

Wichita State University
Master of Science in Materials Engineering

Program Approval

I. General Information

A. Institution Wichita State University

B. Program Identification

Degree Level: Master's
Program Title: Materials Engineering
Degree to be Offered: Master of Science in Materials Engineering
Responsible Department or Unit: College of Engineering
CIP Code: 14.1801
Modality: All (Face-to-Face, Online, and Hybrid)
Proposed Implementation Date: Fall 2021

Total Number of Semester Credit Hours for the Degree: 33

II. Clinical Sites: Does this program require the use of Clinical Sites? No

III. Justification

The manufacturing industry in Kansas including Wichita needs a trained workforce in materials engineering. Modern and emerging technologies exploit materials at their fundamental level to design superior products to be competitive in the global market, including those used in aerostructures. While there are several materials-related academic content areas within Wichita State University (WSU) as well as other Kansas Board of Regents institutions, there currently is not a BS, MS, or PhD program in "Materials Engineering" that specifically focuses on leveraging fundamental materials properties in the design process. Building upon our established strength in advanced materials, the College of Engineering (COE) at WSU has the faculty and graduate courses to develop the proposed program with minimal additional investment.

The proposed interdisciplinary Master's in Materials Engineering program may be achieved by completing 33 credit hours (CHs) of coursework. Various departments within the COE already offer a sufficient number of courses and content in support of the program. Five core courses are defined by graduate-level certificate programs, meaning that these courses will be regularly offered and widely available to students in the proposed program. The MS in Materials Engineering is targeted to students who have an undergraduate degree in any field of engineering or physical science (physics, chemistry, geology, etc.) as well as working professionals who aspire to attain a higher level of knowledge in materials and manufacturing.

IV. Program Demand

A. Survey of Student Interest

Number of surveys administered:	<u>1</u>
Number of completed surveys returned:	<u>109</u>
Number of students interested in program:	<u>54</u>
Percentage of students interested in program: ...	<u>49.5%</u>

The College of Engineering conducted a survey of undergraduate students in engineering and related fields at Wichita State University plus some working professionals in the Wichita area to determine the demand for this proposed program. Responders included 105 full-time students—many who are also working full time or part time in local industry—and four recent graduates. Out of these students, 76% expressed an interest to pursue a master’s degree to advance their career, and 73% indicated interest to have advanced knowledge of materials engineering to be successful in their professional career. Out of the 109 responses received, 54 (49.54%) indicated that they would definitely be interested in pursuing the proposed program if WSU were to offer it, and 30 students wanted to enroll in the program right after their graduation. While most expressing an interest in the proposed program indicated interest only in a master’s degree, some (22%) also indicated interest for a PhD degree in this area after completing the master’s degree.

B. Market Analysis

There has been steady demand for materials engineering graduates in Wichita and Kansas City, the two major metropolitan areas in the state of Kansas. Advertisements for job openings posted at Indeed.com have shown 10+ openings in Wichita and 65+ openings in the Kansas City area that require a master’s degree in Materials Engineering (2021). Similarly, there is a nationwide demand for graduates with the same. For example, Oklahoma City (40+), Denver (160+), Houston (120+), Dallas (190+), and New York City (810+) have posted a high demand for master’s degree graduates in this field because they are critical for a variety of industries such as aerospace, automotive, pharmaceutical, consumer products, and medical devices (2021). Therefore, the demand for the proposed program is quite significant in Kansas as well as in the nation.

Wichita State University has also done a formal market survey of jobs requiring a master’s degree in Materials Engineering in both local areas (Wichita, Kansas City, Newton, Hesston, Salina, Manhattan, and Lawrence) and in the region (Kansas, Missouri, Nebraska, and Oklahoma). The local area had an average of ten openings each month, with the range being 4 to 23 openings. Over the same time period, the greater region had an average of 85 openings per month, with the range being 43 to 104. The top employers seeking these professionals included Spirit AeroSystems, Textron, Honeywell International, Northrop Grumman, and United Technologies Corporation.

