polymeric materials, 5) MEMS materials and systems, 6) organic electronics, and 7) advanced processing and characterization of modern materials. The program will provide an opportunity for interdisciplinary research and education that builds on current strengths in materials research and education in the Erik Jonsson School of Engineering and Computer Science and the School of Natural Sciences and Mathematics. Graduates of the program will go into the workforce to create new jobs, promote economic development, and use science and technology to improve society.

The proposed degree programs will be administered by the Erik Jonsson School of Engineering and Computer Science and will utilize excellent faculty, proven courses, and exemplary facilities of both the Jonsson School and the School of Natural Sciences and Mathematics. The proposed model is similar to the Materials Science program at U.T. Austin and, like that program, the proposed degree programs will draw upon current centers of excellence at U. T. Dallas in electrical engineering, physics, chemistry, nanoscience, and biology.

FORMAT FOR SUBSTANTIVE DEGREE PROGRAM REQUESTS

I. PROGRAM ADMINISTRATION

A. Describe how the program would be administered.

1. Indicate name and title of person(s) who would be responsible for curriculum development and on-going review.

The Dean of the Erik Jonsson School of Engineering and Computer Science, Dr. C.R. Helms, will have the responsibility for curriculum development and on-going review. The Materials Science and Engineering program (MSE) will be supported by a program head and by MSE Affiliated Faculty who hold appointments in the Electrical Engineering Department, the Chemistry Department, the Physics Department and the Biology Department. Under the leadership of the head of the MSE program, the MSE Affiliated Faculty will, as a faculty body, develop appropriate subcommittees, take responsibility for the day-to-day operation of the degree program, including planning, implementation, and evaluation, and will advise the Dean on matters of concern. The head of the MSE program will report to the Dean. Current members of the Materials Science and Engineering Affiliated Faculty are listed in Section VI.A.3.

2. Describe responsibilities for student advisement and supervision.

Tenured and tenure-track members of the Materials Science and Engineering Affiliated Faculty will have primary responsibility for student advisement and supervision.

3. If the program would be administered by more than one administrative unit, what factors make this necessary?

The proposed MSE degree program is inherently interdisciplinary, and therefore requires the collaboration of faculty from the Electrical Engineering Department, the Physics Department, the Chemistry Department and the Biology Department. Like the existing faculty of Telecommunications Engineering and Computer Engineering, the participating faculty from these departments will be organized into the MSE Affiliated Faculty. The program will be administered by the Erik Jonsson School of Engineering and Computer Science to enable logistic support, with active participation of the MSE Affiliated Faculty. This structure is similar to what is in place at The University of Texas at Austin for the Texas Materials Institute.

B. If a non-academic unit, e.g., "institute," or "center" would be involved in administering the program, describe the relationships.

Not applicable

C. If a new organizational unit would be created or an existing organizational entity modified as a result of this program, identify and describe the anticipated result. (Reference: "Format for Administrative Change Request," Fall 1992.)

No organizational entities will be created or changed.

II. PROGRAM DESCRIPTION

A. Educational Objectives

1. Describe the educational objectives of the program. (Include reference to preparation of students for licensure or certification if appropriate and any special outcomes or competencies which the program would provide that are not available from existing degree programs.)

   The Ph.D. program in Materials Science and Engineering will provide 1) doctoral level scientists and engineers to meet the research and development needs of industry in the North Central Texas region, the State of Texas, and the United States, and 2) faculty for Texas's universities to assist them in strengthening this vital sector of the Texas economy. The students in the Doctor of Philosophy and the Master of Science degree programs in Materials Science and Engineering will acquire expertise in modern materials science, including areas such as (1) nanostructured materials, 2) electronic, optical and magnetic materials, 3) biomimetic materials, 4) polymeric materials, 5) MEMs materials and systems, 6) organic electronics, and 7) advanced processing of modern materials.

   The master's program in Materials Science and Engineering will provide professional level scientists and engineers to meet the broad needs of industry in the North Central Texas region, the State of Texas, and the United States. Thus, the master's degree will (1) provide professional advancement for students who do not wish to pursue a Ph.D. in Materials Science and Engineering and (2) serve as a terminal degree for students who do not complete the Ph.D. program in Materials Science and Engineering.

2. If the program design includes multiple curricula (concentrations, emphases, options, specializations, tracks, etc.), describe the educational objectives of each. (Each of these curricula must be identified on the title page, including Texas CIP code. Reference: "Guidelines for recognition and Classification of Courses and Degree Program Offerings," adopted July 20, 1979 and revised to conform to new CIP codes, Fall 1992.)

   Not applicable.

B. Admissions Standards

1. State admission requirements for the program. (If there are different categories of admission, e.g., unconditional, probationary, etc., describe each.)

Admission to the proposed Doctor of Philosophy and Master of Science in Materials Science and Engineering will require that students meet standards equivalent to those currently required for admission to the Ph.D. or Master's degree programs in Electrical Engineering, Chemistry, Physics, or Biology. The requirements for unconditional admission are a Bachelor of Science degree in Materials Science and Engineering or a closely related discipline; a grade-point average in graduate-level course work of 3.5 or better on a 4-point scale, GRE scores of at least 500, 700 and 600 for the verbal, quantitative and analytical components, respectively, or 1800 for the total score. Students who fulfill some of the above requirements, if admitted conditionally, will be required to take graduate level courses as needed to make up any deficiencies.

C. Degree Requirements:

1. In tabular form, indicate the semester credit hour (SCH) requirements in each of the following categories applicable to the proposed program; include the total SCH requirement for the degree:

a. Foundation Courses

(1) general education/core curriculum

Students entering the Materials Science and Engineering programs will be required to have a Bachelor of Science degree in Materials Science and Engineering or a closely related field of study in engineering or science. Students whose preparation is deficient in some respects will be required to take leveling or prerequisite courses. On the basis of previous experience with applicants for the degree program in Electrical Engineering, it is expected that most applicants for the MSE program will be sufficiently well prepared in Materials Science and Engineering or closely related fields that few students will be required to take more than 6 to 9 hours to alleviate deficiencies.

b. courses required of all students in the proposed program

For each of the proposed degree programs, students must pass the following core courses with a grade of B or better:

Note: the presence of a course number in parentheses indicates that this course will be cross-listed with an existing course.

- **MSE 5310 Thermodynamics of Materials ****
- **MSE 5360 Materials Characterization ****
- **MSE 6324 (EE 6324) Electronic Materials**
- **MSE 6377 (PHYS 6377) Physics of Nanostructures: Carbon Nanotubes, Fullerenes, Quantum Wells, Dots and Wires**

A student may petition for waiver of core courses, and if the Materials Science and Engineering Affiliated Faculty, or a designated committee, finds that the student has mastered the course material, the student may replace that core course with an elective course for a total of twelve semester credit hours.

c. elective courses prescribed for those students in the proposed

A minimum of 9 semester credit hours will be required from the Advanced Course List

- **MSE 5340 Advanced Polymer Science and Engineering ****
- **MSE 5370 Ceramics and Metals ****
- **MSE 6310 Mechanical Properties of Materials ****
- **MSE 6319 (EE 6319) Quantum Physical Electronics**
- **MSE 6330 Phase Transformations ****
- **MSE 6350 Imperfections in Solids ****

The total number of credit hours required for the M. S. degree will be 33. The total number of hours for the Ph.D. degree will be a minimum of 60 beyond the master's. The remaining credit hours are to be taken from the following list of Specialized Courses (or approved electives from Physics, Chemistry, or Biology):

