College of Engineering and Computing

Dean **John L. Volakis**
Associate Dean for Academic Affairs **Anthony J. McGoron**
Associate Dean for Research **Osama Mohammed**
Associate Dean for Undergraduate Education **Mark A. Weiss**

The College of Engineering and Computing is committed to **educate** professionals who can **serve industry and the community at large** in a wide variety of fields, as well as **conduct innovative basic and applied research** that meets the technical needs of industry and government, improves the quality of life, and contributes to the economic viability of Florida, the Nation, and the world.

The College of Engineering and Computing consists of five schools: School of Biomedical, Mechanical and Materials Engineering, Knight Foundation School of Computing and Information Sciences, School of Electrical, Computer and Enterprise Engineering, School of Universal Computing, Construction and Engineering Education and Moss School of Construction, Infrastructure and Sustainability; and five academic departments: Biomedical Engineering, Civil and Environmental Engineering, Construction Management, Electrical and Computer Engineering, and Mechanical and Materials Engineering. These academic units offer programs leading to the Bachelor of Arts, Bachelor of Science, Master of Science and Doctor of Philosophy degrees. In addition to the academic departments and schools, the College offers a graduate program that houses the Enterprise and Logistics Engineering.

The College has two institutes and thirteen centers supporting its academic and research programs. The institutes are the Advanced Materials Engineering Research Institute (AMERI) and the Telecommunications and Information Technology Institute (IT2). The centers are the Bioinformatics Research Group (BioRG), Center for Advanced Distributed Systems Engineering, Center for Advanced Technology and Education (CATE), Center for Diversity in Engineering and Computing (CDEC), Center for Emerging Technology for Advanced Information Processing and High-Confidence Systems, Center for the Study of Matter at Extreme Conditions (CeSMEC), Engineering Information Center (EIC), Engineering Manufacturing Center (EMC), High Performance Database Research Center and the Lehman Center for Transportation Research (LCTR). Two major university centers, the Applied Research Center (ARC) and International Hurricane Research Center (IHRC), work very closely with the College of Engineering and Computing with many joint appointments at the faculty level.

The College houses an open-access Motorola Nanofabrication Research Facility to conduct research in nanoelectronics, bio/nanosensors and nanomaterials. In addition, the FIU College of Engineering and Computing has developed many collaborations with the industry and hospitals in Florida and across the nation.

The programs of the College are directed towards the practical use of scientific, engineering, and technical principles to meet the objectives of industry, business, government and the public.

The College provides each student with the opportunity to develop a high level of technical skills and to obtain an education, which will prepare him or her for a rewarding career and personal growth. Through the programs and degrees it offers, the College recognizes the growing impact of technology upon the quality of life and that the proper application of technology is critical to meeting current and emerging human needs.

The College faculty is actively engaged with business, industry and government. Faculty members also participate in a variety of basic and applied research projects in areas such as energy, transportation, solid waste disposal, biotechnology, biomedical devices and instrumentation, computer engineering, artificial intelligence, manufacturing, robotics telecommunications, micro-electronics, nano-electronics, nanotechnology, neuro-sciences/engineering, modeling and simulation, construction engineering, materials, structural systems, virtual prototyping, systems modeling, information technology, environmental sciences and engineering, image processing, engineering education, etc.

Doctor of Philosophy

The College offers Doctor of Philosophy degrees in Biomedical Engineering, Civil Engineering, Computer Science, Electrical and Computer Engineering, Engineering and Computing Education, Mechanical Engineering, and Materials Science and Engineering
Areas of study in Biomedical Engineering include:

- Biomechanics, biomaterials, and medical devices
- Bioinstrumentation, and biomedical image/signal processing
- Drug delivery and Bio-nanotechnology
- Medical physics and Biophotonics
- Reparative and Regenerative Tissue Engineering
- Reparative and Therapeutic Neurotechnology

Areas of study in Civil Engineering include:

- Transportation engineering
- Environmental engineering
- Structural engineering
- Water resources engineering
- Geotechnical engineering
- Construction engineering

Areas of study in Computer Science include:

- Networking and distributed systems, wireless networks, mobile and ubiquitous computing, routers, and switches, system modeling.
- Operating systems, distrusted computing, storage systems, virtualization, security, and real-time systems.
- Database systems, including distributed databases, information retrieval in heterogeneous databases, multimedia databases, data mining, and digital libraries.
- Software engineering, including formal methods, software testing techniques, software architecture, software security, software design, model-driven software development, and grid computing.
- Theory, including algorithms and data structures, programming languages, program verification, and logic.
- Bioinformatics and computational biology.

- Artificial Intelligence, including machine learning, expert systems, intelligent agents, affective computing, cognitive science, intelligent human-computer interaction, social informatics.

Areas of study in Electrical and Computer Engineering include:

- Biomedical sciences and technologies
- Computing systems and VLSI design
- Cybersecurity
- Digital signal and image processing
- Machine learning
- Microelectronics including all types of analog, digital and mixed-signal electronics and integrated circuit designs
- Nanoscale electronics and photonics
- Power and energy systems
- Power electronics
- Renewable energy
- RF and microwave engineering
- Systems, robotics, and control
- Telecommunications and networking

Areas of study in Engineering and Computing Education include:

- Educational systems and culture (e.g., educational change in those systems, leadership and policy issues, institutional and departmental structures impacting education)
- Engineering and Computing student experiences (e.g., agency, identity development, motivation, transitions, experiences of particular student groups)
- Equity, diversity, and inclusion in engineering and computing education, could be focused on students, staff, educators and/or professionals
- Instructional practices and educator development in K-12, undergraduate and graduate school, could be face-to-face, hybrid, and/or online. This could include formal and information education, the use of educational technology, or a focus on a particular pedagogy.
- Learning in K-12, undergraduate and graduate school, could be face-to-face, hybrid, and/or online. This could include exploring certain skill and content development as well as learning within particular pedagogies, with technology, and/or in informal spaces.
- Particular settings (e.g., K-12, Hispanic-Serving Institutions, Historically Black Colleges and University, Two-year colleges, makers/innovation spaces, professional workplaces)