Based on current employment trends, demand for professionals with a master’s degree in Materials Engineering is expected to grow at a rate of 9.7% in the local area over the next ten years. Our study investigated the competition from other universities in the greater region. As stated above, currently, there is not a master’s program in Materials Engineering at any Kansas university, making the proposed program especially important. While Missouri University of Science and Technology, Washington University in St. Louis, and Oklahoma State University offer similar programs, the three schools combined together graduated only ten students over a recent academic year, which again underscores the unmet workforce needs in this area of study.

Taken together, the data demonstrates strong demand for professionals with a master’s degree in Materials Engineering in Wichita and the region. The proposed program will be a critical piece in fulfilling this talent gap, helping the state retain its manufacturing and engineering competitive advantage.

V. Projected Enrollment for the Initial Three Years of the Program

Year	Headcount Per Year		Sem Credit Hrs Per Year	
	Full-Time	Part-Time	Full-Time	Part-Time
Implementation	10	10	210	90
Year 2	25	15	645	225
Year 3	40	20	1,140	405

The headcount projection of full-time and part-time students for years one through three are provided in the above table. Full-time status for graduate students is defined as nine or more credit hours per semester. Full-time credit hours are calculated assuming the student takes a full load of nine credits in the fall and spring semesters, plus – on average – each full-time student takes a single three-credit class in the summer. Part-time credit hours are calculated assuming – on average – each part-time student is half-time enrolled in the fall and spring semesters. The total number of Semester Credit Hours Per Year is calculated based on the projected cumulative number of enrollments for both full-time and part-time students.

VI. Employment

The Bureau of Labor Statistics (BLS) predicts that the national need for materials engineers will remain flat over the 2018–2028 ten-year period (2021). The BLS assessment specifically states, “Materials engineers will be needed to design uses for new materials both in traditional industries, such as aerospace manufacturing, and in industries focused on new medical or scientific products.” Moreover, they stress the importance of materials engineering to manufacturing, making the need in South Central Kansas particularly important. Focusing on specific occupational and wage data for materials engineers in Kansas, the state currently has approximately 270 materials engineers, with an annual average salary of \$105K, which is in the highest stratum that the BLS has defined nationally for this occupation (2020). Given that no Kansas university currently offers a master’s degree in Materials Engineering, the proposed program fills a much-needed workforce training gap for the state.

VII. Admission and Curriculum

A. Admission Criteria

Students admitted to the MS in Materials Engineering program will possess a Bachelor of Science (BS) degree in one or more of the following majors: Materials Engineering, Material Science, Metallurgical Engineering, Mineral Engineering, Mechanical Engineering, Aerospace Engineering, Industrial Engineering, Manufacturing Engineering, Biomedical Engineering, Electrical and Computer Engineering, Chemical Engineering, Process Engineering, Physics, Chemistry, Geology, or a closely related discipline, upon approval by the Graduate Program Coordinator. Entering students must have a cumulative bachelor’s grade point average (GPA) of at least 3.0 (out of 4.0) and must satisfy all other entrance requirements of the Graduate School at Wichita State University.

B. Curriculum

The proposed MS in Materials Engineering curriculum is designed to give students maximum flexibility to tailor courses to their professional goals. Specifically, students must complete at least nine credit hours (three courses) from the set of CORE courses listed in the table below. In addition, students must take an additional 24 credit hours (typically corresponding to eight additional courses) from the union of “core” and “technical elective” course sets. Core courses will typically be offered once a year, and technical elective courses will be offered every one to two years. To satisfy the “applied learning” requirement of Wichita State University, students must take at least one course with significant applied learning components or complete an approved semester-long graduate internship/cooperative education, or a one-credit MS Directed Project, or present one of their class projects/term papers to outside professionals. As a course-only master’s program, no comprehensive exit examination is required for completion of the degree.

The following is a sample curriculum (with advanced structural materials focus) for a full-time graduate student (with nine credit hours enrollment during fall and spring semesters) to complete the program in two years. Typically, CORE courses will be offered once every year and Technical Elective courses will be offered once every one to two years.