- **MSE 5300 Introduction to Materials Science ***
- **MSE 5331 (CHEM 5331) Advanced Organic Chemistry I**
- **MSE 5333 (CHEM 5333) Advanced Organic Chemistry II**
- **MSE 5341 (CHEM 5341) Advanced Inorganic Chemistry**
- **MSE 5344 Thermal Analysis ****
- **MSE 5353 Integrated Circuit Packaging ****
- **MSE 5355 (CHEM 5355) Analytical Techniques I**
- **MSE 5356 (CHEM 5356) Analytical Techniques II**
- **MSE 5361 Fundamentals of Surface and Thin Film Analysis ****
- **MSE 5371 (PHYS 5371) Solid State Physics**
- **MSE 5375 (PHYS 5375) Electronic Devices Based On Organic Solids**
- **MSE 5383 (PHYS 5383 and EE 5383) Plasma Technology**
- **MSE 6313 (EE 6313) Semiconductor Opto-Electronic Devices**
- **MSE 6320 (EE6320) Fundamentals of Semiconductor Devices**

- **MSE 6321 (EE6321) Active Semiconductor Devices**
- **MSE 6322 (EE6322) Semiconductor Processing Technology**
- **MSE 6340 Advanced Electron Microscopy ****
- **MSE 6341 Advanced Electron Microscopy Laboratory ****
- **MSE 6361 Deformation Mechanisms in Solid Materials ****
- **MSE 6362 Diffraction Science ****
- **MSE 6371 (PHYS6371) Advanced Solid State Physics**
- **MSE 6374 (PHYS6374) Optical Properties Of Solids**
- **MSE 7320 (EE7320) Advanced Semiconductor Device Theory**
- **MSE 7382 (EE7382) Introduction to MEMS**
- **MSE 7V80 Special Topics in Materials Science and Engineering ****
- **MSE 8V40 Individual Instruction in Materials Science and Engineering ****
- **MSE 8V70 Research In Materials Science and Engineering ****
- **MSE 8V98 Thesis ****
- **MSE 8V99 Dissertation ****

d. courses freely elected by students,

Not applicable

e. other, specify.

None

2. Identify and describe special requirements for the program, e.g., clinicals, field experience, internship, practicum, thesis, etc.

Each doctoral student must carry out original research in the area of Materials Science and Engineering, under the direction of a member of the Materials Science and Engineering Affiliated Faculty, and complete and defend a dissertation on the research project. A Supervisory Committee will be appointed once the faculty member accepts the student for a research project. Students must be admitted to doctoral candidacy by passing a Qualifying Exam, which will be administered at approximately the time that the students have completed their course work. The rules for the dissertation research and defense are specified by the Office of the Dean of Graduate Studies.

M. S. students undertaking the thesis option must carry out a research project under the direction of a member of the Materials Science and Engineering Affiliated Faculty and complete and defend a thesis on the research project. A Supervisory Committee will be appointed once the faculty member accepts the student for a research project. The rules for the thesis defense are specified by the Office of the Dean of Graduate Studies.

3. If transfer students would be admitted to the program, list agreements completed, in negotiation, or planned.

A student may petition to have appropriate graduate course work taken at another institution counted toward satisfaction of a portion of the required organized course hours for the M. S or Ph.D. degree in Materials Science and Engineering. Transfer petitions will be processed according to the general policies and procedures described in the UTD graduate catalog. The Materials Science and Engineering Affiliated Faculty, or a designated committee, will determine whether the course content is appropriate for transfer credit towards the M. S. or Ph.D. degree in Materials Science and Engineering. Final approval for all such transfer petitions requires the endorsement of the Graduate Dean. However, since the emphasis in the M. S. or Ph.D. program is on preparing leading scientists and engineers for industry and academic positions, it is anticipated that most students will enter the program directly from excellent undergraduate institutions.

The University's policy for transfer credit at the graduate level is stated in the 2004-2006 Graduate Catalog and may be found at this website location: http://www.utdallas.edu/student/catalog/grad04

D. Curriculum

1. Identify by prefix, number, title, and description (including prerequisites) courses to be required or elected in the proposed program. (Identify with an asterisk(*) courses added during the last 3 academic years, and with 2 asterisks(**) courses to be added if the program is authorized.)

<u>CORE COURSES</u>

MSE 5310 Thermodynamics of Materials (*3 semester hours*)**
Work, energy and the first law of thermodynamics; the second law of thermodynamics, thermodynamic potentials, the third law of termodynamics, thermodynamic identities and their uses, phase equilibria in one-component systems, behavior and reactions of gases. Solutions, binary and multicomponent systems: phase equilibria, materials separation and purification. Electrochemistry. Thermodynamics of modern materials. (3-0) R

MSE 5360 Materials Characterization (*3 semester hours*)**
Survey of atomic and structural analysis techniques as applied to surface and bulk materials. Physical processes involved in the interaction of ions,

electrons and photons with solids; characteristics of the emergent radiation in relation to the structure and composition. (3-0) R

MSE 6324 Electronic Materials (*3 semester hours*)
Principles of selection, preparation, and characterization of electronic materials with emphasis on semiconductors. Fundamentals of crystallography and crystal growth. Defect and impurity control. Thermodynamics and phase equilibria as applied to semiconductor processing. Preparation and properties of epitaxial and heteroepitaxial structures. Advanced techniques for structural, chemical and electrical characterization of electronic materials. Prerequisite: EE 6320 or equivalent. (3-0) T Cross listed with EE 6324.

MSE 6377 Physics of Nanostructures: Carbon Nanotubes, Fullerenes, Quantum Wells, Dots and Wires (*3 semester hours*)
Electronic bands in low dimensions. 0-d systems: fullerenes and quantum dots. Optical properties, superconductivity and ferromagnetism of fullerides. 1-d systems: nano-wires and carbon nanotubes (CNT). Energy bands of CNTs: chirality and electronic spectrum. Metallic versus semiconducting CNT: arm-chair, zigzag and chiral tubes. Electrical conductivity and superconductivity of CNTs, thermopower. Electromechanics of SWCNT: artificial muscles. Quantum wells, FETs and organic superlattices: confinement of electrons and excitons. Integer and fractional quantum Hall effect (QHE). Cross listed with PHYS 6377. (3-0) R

<u>ADVANCED COURSE LIST</u>

MSE 5340 Advanced Polymer Science and Engineering (*3 semester hours*)**
Polymer structure-property relations, Linear and nonlinear viscoelasticity. Dynamic mechanical analysis, time temperature superposition, creep and stress relaxation. Mechanical models for prediction of polymer deformation, rubber elasticity, environmental effects on polymer deformation, instrumentation for prediction of long term properties. (3-0) R.

MSE 5370 Ceramics and Metals (*3 semester hours*)**
Emphasis on structure-property relationships: chemical bonding, crystal structures, crystal chemistry, electrical properties, thermal behavior, defect chemistry. Chemical and physical properties of metals and alloys. Topics include: powder preparation, sol-gel synthesis, densification, toughening mechanisms, crystal structure, thermodynamics, phase diagrams, phase transformations, oxidation, mechanical, electrical and magnetic properties. (3-0) R

MSE 6310 Mechanical Properties of Materials (*3 semester hours*)**
Stress, strain and the basics of concepts in deformation and fracture for metals, polymers and ceramics. Analysis of important mechanical properties such as plastic flow, creep, fatigue, fracture toughness and rupture. Application of these principles to the design of improved materials and engineering structures. (3-0) Y.

MSE 6319 Quantum Physical Electronics (*3 semester hours*)
Quantum-mechanical foundation for study of nanometer-scale electronic devices. Principles of quantum physics, stationary-state eigenfunctions and eigenvalues for one-dimensional potentials, interaction with the electromagnetic field, electronic conduction in solids, applications of quantum structures. (3-0) Y Cross Listed with EE 6319.