Areas of study in Mechanical and Materials Engineering include:

- Additive manufacturing
- Applied mechanics
- CAD/CAM
- Ceramics and electronic materials
- Energy materials
- Mechanics of materials
- Metals and advanced composites
- Modeling and simulation
- Nanomaterials and nano devices
- Polymers and biomaterials
- Robotics
- Thermo/Fluids sciences

Master of Science Degree Programs

The College offers Master of Science degrees in:

- Biomedical engineering
- Civil engineering
- Computer engineering
- Computer science
- Construction management
- Cybersecurity
- Data science
- Electrical engineering
- Engineering management
- Environmental engineering
- Information technology
- Logistics engineering
- Materials science and engineering
- Mechanical engineering
- Telecommunications and networking

Distance Learning Programs

The Office of Distance Education (ODE) provides access to graduate and undergraduate level engineering courses and programs to individual students anywhere and anytime, whether it is at home or the workplace. Courses are delivered through streaming video over the internet.

Research Centers and Institutes

Research spans from a single discipline to multidisciplinary areas in the College of Engineering and Computing. Thus, the College, through its research centers and institutes, has established many collaborative and cooperative partnerships with other units in the university as well as with the regional, state and federal governments and industry.

The research units involved in these efforts include:

- Advanced Materials Engineering Research Institute (AMERI)
- Applied Research Center (ARC)
- Bioinformatics Research Center (BioRG)
- Center for Advanced Distributed Systems Engineering
- Center for Advanced Technology and Education (CATE)
- Center for Diversity and Student Success in Engineering and Computing (CD-SSEC)
- Center for the Study of Matters at Extreme Conditions (CeSMEC)
- Distributed Multimedia Information Systems Laboratory (DMIS)
- Division of External Programs (DEP)
- Engineering Information Center (EIC)
- Engineering Manufacturing Center (EMC)
- Florida Center for Cyber Infrastructure Education and Research for Trust and Assurance
- High Performance Database Research Center (HPDRC)
- Industry-University Cooperative Research Center (I/UCRC) Center for Advanced Knowledge Enablement (CAKE)
- Lehman Center for Transportation Research (LCTR)

- Motorola Nanofabrication Research Facility
- Titan America Structures and Construction Testing Laboratory
- Telecommunications and Information Technology Institute (IT2)

Student Access & Success

The Office of Student Access & Success is committed to improving students' learning and success by providing engaged learning experiences through meaningful and strategic programming and services that will facilitate successful transitions between pre-collegiate, undergraduate and graduate education.

Admission Requirements

Prospective students seeking a graduate degree in the College must satisfy all university admission requirements as well as the specific program requirements. Each department evaluates candidates for admission to its programs. Prospective students should refer to the appropriate section of the catalog for specific admission requirements. Contact information of the Graduate Programs Directors can be found at:
cec.fiu.edu/resources/students/advising/graduate-program-directors/

Admitted Student Procedures

A student who has been accepted to a degree program in the College must meet with the department's Graduate Program Director prior to the enrollment in the first class.

Enrolled students must choose an advisor during their first semester in the program.

Continued contact (at least once per semester) with the advisor is required to review progress and select courses for each succeeding semester.

Courses taken without the required prerequisites and co-requisites, or without the consent of the advisor, will be dropped automatically before the end of the term, resulting in a grade of "DR" or "DF".

Scientific Laboratory Fees are assessed for certain courses where laboratory classes are part of the curriculum. Specific information on scientific laboratory fees may be obtained from the University Financial Services.

Fellowships, Assistantships, and Scholarships

The College of Engineering and Computing offers a variety of fellowships, assistantships, and scholarships to qualified students. These awards are highly competitive; hence, prospective students are urged to apply and submit all required records and scores as early as possible so they can be considered for these awards.

The amounts of these awards vary depending on the type of the award, but they may provide full tuition and a monthly stipend. Visit: **cec.fiu.edu** for additional information.

Policies, Requirements, and Regulations

The University, the University Graduate School, and the College of Engineering and Computing have a set of guidelines to protect the student's rights and to ensure a timely graduation. Students must become familiar with all University, the University Graduate School, and College's graduate procedures. These procedures are described in the University's Student Handbook, this catalog and at **http://gradschool.fiu.edu**.

The programs, policies, requirements and regulations listed in the catalog are continually subject to review to serve the needs of the University's various stakeholders, including its students, and to respond to the mandates of the FIU Board of Trustees and the Florida Legislature. Changes may be made without advance notice.

Florida International University and the College adhere to opportunity practices, which conform to all laws against discrimination and are committed to non-discrimination with respect to race, color, creed, age, handicap, sex, marital status, or nationality. Additionally, the University is committed to the principle of taking positive steps necessary to achieve the equalization of educational and employment opportunities.

College of Engineering and Computing Dismissal Policy

A student who has been dismissed from the University for the first time may see the Graduate Program Director for that department to begin the appeal procedure. The Director will determine if the student is eligible to appeal the dismissal or if there is a way to lift the dismissal. If the student is eligible, he or she must make an appointment to see the department's chairperson or associate chairperson. The student must bring a letter stating when he or she was dismissed the first time and what he or she is going to do to ensure that he or she is not dismissed a second time. If the chairperson determines that the student is worthy of reinstatement, he or she will prepare and sign a memo for the College Dean's consideration stating the conditions for the student to be reinstated. The student may be readmitted on academic probation upon the approval of the Dean of the University Graduate School. If the student does not meet these conditions, he or she will be dismissed a second and final time from the program. The student must also sign an agreement stating that he or she understands that the department will not allow a second reinstatement if the student is dismissed again.

Any student who is dismissed a second time from FIU will not be readmitted under any circumstances. Only a first dismissal appeal is considered in the College of Engineering and Computing, a second dismissal appeal will not be accepted.

Department-Specific Information

For additional information refer to your selected department in this catalog, or call the graduate program director of each department. As listed above.