Year 1: Fall

SCH = Semester Credit Hours

Course #	Course Name	9
AE 753	Mechanics of Laminated Composites (Core)	3
ME 762	Polymeric Composite Materials (Core)	3
AE 733 or ME 760	Advanced Mechanics of Materials (Elective) or Fracture Mechanics (Elective)	3

Year 1: Spring

Course #	Course Name	9
ME 665	Selection of Materials for Design and Manufacturing (Core)	3
IME 755	Design of Experiments (Elective)	3
AE 853	Advanced Mechanics of Laminated Composites (Elective)	3

Year 1: Summer

Course #	Course Name	3
BME 771 or IME 775	Polymer Processing and Technology (Core) or Computer Integrated Manufacturing (Core)	3

Year 2: Fall

Course #	Course Name	9
AE 831	Continuum Mechanics (Elective)	3
ME 672 & L	Manufacturing of Composites and Laboratory (Core)	3
IME 758	Analysis of Manufacturing Processes (Elective)	3

Year 2: Spring

Course #	Course Name	3
AE 737 or ME 866 or ME 890	Mechanics of Damage Tolerance (Elective) or Advanced Fracture Mechanics (Elective) or Independent Study in Mechanical Engineering (Elective)	3

Total Number of Semester Credit Hours **33**

VIII. Core Faculty

Faculty Name	Rank	Highest Degree	Tenure Track (Y/N)	Academic Area of Specialization	Percent FTE Devoted to Proposed Program
Muhammad Mustafizur Rahman*	Professor	PhD	Y	Thermodynamics, Phase Change Materials	10
Ramazan Asmatulu	Professor	PhD	Y	Nanomaterials, Corrosion	5
Suresh Keshavanarayana	Professor	PhD	Y	Composite Materials	5

Anil Mahapatro	Associate Professor	PhD	Y	Biomaterials, Polymer	5
Wilfrido Moscoso	Associate Professor	PhD	Y	Machining of Materials	5
Bhisham Sharma	Assistant Professor	PhD	Y	Meta-Materials	5
Gamal Weheba	Professor	PhD	Y	Additive Manufacturing	5
Eylem Asmatulu	Assistant Professor	PhD	Y	Recycling of Materials	5
Bin Li	Associate Professor	PhD	Y	Polymer Materials	5
Davood Askari	Associate Professor	PhD	Y	Composite Materials	5
Rajeev Nair	Associate Professor	PhD	Y	Laser Machining	5
Tewodros Zewde	Assistant Teaching Professor	PhD	N	Wireless-Powered Communications	5

*Graduate Program Coordinator Note:

FTE: 1.0 FTE = Full-Time Equivalency Devoted to Program

Number of graduate assistants assigned to this program 0

IX. Expenditure and Funding Sources (List amounts in dollars. Provide explanations as necessary.)

A. EXPENDITURES	First FY	Second FY	Third FY
Personnel—Reassigned or Existing Positions			
Faculty	\$60,520	\$62,335	\$64,206
Administrators (other than instruction time)	7,508	7,734	\$7,966
Graduate Assistants			
Support Staff for Administration (e.g., secretarial)			
Fringe Benefits (total for all groups)	23,810	24,524	\$25,260
Other Personnel Costs			
Total Existing Personnel Costs—Reassigned or Existing	\$91,838	\$94,593	\$97,431
Personnel—New Positions			
Faculty	\$10,000	\$20,000	\$30,000
Administrators (other than instruction time)			
Graduate Assistants			
Support Staff for Administration (e.g., secretarial)			
Fringe Benefits (total for all groups)	3,500	\$7,000	\$10,500
Other Personnel Costs			
Total Existing Personnel Costs—New Positions	\$13,500	\$27,000	\$40,500

Start-Up Costs—One-Time Expenses			
Library/Learning Resources			
Equipment/Technology			
Physical Facilities: Construction or Renovation			
Other			
Total Start-Up Costs			
Operating Costs—Recurring Expenses			
Supplies/Expenses	\$2,000	\$3,500	\$3,500
Library/Learning Resources			
Equipment/Technology			
Travel			
Other			
Total Operating Costs	\$2,000	\$3,500	\$3,500
GRAND TOTAL COSTS	\$107,338	\$125,093	\$141,431