MSE 6330 Phase Transformations (*3 semester hours*)**
Thermodynamic, kinetic, and structural aspects of metallic and ceramic phase transformations: mechanisms and rate-determining factors in solid-phase reactions; diffusion processes, nucleation theory, precipitations from solid solution, order-disorder phenomena, and applications of binary and ternary phase diagrams. (3-0) R

MSE 6350 Imperfections in Solids (*3 semester hours*)**
Point defects in semiconductors, metals, ceramics, and; nonideal defect structures; nonequilibrium conditions produced by irradiation or quenching; effects of defects on electrical and physical properties, effects of defects at interfaces between differing materials. (3-0) R

SPECIALIZED COURSE LIST

BIOL 5410 Biochemistry of Proteins and Nucleic Acids *(4 semester hours)*
Chemistry and metabolism of amino acids and nucleotides; biosynthesis of nucleic acids; analysis of the structure and function of proteins and nucleic acids and of their interactions including chromatin structure. Prerequisite: biochemistry or equivalent. (4-0) Y

BIOL 5440 Cell Biology *(4 semester hours)* Molecular architecture and function of cells and subcellular organelles; structure and function of membranes; hormone and neurotransmitter action; growth regulation and oncogenes; immune response; eukaryotic gene expression. Prerequisites: BIOL 5410 and BIOL 5420, or the equivalent, or permission of the instructor. (4-0) Y

BIOL 6358* Bionanotechnology *(3 semester hours)* Protein, nucleic acid and lipid structures. Macromolecules as structural and functional units of the intact cell. Parallels between biology and nanotechnology. Applications of nanotechnology to biological systems. (Note: taught as a special topics course in Fall 2004 with 8 enrolled.)

MSE 5300* Introduction to Materials Science (*3 semester hours*)
This course provides an intensive overview of materials science and engineering and includes the foundations required for further graduate study in the field. Topics include atomic structure, crystalline solids, defects, failure mechanisms, phase diagrams and transformations, metal alloys, ceramics, polymers as well as their thermal, electrical, magnetic and optical properties. Prerequisites: None. (3-0) R.

MSE 5331 Advanced Organic Chemistry I (*3 semester hours*)
Modern concepts of bonding and structure in covalent compounds. Static and dynamic stereochemistry and methods for study. Relationships between structure and reactivity. (3-0) Y Cross Listed with CHEM 5331.

MSE 5333 Advanced Organic Chemistry II *(3 semester hours)*
Application of the principles introduced in CHEM 5331, emphasizing their use in correlating the large body of synthetic/preparative organic chemistry. Prerequisite: MSE 5331/CHEM 5331. (3-0) R Cross Listed with CHEM 5333.

MSE 5341 Advanced Inorganic Chemistry *(3 semester hours)*
Physical inorganic chemistry addressing topics in structure and bonding, symmetry, acids and bases, coordination chemistry and spectroscopy. Prerequisite: CHEM 3341, or consent of instructor. (4-0) Y. Cross Listed with CHEM 5341.

MSE 5344 Thermal Analysis *(3 semester hours)***
Differential scanning calorimetry; thermogranvimetric metric analysis; dynamic mechanical and thermomechanical analysis; glass transition; melting transitions, relaxations in the glassy state, liquid crystalline phase changes.

MSE 5353 Integrated Circuit Packaging (*3 semester hours*)**
Basic packaging concepts, materials, fabrication, testing, and reliability, as well as the basics of electrical, thermal, and mechanical considerations as required for the design and manufacturing of microelectronics packaging. Current requirements and future trends will be presented. General review of analytical techniques used in the evaluation and failure analysis of microelectronic packages. (3-0) R

MSE 5355 Analytical Techniques I (*3 semester hours*)
Study of fundamental analytical techniques, including optical spectroscopic techniques and energetic particle and x-ray methods including SEM, EDS, STM, AFM, AES, XPS, XRF, and SIMS. (3-0) Y Cross Listed with CHEM 5355.

MSE 5356 Analytical Techniques II (*3 semester hours*)
Study of statistical methods (standard tests, statistical process control, ANOVA, experimental design, etc.) and problem solving techniques for

dealing with ill-defined analytical problems. (3-0) Y Cross Listed with CHEM 5356.

MSE 5361 Fundamentals of Surface and Thin Film Analysis (*3 semester hours*) Survey of materials characterization techniques; optical microscopy; Rutherford backscattering; secondary ion mass spectroscopy; ion channeling; scanning tunneling and transmission microscopy; x-ray spectroscopy; surface properties. (3-0) R**

MSE 5371 Solid State Physics *(3 semester hours)*
Symmetry description of crystals, bonding, properties of metals, electronic band theory, thermal properties, lattice vibration, elementary properties of semiconductors. Prerequisites: PHYS 5400 and 5421 or equivalent. (3-0) Y Cross Listed with PHYS 5371

MSE 5375 Electronic Devices Based On Organic Solids (*3 semester hours*)
Solid state device physics based on organic condensed matter structures, including: OLEDs (organic light emitting diodes), organic FETs, organic lasers, plastic photocells, molecular electronic chips. (3-0) R Cross Listed with PHYS 5375.

MSE 5383 Plasma Technology (*3 semester hours*)
Hardware oriented study of useful laboratory plasmas. Topics will include vacuum technology, gas kinetic theory, basic plasma theory and an introduction to the uses of plasmas in various industries. Cross Listed with PHYS 5383 and EE 5383

MSE 6313 Semiconductor Opto-Electronic Devices (*3 semester hours*)
Physical principles of semiconductor optoelectronic devices: optical properties of semiconductors, optical gain and absorption, wave guiding, laser oscillation in semiconductors; LEDs, physics of detectors, applications. (3-0) T Cross Listed with EE 6313.

MSE 6320 Fundamentals of Semiconductor Devices (*3 semester hours*)
Semiconductor material properties, equilibrium carrier distribution and non-equilibrium current-transport processes; properties of semiconductor interfaces, including MOS, Schotky-barrier and p-n junctions. (3-0) Y Cross Listed with EE6320.

MSE 6321 Active Semiconductor Devices (*3 semester hours*)
The physics of operation of active devices will be examined, including bipolar junction transistors and field-effect transistors: MOSFETs, JFETS, and MESFETS. Special-purpose MOS devices including memories and imagers will be presented. Prerequisite: MSE 5351/EE 6320. (3-0) Y Cross Listed with EE 6321.

MSE 6322 Semiconductor Processing Technology (*3 semester hours*)
Modern techniques for the manufacture of semiconductor devices and circuits. Techniques for both silicon and compound semiconductor processing are studied as well as an introduction to the design of

experiments. Topics include: wafer growth, oxidation, diffusion, ion implantation, lithography, etch and deposition. (3-0) T. (3-0) R Cross Listed with EE 6322.

MSE 6340 Advanced Electron Microscopy (*3 semester hours*)**
Theory and applications of scanning and transmission electron microscopy; sample preparation and analytical techniques.

MSE 6341 Advanced Electron Microscopy Laboratory (*3 semester hours*)**
Lab support for MSE 6340.

MSE 6361 Deformation Mechanisms in Solid Materials (*3 semester hours*)**
Linear elastic fracture mechanics, elastic-plastic fracture mechanics, time dependent failure, creep and fatigue, experimental analysis of fracture, fracture and failure of metals, ceramics, polymers and composites Failure analysis related to material, product design, manufacturing and product application.

MSE 6362 Diffraction Science (*3 semester hours*)**
Diffraction theory; scattering and diffraction experiments; kinematic theory; dynamical theory; x-ray topography; crystal structure analysis; disordered crystals; quasi-crystals.