Other Important Contact Information

Website:**cec.fiu.edu**

Admissions: **https://admissions.fiu.edu/index.html**	(305) 348-7000
College of Engineering and Computing-Graduate Admissions	(305) 348-1890
Campus Resources	(305) 348-2522
Career & Talent Development	(305) 348-1281
Financial Aid	(305) 348-7000
University Graduate School	(305) 348-2455
International Students and Scholars Services	(305) 348-2421
Registrar's Office	(305) 348-7000

Scholarships	(305) 348-6929
Tuition Waivers	(305) 348-7000

Enterprise and Logistics Engineering

Chin-Sheng Chen, *Professor and Program Director*
Shih-Ming Lee, *Professor of Practice*
Karen E. Schmahl, *Professor of Practice*
Hussein Tavana, *Professor of Practice*
Shabnam Rezapour, *Assistant Professor*

Affiliated and Research Faculty
Paul Bianco, *Affiliated Professor*
Seema Pissaris, *Affiliated Professor*
Jesus Sanchelima, *Affiliated Professor*
Javier Munoz, *Affiliated Professor*
J. Chris Ford*, Affiliated Professor*
Kenneth Oh, *Affiliated Professor*

Master of Science in Engineering Management

The Master of Science in Engineering Management (MSEM) program develops future leaders of business and industry in an engineering and technological environment. The program blends a carefully chosen mix of graduate courses offered by the College of Engineering and Computing, the College of Business Administration, and the College of Law. The MSEM program is designed to offer a tailored degree for those engineers who would like to advance to managerial positions and wish to acquire the necessary knowledge and skills for success. The MSEM program includes coursework that simulates a business environment where students learn and apply engineering tools, managerial theories, and best practices to design and operate industrial systems. Students in the program are expected to acquire contemporary engineering management theories and techniques, and simultaneously build a solid technical foundation in a chosen engineering track.

Admission Policies

The applicant to the MSEM program must have a bachelor's degree in engineering or a closely related field from an accredited institution with a minimum of "B" average in upper-level undergraduate work, or a graduate degree from an accredited institution.
In addition, International applicants whose native language is not English are required to demonstrate English language proficiency through one of the following:
• 80 on the iBT TOEFL (equivalent to 550 on the paper-based version of the Test of English as a Foreign Language);'
• 6.5 overall on the International English Language Testing System (IELTS);
• 53 Pearson Test of English - Academic;
• Cambridge English – Advanced;
• An undergraduate or graduate degree from an accredited institution where the language of instruction is English.
In lieu of the above requirement a student may opt for (a) or (b) below along with an additional method of direct assessment of English language acquisition of an interview or proctored video-taped session

a) Successful completion of University level English courses from an accredited institution (e.g. ENC 1101, ENC 1102 or other equivalent courses with a letter grade of "B" or higher) that prepare applicants to be proficient in English.
OR
b) English Language Institute Level Six: successful completion with passing grades for all content areas;

Plus, one of the following additional methods of assessment:
i) Interview (in person when possible or via videoconference) with admissions committee.
ii) Proctored video-taped responses to questions from the admissions committee.

The applicant whose GPA does not meet the minimum GPA requirement may be considered for conditional admission. For such consideration, the applicant must submit (1) three letters of recommendation; (2) a resume including education, training, and employment history, practical and research experience (such as projects and publications), skills and other pertinent information; and (3) a statement of objective in which the applicant must clearly state his/her intended engineering track, in addition to other information.

Degree Requirements

The MSEM program requires 30 credit hours of course work including 9 credit hours of engineering management core courses, 9 credit hours of business electives and 12 credit hours of approved graduate-level electives from an engineering track.

Engineering Management Core Courses

Students in the Engineering Management program are required to take three courses (9 credit hours) to build an engineering management foundation that includes topics in engineering quality management, systems improvement, engineering project management, intellectual property issues, and business laws. The three core courses are:

EIN 5226C	Total Quality Management For Engineers	3
ESI 6455	Advanced Engineering Project Management	3
LAW 5072	Business Law and Intellectual Property for Engineers and Entrepreneurs	3

Business Electives

Students in the program are required to take three courses (9 credit hours) to gain fundamental knowledge about management functions that includes topics in accounting, finance, organizational behavior, leadership, marketing, and operations management. Additional business electives may be considered subject to the Director's approval. A suggested list of business elective courses is given below:

ACG 6026	Accounting for Managers	3
EIN 5359	Industrial Financial Decisions	3
EIN 6105	Technology Policies and Strategies	3
EIN 6160	Management of Innovation and Technology	3
EIN 6324	Technology Entrepreneurship	3
EIN 6155	Business Plan Development	3
FIN 6406	Corporate Finance	3

FIN 6425	Financial Management Policies	3
FIN 6487	Financial Risk Management- Financial Engineering	3
MAN 6209	Organization Design and Behavior	3
MAR 6805	Marketing Management	3
MAN 6830	Organization Information Systems	3
MAN 6501	Operations Management	3
MAN 6167	Leadership in a Global Environment	3

Engineering Tracks

Students in the Engineering Management program must choose an engineering track from any academic unit in the College of Engineering and Computing. Within a chosen track, students are required to take four courses (12 credit hours) that meet the program's technical requirement. These engineering electives are designed to broaden and deepen the students' understanding of engineering and technology development in a chosen track. Students should have a proper educational background in order to take elective courses. Additional tracks and elective courses may be available, subject to the approval of the Engineering Management program director.