B. FUNDING SOURCES	Current	First FY (New)	Second FY (New)	Third FY (New)
Tuition/State Funds		\$130,060	\$383,630	\$680,300
Student Fees		\$26,096	\$68,435	\$121,209
Other Sources				
GRAND TOTAL FUNDING		\$156,156	\$452,065	\$801,509
C. Projected Surplus/Deficit (+/-) (Grand Total Funding <i>minus</i> Grand Total Costs)		\$48,818 (surplus)	\$326,972 (surplus)	\$660,078 (surplus)

Based on full-time students taking 9 credits in Fall, 9 credits in Spring, and 3 credits in summer the first year, and 9 credits in Fall and 3 credits in Spring in the second year for a total of 33; and part-time students taking 6 credits in Fall and 3 credits in Spring for three years and then taking the last 6 credits in fall of year 4 for a total of 33.

X. Expenditures and Funding Sources Explanations

A. Expenditures

Personnel – Reassigned or Existing Positions

Year 1	The previous table listing Core Faculty was used to multiply faculty salaries by the faculty FTE devoted to the new program. Note that this merely represents a slight reorganization as this cost is latent. Note that all of these faculty have their primary teaching responsibilities in their home departments, and the courses that they teach for this program are already being taught.
	Administrator is calculated as 5% of the Associate Dean for Graduate Program's salary (again, a latent cost).
	Fringe is calculated based on current WSU fringe rates.

Year 2	Accounting for raises, all salary costs are increased by 3%.
Year 3	Accounting for raises, all salary costs are increased by another 3%.

Personnel – New Positions

Year 1	10% effort of a new faculty member’s salary + fringe is budgeted.
Year 2	A second 10% effort of a new faculty member’s salary + fringe is budgeted (plus costs carried over from year 1).
Year 3	A third 10% effort of a new faculty member’s salary + fringe is budgeted (plus costs carried over from years 1 and 2).

Start-up Costs – One-Time Expenses

Years 1–3	Given that the proposed program is based on existing courses, no one-time start-up costs are necessary.
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Operating Costs – Recurring Expenses

Year 1	Consumable office supplies are estimated at \$2,000.
Year 2	Consumable office supplies are estimated at \$3,500.
Year 3	Consumable office supplies are estimated at \$3,500.

B. Revenue: Funding Sources

Revenue is calculated based on the projected enrollment from the table in Section V. In-state graduate tuition of \$307.98/CH is calculated for 60% of the full-time student credit hours, whereas given the large number of international students expected to be interested in this program, out-of-state tuition of \$756.38/CH is calculated for the remainder of the full-time credit hours. All part-time student credit hours are calculated using the in-state rate.

Students pay mandatory and student support fees on a semester basis and the fee is based on the number of credit hours they take in each semester. For the student support fees, the full-time students (7 or more credit hours) pay \$679.18 for fall and spring semesters and \$339.60 for summer semester. The part-time students (4 – 6.75 credit hours) pay \$452.78 for fall and spring semesters and \$226.40 for summer semester. And the student support fees for up to 3.75 credit hours are \$226.40 in fall and spring semesters and \$113.21 for summer. The other mandatory fees are calculated at a rate of \$7.75/CH, which includes the campus infrastructure and support fee (\$6/CH), the campus technology fee (\$1/CH), and the campus transportation fee (\$0.75/CH). Funding will be allocated through existing resources in the College of Engineering.

C. Projected Surplus/Deficit

A modest surplus is projected in year 1 (\$48.8K), which increases to healthy surpluses in years 2 and 3 (\$326.9K and \$660K, respectively).

XI. References

Indeed Jobs. (2021). Retrieved May 19, 2021 from: <https://www.indeed.com>

U.S. Department of Labor. (2021). Occupational Handbook, Architecture and Engineering. Bureau of Labor Statistics. <https://www.bls.gov/ooh/architecture-and-engineering/materials-engineers.htm>

U.S. Department of Labor. (2020). Occupational Employment and Wages. May 2020. 17-2131 Materials Engineers. Bureau of Labor Statistics. <https://www.bls.gov/oes/current/oes172131.htm#st>