MSE 6371 Advanced Solid State Physics (3 semester hours) Continuation of MSE5371/PHYS 5371, transport properties of semiconductors, ferroelectricity and structural phase transitions, magnetism, superconductivity, quantum devices, surfaces. Prerequisite: MSE 5371/PHYS 5371 or equivalent. (3-0) R Cross Listed with PHYS 6371.

MSE 6374 Optical Properties of Solids (*3 semester hours*)
Optical response in solids and its applications. Lorentz, Drude and quantum mechanical models for dielectric response function. Kramers-Kronig transformation and sum rules considered. Basic properties related to band structure effects, excitons and other excitations. Experimental techniques including reflectance, absorption, modulated reflectance, Raman scattering. Prerequisite: MSE 5371/PHYS 5371 or equivalent. (3-0) T Cross Listed with PHYS 6374.

MSE 7320 Advanced Semiconductor Device Theory (*3 semester hours*)
Quantum mechanical description of fundamental semiconductor devices; carrier transport on the submicron scale; heterostructure devices; quantum-effect devices. Prerequisite: MSE 5351/EE 6320 (3-0) R Cross Listed with EE 7320

MSE 7382 Introduction to MEMS (*3 semester hours*)
Study of fabrication techniques for micro-electro-mechanical and micro-opto-mechanical devices and systems and their applications. Techniques for both silicon, non-silicon processing and emerging new micromachining processes are studied as well as their process physics. Topics to include:

bulk and surface micromachining, electroplating-based micromachining and micro devices packaging. (3-0) Y Cross Listed with EE 7382.

MSE 7V80 Special Topics in Materials Science and Engineering (1-6 semester hours) For letter grade credit only. (May be repeated to a maximum of 9 hours.) ([1-6]-0) S**

MSE 8V40 Individual Instruction in Materials Science and Engineering (1-6 semester hours) (May be repeated for credit.) For pass/fail credit only. ([1-6]-0) R**

MSE 8V70 Research In Materials Science and Engineering (3-9 semester hours) (May be repeated for credit.) For pass/fail credit only. ([3-9]-0) R**

MSE 8V98 Thesis (3-9 semester hours) (May be repeated for credit.) For pass/fail credit only. ([3-9]-0) S**

MSE 8V99 Dissertation (3-9 semester hours) (May be repeated for credit.) For pass/fail credit only. ([3-9]-0) S**

2. If the program design includes multiple curricula (concentrations, emphases, options, specializations, tracks, etc.), identify courses unique to each alternative.

   Not applicable

3. Provide a semester-by-semester projection for offering of the required and prescribed courses during the first five years.

   Note: First four courses (shaded gray) are core, Next six courses (shaded light gray) are Advanced Course List, remainder of table (unshaded) comprises Specialized Courses.

   Note: Existing Courses currently taught in accordance with the illustrated rotation are marked with a check in the Table. The 14 new, organized course offerings are indicated with an “N” for the semester in which the course will be offered for the first time.

	F05	S06	F06	S07	F07	S08	F08	S09	F09	S10
MSE 5310	N		✓		✓		✓		✓	
MSE 5360		N		✓		✓		✓		✓
MSE 6324		✓		✓		✓		✓		✓
MSE 6377	✓		✓		✓		✓		✓	
MSE 5340	N			✓			✓			✓
MSE 5370	N			✓			✓			✓
MSE 6310		N		✓		✓		✓		✓
MSE 6319		✓		✓		✓		✓		✓
MSE 6330	N			✓			✓			✓
MSE 6350		N		✓		✓		✓		✓
BIO 5410	✓		✓		✓		✓		✓	
BIO 5440		✓		✓		✓		✓		✓
BIO 6358	✓		✓		✓		✓		✓	
MSE 5300	✓		✓		✓		✓		✓	
MSE 5331	✓		✓		✓		✓		✓	
MSE 5333		✓		✓		✓		✓		✓
MSE 5341	✓		✓		✓		✓		✓	
MSE 5355	✓		✓		✓		✓		✓	
MSE 5356		✓		✓		✓		✓		✓
MSE 5344			N				✓			
MSE 5353				N				✓		
MSE 5361					N				✓	
MSE 5371		✓		✓		✓		✓		
MSE 5375			✓			✓			✓	
MSE 5383	✓		✓		✓		✓		✓	
MSE 6313		✓		✓		✓		✓		✓
MSE 6320	✓		✓		✓		✓		✓	
MSE 6321		✓		✓		✓		✓		✓
MSE 6322	✓		✓		✓		✓		✓	
MSE 6340				N				✓		
MSE 6341			N				✓			
MSE 6361				N				✓		
MSE 6362					N				✓	
MSE 6371		✓		✓		✓		✓		✓
MSE 6374	✓		✓		✓		✓		✓	
MSE 7320		✓		✓		✓		✓		✓
MSE 7382	✓		✓		✓		✓		✓	

4. Describe arrangements that would serve non-traditional students, e.g., non-traditionally scheduled classes, delivery of instruction by telecommunications and/or off-campus instruction sites, library services, student advisement, etc., if applicable.

Many of the M. S. students and some of the Ph.D. students in the proposed program are expected to have full-time jobs in the local semiconductor and aerospace industry. In those cases, research and advisement meetings will be arranged at hours that are mutually convenient for the student and the research supervisor. Many of the courses for the Ph.D. program are also part of the M. S. program, and, since many M. S. students will have full-time

jobs, those courses will be regularly offered during evening hours. The U. T. System digital library will be available to students in the proposed program.

5. If the general education/core curriculum component of the proposed program differs from that required for all or most undergraduate programs at the institution, indicate how and why.

   Not applicable

E. Supporting Fields

1. Identify existing degree programs and non-degree supporting fields that would complement the proposed program; describe the relationship of each to the proposed program.

   More than half of the courses associated with the Materials Science and Engineering program will be cross-listed with existing Physics, Chemistry and Electrical Engineering offerings. Also, several of the faculty from these departments will be members of the MSE Affiliated Faculty and will advise students in the MSE program. Thus there will be a significant sharing of resources between the MSE program and Physics, Chemistry, Biology and Electrical Engineering.

2. If the existing programs or supporting fields would require updating or expansion because of the new program, explain how and why.

   None of the existing programs should require updating. The MSE program will complement and enhance the existing programs.

F. Effect on Existing Programs

1. Describe how existing courses would be affected by enrollments generated in the proposed program, including, but not limited to, the potential need for additional sections or increased class sizes, faculty, library resources, equipment, supplies, and/or space.

   Classes that are cross-listed with Chemistry, Physics, Electrical Engineering and Biology will increase in size, but not enough to require new sections. New faculty will be added to the MSE program over the next three to five years as part of the growth plan for the Erik Jonsson School of Engineering and Computer Science. The current Engineering and Computer Science Complex at UTD, along with the planned Natural Science and Engineering Research Building, will provide adequate laboratory, office, and classroom space for the MSE program. Requirements for the library are discussed in detail in Section VI. B.

2. For a graduate program, describe how related undergraduate programs would be affected by enrollments in the proposed program, including changes anticipated in the rank and/or credentials of faculty teaching in the undergraduate program, and use of graduate student Teaching Assistants, Graduate Assistants, Assistant Instructors, etc., and their credentials. Provide evidence that faculty (full-time,

part-time, or TA's) in the proposed program, or who would replace current faculty reassigned to the proposed program, would meet Southern Association minimum standards for credentials and experience.

The current members of the MSE Affiliated Faculty are listed in Section VI.A.3. They all meet or exceed Southern Association minimum standards for credentials and experience. New faculty brought into the program will be required to meet or exceed these standards as a minimum as well. Current undergraduate programs will only be affected in a positive manner in that as new faculty with experience in Materials Science are added, they will bring that expertise to the classroom. Also, we plan to recruit heavily UTD undergraduates to join the MSE graduate programs.