Biomedical Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

BME 5005	Applied Biomedical Engineering Principles	3
BME 5036	Biotransport Processes	3
BME 5105	Intermediate Biomaterials Science	3
BME 5316	Molecular Bioprocess Engineering	3
BME 5340	Introduction to Cardiovascular Engineering	3
BME 5560	Biomedical Engineering Optics	3
BME 5573	Nanomedicine	3
BME 5505C	Engineering Foundations of Medical Imaging Instrument	3

Computer Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EEL 5718	Computer Communication Network Engineering	3
EEL 5725	Hardware Description Languages (VHDL or Verilog)	3
EEL 5757	Real-Time DSP Implementations	3
EEL 6167	VLSI Design	3
EEL 6253	Computer Analysis of Power Systems	3
EEE 6502	Digital Signal Processing	3
EEL 6575	Data Communications Engineering	3
EEL 6681	Fuzzy System Design	3

Computer Science Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

CEN 5011	Advanced Software Engineering	3
COP 5725	Principles of Database Management Systems	3
COP 5614	Operating Systems	3
COT 5310	Theory of Computation I	3
COT 5407	Introduction to Algorithms	3

Construction Management Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

BCN 5716	Productivity in Construction	3
BCN 5626	Construction Cost Analysis & Control	3
BCN 5645	Construction Economic Analysis	3
BCN 5728	Principles of Construction Scheduling	3
BCN 5774	Topics in International Construction	3
BCN 6775	Decision & Risk Analysis in Construction	3
BCN 6916	Development in Construction Technology	3
CCE 5505	Computer Integrated Construction	3

Electrical Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EEE 5425	Introduction to Nanotechnology	3
EEL 5171	Advanced Systems Theory	3
EEL 5500	Digital Communication Systems I	3
EEL 5501	Digital Communication Systems II	3
EEL 6219	Electric Power Quality	3
EEL 6261	Power Systems Engineering	3
EEL 6443	Electro-Optical Devices and Systems	3
EEE 6502	Digital Signal Processing	3

Enterprise Systems Track

This track is designed for students who have a career interest in management of operations at the entire enterprise level. Systems engineering tools and information technology are applied to planning, modeling, analysis, design, and implementation of contemporary enterprise systems in any business sector. Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EGS 5620	Enterprise Systems Configuration	3
EGS 5621	Enterprise Systems Collaboration	3
EGS 5622	Enterprise Systems Integration	3
EGS 5623	Enterprise Systems Optimization	3
EIN 5346	Logistics Engineering	3
EN 5367	Design of Production Systems	3
EIN 6133	Enterprise Engineering	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6345	Inventory Control Systems	3
ESI 5010C	Forecasting and Demand Management	3

Engineering Entrepreneurship Track

This track is designed for students who have a career interest in becoming an engineering entrepreneur who creates jobs in new business ventures or becoming an engineering manager who manages innovation working within a company. Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EGN 5550	Risk Analysis in Business Concept Development for Engineers and Entrepreneurs	3
EGN 5644	Commercializing Innovation	3
EGN 6436	Manufacturing Process Design	3
EIN 5367	Design of Production Systems	3
EIN 6105	Technology Policies and Strategies	3
EIN 6160	Management of Innovation and Technology	3

EIN 6324	Technology Entrepreneurship	3
EIN 6155	Business Plan Development	3
EIN 6327	Entrepreneurship and New Venture Initiation	3
EIN 6329	Advanced Engineering Business Plan Development	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6392	Product Design for Manufacturability and Automation	3

Environmental Engineering Track

Students in this track are required to take four courses from the following list with the approval of the Graduate Program Director and after meeting prerequisite requirements. Additional courses may be selected with approval of the program director.

ENV 5406	Water Treatment Systems and Design	3
ENV 5517	Design of Wastewater Treatment Plants	3
ENV 5666	Water Quality Management	3
CWR 5235	Open Channel Hydraulics	3
CWR 5125	Groundwater Hydrology	3
ENV 5104	Indoor Air Quality	3
ENV 5105	Air Quality Management	3
ENV 5347	Waste Incineration	3
ENV 5126	Particulate Air Pollution Control	3
ENV 5127	Gaseous Air Pollution Control	3
ENV 5356	Solid and Hazardous Waste	3
ENV 5027	Biomediation Processes	3
ENV 5335	Advanced Hazardous Waste Treatment Processes	3
ENV 5008	Appropriate Technologies for Developing Countries	3
ENV5007	Environmental Planning	3
ENV 5519	Chemistry for Environmental Engineers	3
ENV 6045	Environmental Modeling	3
ENV 6070	Green Engineering	3
ENV 6614	Environmental Impact Assessment	3

Information Technology Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

CIS 5027	Computer Systems Fundamentals	3
CIS 5372	Fundamentals of Computer Security	3
CEN 5087	Software and Data Modeling	3
COP 5725	Principles of Database Management Systems	3
TCN 5030	Computer Communications and Networking Technology	3
EGS 5620	Enterprise Systems Configuration	3
EGS 5621	Enterprise Systems Collaboration	3
EGS 5622	Enterprise Systems Integration	3
EGS 5623	Enterprise Systems Optimization	3
EIN 6117	Advanced Industrial Information Systems	3
EIN 6133	Enterprise Engineering	3
ESI 5602	Engineering Data Representation and Modeling	3
ESI 6601	Data Warehousing and Mining	3

Logistics Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EIN 5346	Logistics Engineering	3
EIN 5367	Design of Production Systems	3
EIN 5436	Regulatory Compliance in Logistics and Supply Chain Management	3
EIN 6133	Enterprise Engineering	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6345	Inventory Control Systems	3
ESI 5522	Simulation Models of Engineering Systems	3
ESI 5010C	Forecasting and Demand Management	3
ESI 6316	Applications of OR in Manufacturing	3
ESI 6324	Advances in Logistics Technology	3
ESI 6470	Stochastic Optimization	3
ESI 6546	Network Flow Analysis	3

Mechanical Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EGM 5346	Computational Engineering Analysis	3
EGM 5354	Finite Element Methods Applications in ME	3
EGM 5615	Synthesis of Engineering Mechanics	3
EGM 6422	Advanced Computational Engineering Analysis	3
EML 5103	Intermediate Thermodynamics	3
EML 5152	Intermediate Heat Transfer	3
EML 5505	Smart Machine Design and Development	3
EML 5509	Optimization Algorithms	3
EML 5530	Intermediate CAD/CAE	3
EML 5606C	Advanced Refrigeration and AC Systems	3
EML 5709	Intermediate Fluid Mechanics	3
EML 6725	Computational Fluid Dynamics	3

Operations Management of Orthotics and Prosthetics Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of program director.

BME 5141L	Introduction to Laboratory Skills and Materials in Prosthetics and Orthotics	1
BME 5213L	Modern Clinical Evaluation Tools	3
BME 5214L	Orthotic Mgt. of the Lower Limb I	4
BME 5218L	Orthotic Mgt. of the Spine	3
EGN 5435	Product Modeling	3
EGS 5620	Enterprise Systems Configuration	3
EGN 6436	Manufacturing Process Design	3
EGN 6438	Manufacturing Engineering	3
EGN 6940	Graduate Internship - Orthotics and Prosthetics Clinical Rotation	1-6
EGN 6971	Master's Project	3
EIN 6133	Enterprise Engineering	3
EIN 6160	Management of Innovation and Technology	3
EIN 6324	Technology Entrepreneurship	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6392	Product Design for Manufacturability and Automation	3
EIN 6940	ISE Internship	3

Production and Manufacturing Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EGN 5540	Quality and EH&S Management Systems	3
EGN 6436	Manufacturing Process Design	3
EGS 5620	Enterprise Systems Configuration	3
EGS 5622	Enterprise Systems Integration	3
EIN 5332	Quality Engineering	3
EIN 5346	Logistics Engineering	3
EIN 5367	Design of Production Systems	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6345	Inventory Control Systems	3
EIN 6392	Product Design for Manufacturability and Automation	3
ESI 5010C	Forecasting and Demand Management	3

Quality Engineering and Management

Students in this track are required to take four courses from the following list.

EIN 5332	Quality Engineering	3
EGN 5540	Quality and EH&S Management Systems	3
ESI 6316	Applications of OR in Manufacturing	3
EIN 5367	Design of Production Systems	3
EIN 5106	Regulatory Aspects of Engineering	3
EIN 6133	Enterprise Engineering	3
EIN 6179C	Advanced Total Quality Management for Engineers	3

Risk and Disaster Management Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

BCN 5588	Vulnerability Analysis	3
BCN 5589	Hazard Mitigation	3
EGN 5550	Risk Analysis in Business Concept Development for Engineers	3
ENV 6614	Environmental Risk Assessment	3
FIN 6487	Financial Risk Management- Financial Engineering	3
PHC 6251	Disaster and Emergency Epidemiology	3
MAN 6706	Crisis Management	3
MAP 6630	Numerical Analysis in Risk Analysis and Management	3
MAP 6635	Risk Analysis and Management I	3
MAP 6636	Risk Analysis and Management II	3

Structural/Wind/Construction Track

Students in this track are required to take four courses from the following four groups (one per group) with the approval of the Graduate Program Director and after meeting prerequisite requirements. Additional courses may be selected with approval of the program director.

Group 1

CCE 5035	Construction Engineering Management	3
CCE 5036	Advanced Project Planning for Civil Engineers	3

Group 2

CES 5106	Advanced Structural Analysis	3
EGM 5421	Structural Dynamics	3

Group 3

CES 5715	Prestressed Concrete Design	3
CES 5606	Advanced Structural Steel Design	3
CES 6706	Advanced Reinforced Concrete Design	3
EGN 5439	Design of Tall Buildings	3

Group 4

CEG 5065	Geotechnical Dynamics	3
CEG 6105	Advanced Foundations Engineering	3

Systems Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

EGN 5540	Quality and EH&S Management Systems	3
EIN 5332	Quality Engineering	3
EIN 5346	Logistics Engineering	3
EIN 5367	Design of Production Systems	3
EIN 6133	Enterprise Engineering	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6345	Inventory Control Systems	3
EIN 6357	Advanced Engineering Economy	3
EIN 6940	Industrial and Systems Engineering Internship	3
ESI 5010C	Forecasting and Demand Management	3
ESI 5522	Simulation Models of Engineering Systems	3
ESI 6316	Applications of OR in Manufacturing	3
ESI 6440	Integer Programming	3
ESI 6470	Stochastic Optimization	3
ESI 6524	Advanced Industrial Systems Simulation	3
ESI 6546	Network Flow Analysis	3

Telecommunications Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

TCN 5010	Telecommunications Technology and Applications	3
TCN 5030	Computer Communications and Networking Technologies	3
TCN 5060	Telecommunications Software and Methodologies	3
TCN 5640	Telecommunications Enterprise Planning and Strategy	3
TCN 6210	Telecommunications Network Analysis and Design	3
TCN 6430	Network Management and Control Standards	3
TCN 6450	Wireless Information Systems	3
TCN 6880	Telecommunications Public Policy Development and Standards	3

Transportation Engineering Track

Students in this track are required to take four courses from the following list. Additional courses may be selected with approval of the program director.

TTE 5205	Advanced Highway Capacity Analysis	3
TTE 5215	Fundamentals of Traffic Engineering	3
TTE 5607	Transportation Demand Analysis	3
TTE 5805	Advanced Geometric Design of Highways	3
TTE 6257	Traffic Control Systems Design	3
TTE 6506	Mass Transit Planning	3
CGN 5320	GIS Applications in Civil and Environmental Engineering	3

Water Resources Engineering Track

Students in this track are required to take four courses from the following list with the approval of the Graduate Program Director and after meeting prerequisite requirements. Additional courses may be selected with approval of the program director.

CWR 5140C	Ecohydrology	3
CWR 5235	Open Channel Hydraulics	3
CWR 5251	Environmental Hydraulics	3
CWR 5535C	Advanced Modeling Applications in Water Resources Engineering	3
CWR 6117	Stochastic Hydrology	3
CWR 5125	Groundwater Hydrology	3
CWR 6126	Advanced Groundwater Hydrology	3
CWR 6236	Engineering Sediment Transport	3
ENV 5666	Water Quality Management	3

Master's Project and Thesis Option

Students in the Engineering Management graduate program may receive permission to conduct a master's project of three credit hours or a thesis of six credit hours within their chosen track to complete the degree program. The master's project (EIN 6916) will replace one graduate elective course. The Master's Thesis (EIN 6971) will replace two technical elective courses.

Grades and Credits

Students are required to maintain a GPA of 3.0. Courses with a grade below 'C' will not be counted toward the Master of Science degree in Engineering Management.