G. Accreditation

1. If there is a professional program accreditation procedure in this field, attach current standards.

Since these are graduate only programs, specific engineering accreditation is not required.

2. State intention regarding accreditation.

Not applicable

III. Evaluation

A. Describe procedures for evaluation of the program and its effectiveness in the first five years of the program, including admission and retention rates, program outcomes assessments, placement of graduates, changes of job market need/demand, ex-student/graduate survey, or other procedures. How would evaluations be carried out?

The procedures to be used for the institutional evaluation of the proposed programs, as well as for any existing graduate programs, have been established by The University of Texas at Dallas and are described in Policy Memorandum 94-III.24-63 Academic Program Review. In accordance with this policy the proposed program will be reviewed every five years. In addition, there will be periodic internal evaluations which will encompass job offerings, initial salary, and supervisor satisfaction.

IV. Program Need/Demand

A. Identify similar programs at:

1. Texas public and independent universities.

University of North Texas, The University of Texas at Austin, The University of Texas at El Paso, The University of Texas at Arlington

The MSE program at UTD will complement the existing DFW programs at U. T. Arlington and the University of North Texas. The U. T. Arlington program has a significant emphasis on materials science associated with interconnection technologies (so-called "back-end of the line" technology) for integrated circuit applications. The program at UNT has an emphasis in polymer science and, more recently, in metallurgy. The program at UTD will emphasize nanotechnology including nanoelectronic materials research for advanced transistor and quantum electronic devices as well as heterogeneous integration of electronic and photonic materials with Si-based integrated circuit technology.

2. Out-of-state institutions, if the proposed program would be unique in Texas.

Not applicable

B. Describe justification for the proposed program in terms of the following, as applicable:

1. Local, regional, state, national and international needs. NOTE: State need is the preeminent criterion for consideration of new degree programs (Reference: Coordinating Board "Standards for Consideration of New Doctoral Program Requests," July 1982 and revised Fall 1992).

The recent report by the Washington Advisory Group recommended to The University of Texas System that the Erik Jonsson School of Engineering and Computer Science add materials engineering, among others, to its inventory of offerings. "This expansion of the engineering mission would give the college a modern and comprehensive look and a more realistic base from which to achieve its stated goals."

There are good reasons for the particular choice of Materials Science and Engineering. The Dallas – Fort Worth area has many high tech industries that would benefit from having a more nationally competitive Materials Science and Engineering (MSE) program in the area. Local economic data indicates that approximately 600-1000 new MSE related jobs are generated in the DFW area annually. (Data from a recent National Academy report suggests that this number would be approximately 4,200 for the state of Texas.) Specific segments include the semiconductor industry (Texas Instruments, TriQuint, Marlow, and Maxim), the MEMS industry (Texas Instruments, Raytheon, Memtronics and Zyvex), and the defense industry (Raytheon and Lockheed Martin) to name only a few. Jim von Ehr, CEO of Zyvex, states "We need students trained in the fundamentals of materials science and materials processing. Zyvex hopes to grow significantly over the next five years and having access to highly trained students will be critical to our success." These industries are driven by advances in materials science. They require employees that are experts in the field of materials science. The materials science related faculty at UTD have strong working relationships with each of these companies and understand their needs in student career preparation and research. This close interaction will focus both the curriculum and the research areas for the MSE program on modern materials that are required by these companies. The companies will

strengthen the M. S. and Ph.D. in MSE degree program by presenting their materials needs to the (close-by) UTD MSE faculty. As a result, both UTD and its partner companies will become more capable in their competitive spheres. M. S. and Ph.D. graduates of the MSE program will, of course, take career positions throughout Texas high-technology industry and universities. In the words of Don Hayes, President of MicroFab Technologies, "It is especially important for a small company such as MicroFab to be able to recruit top students from local universities because we do not have the manpower to recruit across the country."

2. The long-range academic plan of the institution.

The mission of The University of Texas at Dallas is to provide Texas and the nation with the benefits of educational and research programs of the highest quality. These programs address the multi-dimensional needs of a dynamic, modern society driven by the development, diffusion, understanding and management of advanced technology. In particular, UTD is concentrating its efforts and resources in the areas of information transmission and processing, advanced materials and instrumentation, and disease-centric science and technology. Thus, the addition of the proposed MSE degrees is fully consistent with the broad strategy for the future of The University of Texas at Dallas as well as the stated goals for the University in the State's economic development envisioned through efforts supported by the Texas Enterprise Fund.

The Erik Jonsson School of Engineering and Computer Science will benefit from the proposed MSE degrees because of direct synergy to the microelectronics thrust within electrical engineering. The addition of the proposed degrees also will broaden the Erik Jonsson School in a direction that was recommended by the recent Washington Advisory Group report.

3. Demand from prospective students.

At 17% per year, The Erik Jonsson School has seen impressive growth over the past half decade despite a limited set of degree offerings. We expect a similar rate of growth in the Materials Science and Engineering program. Existing Texas Materials Science programs at the graduate level are also growing rapidly because of the large statewide demand noted above. Discussions with visiting experts and with local industry managers indicate that the DFW demand for Materials Science education is not being met. In the past twelve months, there has been a high level of interest from employees at Texas Instruments and Raytheon about obtaining an M. S. or a Ph.D. degree in Materials Science and Engineering from UTD. To date, the principals of this program have received over four dozen enquiries for this un-advertised program.

4. Job market needs (identify specific potential employers and supply names, addresses and phone numbers where possible).

Potential area employers include, but are not limited to:

Texas Instruments, Inc.	**Hans Stork, Sr VP and CTO**	**13560 North Central Expwy, Dallas, TX 75243 972-995-2371**
Raytheon	**Bruce Snider, Director**	**6620 Chase Oaks Blvd, Plano, TX 75023 972-952-3853**
Lockheed Martin	**Dr. Armand Chaput, Sr Technical Fellow**	**Lockheed Martin, Fort Worth, TX 76101 817-763-7427**
Northrup Grumman	**Joe Estrera, Director of R&D**	**Northrup Grumman, Garland, TX 972-840-5618**
TriQuint	**Anthony Balistreri, R&D Manager**	**Richardson, TX 75083 972-994-8669**
Marlow, Ind.	**Dwight Johnson, VP**	**10451 Vista Park Road, Dallas, TX 75238 214-340-4900**
MicroFab	**Donald J. Hayes, President**	**1104 Summit Ave, Plano, TX 75074 972-578-8076**
Zyvex	**James R. Von Ehr, CEO**	**1321 North Plano Road, Richardson, TX 75081 972-235-7881**
Nortel	**John Stankus, Project Manager for Advanced Optical Materials**	**2221 Lakeside Blvd, Richardson, TX 75082 972-684-8823**
Alcatel	**Rajiv Shah, Vice President Research & Network Strategy Location Director, Corporate Research Center Plano**	**3400 Plano Parkway, CTO-2 Plano, TX 75075 (972)477-2862**

5. Educational and cultural needs of the community.

Dallas County and Collin County abound in high-technology industries, and many of the employees of these companies desire to upgrade their professional skills and opportunities. The proposed M. S. and Ph.D. degrees in Materials Science and Engineering will allow some of these individuals, recruited by companies for their extraordinary technical skills, to move to larger roles within their companies, benefiting them personally and increasing their company's competitive position in the world economy.

V. PROGRAM POTENTIAL

A. Estimate the cumulative headcount and full-time equivalent (FTE) enrollment for each of the first 5 years (majors only, considering expected attrition and graduation) and indicate the number expected to be new to the institution each year.

Ph.D.

	Majors (FT)	Majors (PT)*	Attrition (FTE)	Graduation (FTE)	Majors (Total)	FTE's
1	8	2	2	0	8	7
2	10	3	2	0	19	17
3	13	4	2	2	31	27
4	16	4	3	4	44	38
5	20	5	4	8	57	49

*Defined as half-time

M. S.

	Majors (FT)	Majors (PT)*	Attrition (FTE)	Graduation (FTE)	Majors (Total)	FTE's
1	15	15	5	0	25	19
2	19	19	6	8	49	38
3	22	22	6	24	63	48
4	25	25	7	37	70	53
5	29	29	9	43	76	57

*Defined as half-time

B. Explain assumptions used in making these estimates.

Assumptions for the Ph.D.: 25% growth per year, part-time students will comprise approximately 20% of total students enrolled, attrition is 15% per year, and average time to graduation is approximately 4 years. These numbers reflect historical trends in the Jonsson School and benchmarked data from universities including Arizona State University, another recently started urban MSE program.

M. S. Assumptions: 25% growth per year, part-time students will comprise approximately 50% of total students enrolled, attrition is 15% per year, and average time to graduation is approximately 2 years. These numbers reflect historical trends in the Jonsson School and benchmarked data from universities including Arizona State University, another recently started urban MSE program.

VI. RESOURCES

A. Personnel

1. Describe any personnel additions or changes in the past three years made in anticipation of the program.

Three faculty members with expertise in materials science and engineering were added during 2003-2004 in response to the expressed interest of area

industry leaders. Other faculty have been added, and are being added, in response to the strong, steady growth in enrollment in existing degree programs in the Electrical Engineering and Computer Science Departments at U. T. Dallas.

2. Indicate for the first five years the cumulative number of FTE personnel who would be involved in delivery of the program in each of the following categories:

   a. released time for administration and other services,

      The Head of the Materials Science and Engineering Affiliated Faculty will administer this program under released time (0.5 FTE).

   b. full-time faculty,

      Full-time faculty who have already been hired, or who will be hired, in support of existing degree programs will teach all core courses and supervise all theses. There are currently 20 MSE affiliated full-time faculty. We anticipate 3 additional FTE faculty hires in MSE.

   c. part-time faculty,

      Some of the courses that may be prescribed for M. S. MSE students may be taught by part-time lecturers (.25 FTE).

   d. graduate student assistants,

      Teaching Assistants will not be required. There will be Research Assistants who will be funded from external research funds as available.

   e. clerical/support staff, and

      1 FTE clerical staff will be added to support the MSE program.

   f. others, specify

      None

3. List current faculty members, indicating highest earned degree/institution, field of study, current teaching and research assignments, dates of appointment, and anticipated contribution to the program. Specify course(s) each faculty member would teach.

Kenneth J. Balkus, Jr., Ph.D. in Inorganic Chemistry, University of Florida, 1986. Dr. Balkus joined U. T. Dallas in September 1987 and is a Professor in the Department of Chemistry and is affiliated with the NanoTech Institute. His research interests include the synthesis and application of nanoporous materials. MSE 5310, MSE 6310, MSE 5341

Ray H. Baughman, Ph.D. in Applied Physics, Harvard University, 1969. Dr. Baughman joined U. T. Dallas in September 2002 and is Professor of Chemistry and Robert A. Welch Chemistry Chair. His research interests include forefront materials and carbon nanontubes. He is director of the NanoTech Institute. MSE 5340

Cyrus D. Cantrell, Ph.D. in Physics, Princeton University, 1968. Dr. Cantrell joined U. T. Dallas in 1980 and is a Professor in the Electrical Engineering Department. His research interests include optical transmission systems, nonlinear optics, and electromagnetic effects in deep-submicron, very-high-speed VLSI circuits. MSE 5310, MSE 6310, MSE 6313, MSE 6361, MSE 6371, MSE 6374

Santosh R. D'Mello, Ph.D. in Biological Sciences, University of Pittsburgh, 1989. Dr. D'Mello joined U. T. Dallas in September 1998 and is an Associate Professor in the Molecular and Cell Biology Department. His research interests include the study of the molecular mechanisms underlying neurodegeneration and the development of neuroprotective drugs and strategies. Research Supervisor.

Rockford K. Draper, Ph.D. in Biological Chemistry, University of California at Los Angeles, 1974. Dr. Draper joined U. T. Dallas in 1980 and is a Professor in the Molecular and Cell Biology Department and Chemistry. His research interests include membrane cell biology and bio-nanotechnology. Research Supervisor. BIO 6358

John P. Ferraris, Ph. D. in Chemistry, The Johns Hopkins University, 1973 Dr. Ferraris joined U. T. Dallas in September 1975 and is a Professor in the Chemistry Department and Interim Dean of the School of Natural Sciences and Mathematics. Dr. Ferraris' research is in the area of (electroactive) organic small molecules and polymers for applications in electrochromics, light-emission (OLEDs/PLEDs), energy storage (electrochemical supercapacitors), membrane-based gas separations, and high temperature fuel cell membranes. His teaching interests include Polymer chemistry and materials chemistry. MSE 5340, MSE 5375

Yuri Gartstein, Ph.D. in Physics, USSR Academy of Sciences, 1988. Dr. Gartstein joined U. T. Dallas in September 2003 and is an Associate Professor in the Department of Physics. His research interests include theory and modeling of electronic, optical and transport properties of novel and synthetic advanced materials. MSE 5371, MSE 5375, MSE 6319, MSE 6324, MSE 6377

Robert Glosser, Ph.D. in Physics, University of Chicago, 1967. Dr. Glosser joined U. T. Dallas in September 1975 and is a Professor in the Physics Department. His research interests are in the area of optical properties of solids. MSE 5371, MSE 6371, MSE 6374

Bruce E. Gnade, Ph.D. in Nuclear Chemistry, Georgia Institute of Technology, 1976. Dr. Gnade joined U. T. Dallas in September 2003 and is a Professor in the Electrical Engineering Department and Chemistry. His research interests include microelectronics and displays. MSE 5370, MSE 5344, MSE 6320, MSE 6350

Juan E. González, Ph.D. In Microbiology and Molecular Genetics, University of California, Los Angeles, 1991. Dr. González joined U. T. Dallas in September 1996 and is an Associate Professor in the Molecular and Cell Biology Department. His research interests include control of bacterial biofilm formation and polysaccharide biosynthesis. Research Supervisor.

Steven R. Goodman, Ph.D. in Biochemistry, Saint Louis University Medical School, 1976. Dr. Goodman joined U. T. Dallas in August 2001 and is C.L. and Amelia A. Lundell Professor of Life Sciences, Professor of Molecular and Cell Biology, Director of the Institute of Biomedical Sciences and Technology, and Adjunct Professor of Cell Biology at UT Southwestern Medical Center. His research interests include Sickle Cell Disease, Neuroscience, and Proteomics. Research Supervisor.

Moon J. Kim, Ph.D. in Materials Science, Arizona State University, 1988. Dr. Kim joined U. T. Dallas in September 2003 and is a Professor in the Electrical Engineering Department. His research interests include materials integration by wafer bonding and electron microscopy. MSE 5360, MSE 6340, MSE 5361, MSE 5300, MSE 6340, MSE 6341

Gil S. Lee, Ph.D. in Electrical Engineering, North Carolina State University, 1987. Dr. Lee joined U. T. Dallas in August 2001 and is a Professor in the Electrical Engineering Department. His research interests include Microelectronics and Device Processing. MSE 6321, MSE 6362, MSE 5353

Jeong-Bong (J-B.) Lee, Ph.D. in Electrical Engineering, Georgia Institute of Technology, 1997. Dr. Lee joined U. T. Dallas in May 2001 and is an Assistant Professor in the Electrical Engineering Department. His research interests include MEMS and nano-scale devices. MSE 6324, MSE 6320, MSE 6321, MSE 7382

Alan G. MacDiarmid, Ph.D. in Inorganic Chemistry, Cambridge University, 1955. Nobel Laureate MacDiarmid joined U. T. Dallas in September 2001 and is James Von Ehr Distinguished Chair in Science & Technology and Professor of Chemistry and Physics. His research interests include synthesis and application of novel electronic organic materials.