Transfer Credit

Students may receive permission to transfer up to a maximum of six semester credits provided that: (1) the courses were taken at the graduate level at an accredited college or university; (2) with a grade of 'B' or better; (3) the courses were judged relevant by the program director; (4) the credits were not used toward another degree; and (5) the credits will be no older than six years at the time of graduation. Students who already have earned (or are earning) a Master's degree that is closely related to his/her technical track (i.e., MSEM sub-plan) may transfer up to 12 semester hours to meet the track requirement, subject to the Program Director's approval. No more than 12 semester hours taken at FIU as a non-degree seeking student may be counted toward the Engineering Management graduate program.

Time Limit

All works applicable to the Master of Science degree in Engineering Management, including transfer credits, must be completed within six years of conferral of the degree.

Combined BS in Biomedical Engineering/MS in Engineering Management (BSBME/MSEM) Degree Pathway

Students who pursue a BS degree and have completed 75 credits in the undergraduate program of Biomedical Engineering with an overall GPA of 3.2 or higher may, upon recommendation from three faculty members, apply to the department to enroll in the combined BSBME/MSEM pathway. Students must also submit an online application to the University Graduate School for admission to the MSEM program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students enrolled in the combined degree pathway could count up to three BME graduate courses for both the BSBME electives and the MSEM electives, for a total saving of 9 credit hours. The following is a list of eligible BME graduate courses:

BME 5005	Applied Biomedical Engineering Principles	3
BME 5036	Biotransport Processes	3
BME 5105	Intermediate Biomaterials Science	3
BME 5316	Molecular Bioprocess Engineering	3
BME 5340	Introduction to Cardiovascular Engineering	3
BME 5560	Biomedical Engineering Optics	3
BME 5573	Nanomedicine	3

The combined BSBME/MSEM pathway has been designed to be a continuous pathway enrollment. During this combined BSBME/MSEM pathway, upon completion of all the requirements of the BSBME program, students will receive their BSBME degree. Students may elect to permanently leave the combined pathway and earn only the BSBME degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student, but will not be able to use the 9 credit hours in both the BSBME and MSEM degrees.

For each of the graduate courses counted as credits for both BSBME and MSEM degrees, a minimum grade of "B" is required. Only graduate courses with formal lecture can be counted for both degrees. The students are responsible for confirming the eligibility of each course with their undergraduate advisors.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Combined BS in Computer Engineering/MS in Engineering Management (BSCpE/MSEM) Degree Pathway

Students, who are pursuing a Bachelor of Science degree in Computer Engineering and have completed at least 75 credits with a minimum of a 3.2 overall GPA on both lower and upper division courses may, upon recommendation from three ECE faculty members, apply to enroll in the combined BSCpE/MSEM pathway. Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students enrolled in the combined degree pathway could count up to two Electrical Engineering graduate courses for both the BSCpE electives and the MSEM electives, for a total saving of 6 credit hours. A minimum grade of "B" is required graduate courses counted as credits for both BSCpE and MSEM degrees. Only 5000-level or higher courses may be applied toward both degrees. Only graduate courses with formal lecture can be counted for both degrees.

The combined BSCpE/MSEM pathway has been designed to be a continuous pathway enrollment. Students will receive their BSCpE degree upon completion of all the requirements of the BSCpE program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from his/her bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students may elect to permanently leave the combined pathway and earn only the BSCpE degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student but will not be able to use the 6 credit hours in both the BSCpE and MSEM degrees.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Combined BS in Computer Science/MS in Engineering Management (BSCS/MSEM) Degree Pathway

Students who pursue a BS degree and are in their first semester of the senior year in Computer Science and have earned at least a 3.2 overall GPA may, upon recommendation from three faculty members, apply to the department to enroll in the combined BSCS/MSEM program. Students must also submit an online application to the University Graduate School for admission to the MSEM program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students enrolled in the combined degree pathway could count up to three Computer Science graduate courses toward satisfying both the BSCS and the MSEM requirements, for a total saving of 9 credit hours. Students are required to take courses from the following list. Additional courses may be selected with approval of the program director.

CEN 5011	Advanced Software Engineering
COP 5725	Principles of Database Management Systems
COP 5614	Operating Systems
COT 5310	Theory of Computation I
COT 5407	Introduction to Algorithms

The combined BSCS/MSEM pathway has been designed to be a continuous enrollment pathway. During this combined BSCS/MSEM pathway, upon completion of all the requirements of the BSCS pathway, students will receive their BSCS degree. Students may elect to permanently leave the combined pathway and earn only the BSCS degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student, but will not be able to use the 9 credit hours in both the BSCS and MSEM degrees.

For each of the graduate courses counted as credits for both BSCS and MSEM degrees, a minimum grade of "B" is required. Only graduate courses with formal lecture can be counted for both degrees. The students are responsible for confirming the eligibility of each course with their undergraduate advisors.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway, preferably during their junior year, since appropriate planning of coursework is required in order to achieve the full nine-credit benefit. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Combined BS in Electrical Engineering/ MS in Engineering Management (BSEE/MSEM) Degree Pathway

Students, who are pursuing a Bachelor of Science degree in Electrical Engineering and have completed at least 75

credits with a minimum of a 3.2 overall GPA on both lower and upper division courses, may, upon recommendation from three ECE faculty members, apply to enroll in the combined BSEE/MSEM pathway. Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students enrolled in the combined degree pathway could count up to two Electrical Engineering graduate courses for both the BSEE electives and the MSEM electives, for a total saving of 6 credit hours. A minimum grade of "B" is required graduate courses counted as credits for both BSEE and MSEM degrees. Only 5000-level or higher courses may be applied toward both degrees. Only graduate courses with formal lecture can be counted for both degrees.

The combined BSEE/MSEM pathway has been designed to be a continuous enrollment pathway. Students will receive their BSEE degree upon completion of all the requirements of the BSEE program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from his/her bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students may elect to permanently leave the combined pathway and earn only the BSEE degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student but will not be able to use the 6 credit hours in both the BSEE and MSEM degrees.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Combined BS in Information Technology/MS in Engineering Management (BSIT/MSEM) Degree Pathway

Students who pursue a BS degree and are approaching their first semester of the senior year in Information Technology and have earned at least a 3.2 overall GPA may, upon recommendation from three faculty members, apply to the department to enroll in the combined BSIT/MSEM pathway. Students must also submit an online application to the University Graduate School for admission to the MSEM program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students enrolled in the combined degree pathway could count up to three Management Electives toward their nine "interdisciplinary credits" in the BSIT degree program, for a total saving of 9 credit hours.