Sanjeev K. Manohar, Ph.D. in Organic/Polymer Chemistry, University of Pennsylvania, 1992. Dr. Manohar joined U. T. Dallas in September 2001 and is Research Associate Professor in the Chemistry Department and Chemistry. His research interests include synthesis and application of novel electronic organic materials. MSE 5331, MSE 5333

Inga Holl Musselman, Ph.D. in Analytical Chemistry, University of North Carolina - Chapel Hill, 1988. Dr. Musselman joined U. T. Dallas in September 1992 and is an Associate Professor in the Department of Chemistry. Her research interests include investigating image contrast mechanisms in scanning tunneling microscopy and applying scanning probe and other microscopy techniques to polymer-based systems, including peptide-wrapped carbon nanotubes and mixed-matrix membranes for gas separations. MSE 5355, MSE 5356, MSE 5360, MSE 6340, MSE 6341

Lawrence J. Overzet, Ph.D. in Electrical Engineering, University of Illinois at Urbana-Champaign, 1988. Dr. Overzet joined U. T. Dallas in October 1988 and is a Professor in the Electrical Engineering Department. His research interests include Microelectronics and Device Processing. MSE 5383, MSE 6320, MSE 6322

Robert M. Wallace, Ph.D. in Physics, University of Pittsburgh, 1988. Dr. Wallace joined U. T. Dallas in September 2003 and is a Professor in the Electrical Engineering Department and Physics. His research interests include electronic materials and devices. MSE 5370, MSE 5344, MSE 6310, MSE 6330

Anvar A. Zakhidov, Ph.D. Physics, USSR Academy (Moscow), 1980. Dr. Zakhidov joined U.T, Dallas in September 2002 and is Professor in the Physics Department. His research interests include forefront materials and nanostructured materials. He is co-director of the NanoTech Institute. MSE 6362, MSE6371, MSE6377

4. If current faculty would be teaching new courses, how would their teaching assignments change, and how would their current assignments be accommodated?

   Most of the MSE courses will be cross-listed with existing courses in Chemistry, Physics, Electrical Engineering and Biology. These would not involve course development. In the case where a faculty member is required to develop a new course, that will be considered part of his or her work load for that semester. It is expected that newly or recently hired faculty will each contribute 2-3 new courses to the MSE curriculum.

5. List all new positions (faculty, graduate assistant, clerical/support, etc.) required during the first five years of the program and indicate whether the positions would be additions or reassignments. If reassignments, indicate the source.

   In accordance with the planned growth of the Erik Jonsson School of Engineering and Computer Science, three new FTE faculty members will be hired to support projected enrollment growth. Graduate assistantships will be primarily in the form of research assistantships that will be funded by research projects. One new clerical/support position will be added to support the program related educational activities. An estimated .25 FTE part-time Lecturer will be added to teach existing courses now taught by faculty who will be teaching the new courses.

6. Describe qualifications that would be sought in new faculty, indicate the expected level of appointment and anticipated contributions to the program (including research grants, contract resources, etc.)

   New faculty will be recruited using the same standards as in the existing Electrical Engineering and Computer Science departments. New faculty are expected to teach at the graduate level, carry out and publish research, and obtain adequate external funding to support their research programs. In order to grow in scale and stature, UTD must recruit the best faculty, and

attract the best students. The quality of a program is defined by the quality of its graduates. In FY 2003, the Erik Jonsson School of Engineering and Computer Science received over $11 million in external funding, or approximately $140,000 per tenured or tenure-track faculty member. In the same time period, the existing Electrical Engineering and Computer Science faculty published 125 journal articles, or an average of approximately two journal articles per year, per tenured or tenure-track faculty member. It is expected that the average productivity of new tenure-track faculty members will adhere to these norms as a minimum.

7. For graduate programs:

   a. describe departmental faculty policy regarding chairing or serving on thesis/dissertation committees, numbers of students supervised at one time, etc.

   Any MSE affiliated tenure-track faculty member may supervise Ph.D. dissertations and serve on supervising committees. No limits are imposed on the number of students that may be supervised simultaneously. We expect that, on average, a faculty member will supervise 3-5 M. S. students, in addition to 3-5 Ph.D. students.

   b. identify faculty who would supervise theses, dissertations, and internships, etc.; provide examples of their ongoing research projects.

   The Materials Science and Engineering faculty will supervise theses and dissertations, and are listed above in response to Question 3 of Section VI. Complete vita of the faculty, including research publications, may be found in the appendix.

B. Library

1. List any library holding added in the <u>past</u> three years in anticipation of the program.

   No holdings were added in anticipation of the proposed program. However, the holdings that have been added, since the inception of the Jonsson School, in the area of materials research all support the needs of the proposed program. The Library continually builds its collections in support of all programs at U. T. Dallas. As part of that process, the Library is licensing publisher's journal collections, electronic book libraries, and databases containing full-text articles. Every program, including Materials Science and Engineering, benefits from this ongoing process.

2. Describe library holding specifically relevant to the proposed program, noting strengths and weaknesses. If there are guidelines for the discipline, do current holding meet or exceed standards? Describe planned actions that would maintain strengths and/or remedy weaknesses.

The U. T. Dallas library subscribes to most of the archival journals that are relevant to the proposed program because these same journals are needed for the materials research areas of faculty in the existing Chemistry, Physics, Electrical Engineering and Biology departments that are home to the Materials Science and Engineering affiliated faculty. The Librarians have reviewed the holdings with these faculty members. The categories considered include the archival journals, the article databases, the books and monographs and the technical standards. In general, the library is receiving about 69% of the library material that schools awarding the Ph.D. typically acquire. It is anticipated that a one-time investment of $47,000 in article databases, monographs, and technical standards will bridge the acquisitions gap. In an acquisitions budget in excess of $3,000,000 this expenditure is manageable.

Because of the specific types of materials science proposed by the faculty at The University of Texas at Dallas, the Library subscribes to over 95% of the materials science journals needed. If the Library reviews all of the core titles produced in all aspects of material science (metal, ceramic, polymer, etc.), the Library subscribes to over 60% of the journals; however, there are many aspects of the discipline that are unrelated to the degree plan proposed. Also, through collaborative agreements with other U. T. System schools, UTD has access to over 95% of the journals in materials science and engineering contemplated in the proposed program.

The Library subscribes to the most important indexing services to access the periodical literature in materials science including Compendex (engineering literature), SciFinder Scholar (online equivalent of Chemical Abstracts), the Web of Science (the citation indexes), and Inspec (computer science, physics, and electronic engineering). The Library would recommend the addition of the Cambridge Scientific Abstracts Materials Research Database at a cost of approximately $9,000.

The Librarian reviewed the book collections in the field of materials science for the institutions granting a doctorate in the field. The Librarian compared the collection title by title for a series of these libraries. In many cases, UTD has approximately 65% of the titles held in those libraries. To reduce the deficiency approximately 80 additional titles would be ordered from current funds at a cost of approximately $8,000. By including these additional monographs, the Library would own approximately 500 core titles in support of materials science. Over the past 4 years, the comparison to other libraries is approximately 85%. The current acquisitions' programs are thus sufficient to support the initial stages of the program.

An area UTD will need to address is technical standards for materials science, since these are commonly included in libraries supporting Ph.D. programs in Materials Science and Engineering. If this program is approved the library will expend the $30,000 necessary to obtain access to those standards.