ACG 6026	Accounting for Managers
EIN 5359	Industrial Financial Decisions
FIN 6406	Corporate Finance
MAN 6167	Leadership in a Global Environment
MAN 6209	Organization Design and Behavior
MAN 6501	Operations Management
MAN 6830	Organization Information Systems
MAR 6805	Marketing Management

The combined BSIT/MSEM pathway has been designed to be a continuous enrollment pathway. During this combined BSIT/MSEM pathway, upon completion of all the requirements of the BSIT program, students will receive their BSIT degree. Students may elect to permanently leave the combined pathway and earn only the BSIT degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student, but will not be able to use the 9 credit hours in both the BSIT and MSEM degrees.

For each of the graduate courses counted as credits for both BSIT and MSEM degrees, a minimum grade of "B" is required. Only graduate courses with formal lecture can be counted for both degrees. The students are responsible for confirming the eligibility of each course with their undergraduate advisors.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway, preferably during their junior year, since appropriate planning of coursework is required in order to achieve the full nine-credit benefit. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Combined BS in Interdisciplinary Engineering/MS in Engineering Management (BSIE/MSEM) Degree Pathway

Students who pursue a BS degree and are in their first semester of the senior year in Interdisciplinary

Engineering and have earned at least a 3.2 overall GPA may, upon recommendation from three faculty members, apply to the department to enroll in the combined BSIE/MSEM pathway. Students must also submit an online application to the University Graduate School for admission to the MSEM program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students enrolled in the combined degree pathway could count up to three Management Electives toward their twelve "Engineering Business and Leadership" in the BSIE degree program, for a total saving of 9 credit hours.

ACG 6026	Accounting for Managers
EIN 5359	Industrial Financial Decisions
EIN 6160	Management of Innovation and Technology
EIN 6325	Business Plan Development
FIN 6406	Corporate Finance
FIN 6425	Financial Management Policies
FIN 6487	Financial Risk Management- Financial Engineering
MAN 6167	Leadership in a Global Environment
MAN 6209	Organization Design and Behavior
MAN 6501	Operations Management
MAN 6830	Organization Information Systems
MAR 6805	Marketing Management

The combined BSIE/MSEM pathway has been designed to be a continuous program. During this combined BSIE/MSEM pathway, upon completion of all the requirements of the BSIE program, students will receive their BSIE degree. Students may elect to permanently leave the combined pathway and earn only the BSIE degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student, but will not be able to use the 9 credit hours in both the BSIE and MSEM degrees

For each of the graduate courses counted as credits for both BSIE and MSEM degrees, a minimum grade of "B" is required. Only graduate courses with formal lecture can be counted for both degrees. The students are responsible for confirming the eligibility of each course with their undergraduate advisors.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway, preferably during their junior year, since appropriate planning of coursework is required in order to achieve the full nine-credit benefit. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Combined BS in Mechanical Engineering/MS in Engineering Management (BSME/MSEM) Degree Pathway

Students who pursue a BS degree and have completed 75 credits in the undergraduate program of Mechanical Engineering with an overall GPA of 3.2 or higher may, upon recommendation from three faculty members, apply to the department to enroll in the combined BSME/MSEM pathway. Students must also submit an online application to the University Graduate School for admission to the MSEM program. In addition to the admission requirements of the MSEM program, students must meet all the admission requirements of the University Graduate School.

Students need only apply once to the combined degree pathway; the application is submitted to Graduate Admissions typically before the student starts the last 30 credits of the bachelor's degree program. A student admitted to the combined degree pathway will be considered to have undergraduate status until the student applies for graduation from their bachelor's degree program. Upon conferral of the bachelor's degree, the student will be granted graduate status and be eligible for graduate assistantships.

Students enrolled in the combined degree pathway could count up to three Mechanical Engineering graduate courses for both the BSME electives and the MSEM electives, for a total saving of 9 credit hours. The following is a list of eligible Mechanical Engineering graduate courses:

EGM 5346	Computational Engineering Analysis
EGM 5354	Finite Element Method Applications in ME
EGM 5615	Synthesis of Engineering Mechanics
EML 5103	Intermediate Thermodynamics
EML 5152	Intermediate Heat Transfer
EML 5505	Smart Machine Design and Development
EML 5509	Optimization Algorithms
EML 5530	Intermediate CAD/CAE
EML 5606C	Advanced Refrigeration and AC Systems
EML 5709	Intermediate Fluid Mechanics

The combined BSME/MSEM pathway has been designed to be a continuous enrollment pathway. During this combined BSME/MSEM pathway, upon completion of all the requirements of the BSME program, students will receive their BSME degree. Students may elect to permanently leave the combined pathway and earn only the BSME degree. Students who elect to leave the combined pathway and earn only the BS degree will have the same access requirements to regular graduate programs as any other student, but will not be able to use the 9 credit hours in both the BSME and MSEM degrees.

For each of the graduate courses counted as credits for both BSME and MSEM degrees, a minimum grade of "B" is required. Only graduate courses with formal lecture can be counted for both degrees. The students are

responsible for confirming the eligibility of each course with their undergraduate advisors.

Students interested in the combined pathway should consult with their undergraduate advisor on their eligibility to the pathway. The student should also meet the MSEM Program Director to learn about the graduate program and available tracks/courses before completing the application form and submitting it to their undergraduate advisor. Final decision for admission to the MSEM program will be made by the University Graduate School upon recommendation by the Engineering Management program director. Applicants will be notified by the Engineering Management Program and the University Graduate School of the decision on their applications.