3. Describe cooperative library arrangements that would be available to students in this program.

The U.T. System Digital Library will be available to faculty and students in the proposed program. The UTD library participates in a consortium program with the other U. T. System university libraries which gives our students and faculty access to over 30,000 titles and hundreds of online databases. These are available from any UTD IP address and remotely for our students and faculty through the proxy server.

The UTD library shares resources with numerous other academic and research libraries in the region. In addition, nationwide interlibrary loan is provided through membership in OCLC, a bibliographic utility shared by more than 6000 libraries.

Finally, the Library subscribes to thousands of electronic resources through cooperative agreements including TexShare (Texas State Library and Archives), Amigos and the local Phoenix library consortium.

4. Provide library director's assessment of library resources necessary for the proposed program.

The library collections of The University of Texas at Dallas are adequate to begin this program. The library annually spends two-thirds of its entire materials budget of $3,000,000 on science and engineering materials. The collections of the Eugene McDermott Library are strongest in the relevant areas of Physical Science, Chemical Science, Biological Science, and Mathematics and Statistics. An area that will need to be addressed is technical standards for materials science. Access to those standards and the addition of 80 book titles and one indexing service can be addressed within the existing annual acquisitions budget. Given the information outlined above, it is my assessment that the library resources are either in place or readily attainable to support the proposed Ph.D. in Materials Science and Engineering at The University of Texas at Dallas. [Dr. Larry Sall, Dean of Libraries]

C. Equipment

1. List any equipment acquired in the <u>past</u> three years in anticipation of the program.

Funded by UTD's Texas Enterprise Funds, two transmission electron microscopes, a new multi-chamber materials deposition system, and a focused ion beam system have been purchased for the School's heterogeneous materials integration laboratory that also has a sophisticated ultra high vacuum wafer bonding system. The Materials Science and Engineering program will make extensive use of this equipment as well as of the clean room facilities that include:

- **Furnace**
- **Rapid Thermal Annealing**
- **Plasma Enhanced CVD System**
- **Low Pressure CVD System**
- **Electrical Probe Stations**
- **X-Ray Diffractometers**
- **E-Beam Lithography**
- **Optical Lithography**
- **Physical Vapor Deposition**

2. Itemize expenditures projected during each of the first five years for equipment and supplies specifically for the proposed program.

   Because of the recent expenditures listed above, no major additional equipment needs will be funded directly from the School. Most of the expenditures for the first five years will be part of the overall growth of the School, as well as the materials and equipment purchased to support externally funded research grants and contracts. Office and teaching supplies are estimated to be about $12,000 annually.

D. Facilities

1. Describe any facility added or modified in the past three years in anticipation of the program.

   None

2. Describe the availability and adequacy of existing facilities that would be used for the proposed program.

   Existing classroom and laboratory space will support most of the needs of this program. Needs for additional laboratory space will be met by the new Natural Science and Engineering Research building, which is currently being planned and is due to be completed in 2006.

3. Describe planned alteration or renovation of existing facilities needed for the program; estimate date of availability and display estimated cost in Item VII.

   No additional alteration or renovation of existing facilities is required for the proposed degree programs.

4. Describe planned new facilities needed for the program; estimate date of availability and display estimated cost in Item VII.

   Needs for additional laboratory space will be met by the new Natural Science and Engineering Research building, which is currently being planned and is due to be completed in 2006.

VII. COSTS

On the attached forms, provide estimates of new costs to the institution related to the proposed program(s) and provide information regarding sources of the funding that would defray those costs.

NOTE: Under Coordinating Board procedures, proposals for new programs and administrative units must be accompanied by (a) a statement certifying the adequacy of funding, or (b) a statement regarding the need for funds not yet available to the institution. The statement must be from the chief administrative officer of the requesting institution.

(Policy on Adequate Financing, Coordinating Board, January, 1992.)

See tables following Section VIII.

VIII. ADDITIONAL COMMENTS THAT WOULD BE HELPFUL TO THE COORDINATING BOARD IN EVALUATING THIS PROGRAM REQUEST.

See Executive Summary.

Name of Degree(s): PhD, MS in Materials Science and Engineering

COSTS TO THE INSTITUTION OF THE PROGRAM/ADMINISTRATIVE CHANGE

Note: Use this chart to indicate the dollar costs to the institution that are anticipated from the change requested.

Cost Category	Cost Sub-Category	Before Approval Year*	1st Year	2nd Year	3rd Year	4th Year	5th Year	TOTALS
Faculty Salaries(1)	**(New)**		$21,635	$112,500	$210,600	$316,368	$329,023	$990,125
	(Reallocated)							$0
Program Administration (2)	**(New)**		$50,000	$52,000	$54,080	$56,243	$58,493	$270,816
	(Reassignments)							
Graduate Assistants	**(New)**							$0
	(Reallocated)							$0
Clerical/Staff (3)	**(New)**		$36,000	$37,440	$38,938	$40,495	$42,115	$194,988
	(Reallocated)							
Supplies & Materials (4)			$12,000	$12,480	$12,979	$13,498	$114,038	$64,996
Library & IT Resources(5)**			$47,000					$47,000
Equipment								$0
Facilities								$0
Other (Identify)								$0
TOTALS			$166,635	$214,420	$316,597	$426,605	$443,669	$1,567,925

* Include costs incurred for three years before the proposal is approved by the Board (e.g., new faculty, library resources, equipment, facilities remodeling, etc.).

** IT = Instructional Technology

Explanations:

(1) .25 FTE part-time Lecturer beginning in Year 1 with 4% increase per year for inflation.
(2) .50 FTE faculty for program administration with 4% increase per year for inflation.
(3) 1.0 FTE faculty added in Year 2; 2.0 FTE faculty added in Year 3; 4% inflation per year.
(4) Office supplies and teaching supplies with 4% inflation added.
(5) Library article databases, monographs, and technical standards.

Name of Degree(s): PhD, MS in Materials Science and Engineering

ANTICIPATED SOURCES OF FUNDING

Note: Use this chart to indicate the dollar amounts anticipated from the various sources. Use page 2 of this form to specify as completely as possible each non-formula funding source.

Funding Category	**1st Year**	**2nd Year**	**3rd Year**	**4th Year**	**5th Year**	**TOTALS**
I. Formula Income*			$158,298	$213,302	$221,834	$593,435
II. Other State Funding*	$166,635	$214,420	$158,298	$213,302	221,834	$974,490
III. Reallocation of Existing Resources*						$0
IV. Federal Funding* (In-hand only)						$0
V. Other Funding*						$0
TOTALS	$166,635	$214,420	$316,597	$426,605	$443,669	$1,567,925

*For more information, please refer to the accompanying *Anticipated Sources of Funding: Explanatory Notes and Examples.*

Formula Funding Master's: Year 3 48x24x51.25x8.2=484,128
Year 4 53x24x51.25x8.2=534,558
Year 5 57x24x51.25x8.2=574,902

Formula Funding Ph.D.: Year 3 27x18x51.25x21.4=533,021
Year 4 38x18x51.25x21.4=750,177
Year 5 49x18x51.25x21.4=967,334

Total Formula Funding, Years 3-5: $5,437,708; program projected to be self-supporting beginning in Year 3.

Name of Degree(s): PhD, MS in Materials Science and Engineering

NON-FORMULA SOURCES OF FUNDING

Note: Use this form to specify as completely as possible each of the non-formula funding sources for the dollar amounts listed on page 1 of this form.

Funding Category		**Non-Formula Funding Sources**
II. Other State Funding	**#1**	Texas Enterprise Fund
	#2	
III. Reallocation of Existing Resources	**#1**	
	#2	
IV. Federal Funding	**#1**	
	#2	
V. Other Funding	**#1**	
	#2	