Master of Science in Logistics Engineering

The MS-Logistics Engineering program will include student learning outcomes that address logistics from several complementary perspectives: (1) Students will gain structural technical training dedicated to logistics engineering by teaching contemporary logistics systems, technology, and operations; (2) students will gain the systems engineering tools and techniques that apply to addressing emerging challenges in the industry with respect to design and development of logistics systems and technology; and (3) students will gain deeper knowledge of specific areas in logistics such as warehouse or inventory systems design through selection of elective courses.

Admission Policies

The applicant to the MS program in Logistics Engineering must have a bachelor's degree in industrial engineering, systems engineering, operations research, or a closely related area such as business administration, MIS, SCM, or other engineering disciplines, from an accredited institution with a minimum of "B" average in upper-level undergraduate work, or a graduate degree from an accredited institution.

In addition, International applicants whose native language is not English are required to demonstrate English language proficiency through one of the following:

• 80 on the iBT TOEFL (equivalent to 550 on the paper-based version of the Test of English as a Foreign Language);'

• 6.5 overall on the International English Language Testing System (IELTS);

• 53 Pearson Test of English - Academic;

• Cambridge English – Advanced;

• An undergraduate or graduate degree from an accredited institution where the language of instruction is English.

In lieu of the above requirement a student may opt for (a) or (b) below along with an additional method of direct assessment of English language acquisition of an interview or proctored video-taped session

a) Successful completion of University level English courses from an accredited institution (e.g. ENC 1101, ENC 1102 or other equivalent courses with a letter grade of "B" or higher) that prepare applicants to be proficient in English.

OR

b) English Language Institute Level Six: successful completion with passing grades for all content areas;

Plus one of the following additional methods of assessment:

i) Interview (in person when possible or via videoconference) with admissions committee.

ii) Proctored video-taped responses to questions from the admissions committee.

Degree Requirements

The MS program in Logistics Engineering requires 30 credit hours of 10 coursework from three clusters of graduate courses. The first consists of 4 core courses in logistics operations, the second consists of 3 elective courses in systems engineering, and the third consists of 3 elective courses in logistics systems and technology. Additional courses may be considered, subject to approval of the program director.

Logistics Engineering Core Courses: (4 courses, 12 credit hours)

ESI 5010C	Forecasting and Demand Management	3
EIN 5346	Logistics Engineering	3
EIN 5436	Regulatory Compliance in Logistics and Supply Chain Management	3
EIN 6336	Advanced Production Planning and Control	3

Elective Systems Engineering Courses: (3 courses, 9 credit hours)

EIN 5226C	Total Quality Management for Engineers	3
EIN 5332	Quality Engineering	3
EIN 5359	Industrial Financial Decisions	3
ESI 6316	Applications of OR in Manufacturing	3
ESI 6440	Integer Programming	3
ESI 6455	Advanced Engineering Project Management	3
ESI 6470	Stochastic Optimization	3
ESI 6524	Advanced Industrial Systems Simulation	3
ESI 6546	Network Flow Analysis	3
EIN 6133	Enterprise Engineering	3

Elective Logistics Systems and Technology Courses: (3 courses, 9 credit hours)

EGS 5620	Enterprise Systems Configuration	3
EGS 5621	Enterprise Systems Collaboration	3
EGS 5622	Enterprise Systems Integration	3
EGS 5623	Enterprise Systems Optimization	3
EIN 5367	Design of Production Systems	3
ESI 5522	Simulation Models of Engineering Systems	3
EIN 6345	Inventory Control Systems	3
ESI 6324	Advanced in Logistics Technology	3

Master's Project and Thesis Options

Students in the Logistics Engineering graduate program may receive permission to conduct a master's project of three credit hours or a master's thesis of six credit hours within their chosen track to complete the degree program. The master's project (EIN 6971) will replace one graduate elective course. The Master Thesis (EIN 6971) will replace two graduate elective courses.

Grades and Credits

Students are required to maintain a GPA of 3.0. Courses with a grade below "C" will not be counted toward the Master of Science degree in Logistics Engineering.

Transfer Credit

Students may receive permission to transfer up to a maximum of six semester credits provided that:

1. The courses were taken at the graduate level at an accredited college or university;
2. With a grade of 'B' or better;
3. The courses were judged relevant by the program director; and
4. The credits will be no older than six years at the time of graduation. No more than 12 semester hours taken at FIU as a non-degree seeking student may be counted toward the Logistics Engineering graduate program.

Time Limit

All works applicable to the Master of Science degree in Logistics Engineering, including transfer credits, must be completed within six years of conferral of the degree.

Graduate Certificate in Engineering Management (GCEM)

This certificate program is designed for practicing engineers and graduate students in all engineering majors, who are interested in acquiring skills for managerial careers in the engineering and technology industries. The GCEM program is especially helpful for those engineers who are seeking to transition into management and wish to acquire the necessary perquisite knowledge and skills. More than a sequence of coursework, the certificate program also simulates a business environment where students learn and apply engineering tools, managerial theories, and best practices to design and operate industrial and engineering systems. Students in the program are expected to acquire contemporary engineering management theories and techniques. This certificate program is open to both degree- and non-degree seeking students.

Admission Requirements

A minimum undergraduate GPA of 2.75 is required for admission. International graduate student applicants whose native language is not English are required to submit a score for the Test of English as a Foreign Language (TOEFL) or for the International English Language Testing System (IELTS). A total score of 80 on the iBT TOEFL or 6.5 overall on the IELTS is required.

Certificate Requirements

Students must take at least 5 graduate courses from the list below and receive an average grade of "B" or higher. All the credits earned in this Certificate program with "B" or better may be used in the Master of Science in Engineering Management (MSEM) degree program provided the student is admitted to the MSEM degree program prior to the completion of no more than 12 Graduate Certificate credits. Additional courses may be considered, subject to approval of the program director.

EIN 5226C	Total Quality Management for Engineers	3
EIN 5346	Logistics Engineering	3
EIN 5359	Industrial Financial Decisions	3
EIN 6133	Enterprise Engineering	3
EIN 6160	Management of Innovation and Technology	3
EIN 6336	Advanced Production Planning and Control	3
EIN 6345	Inventory Control Systems	3
EIN 6357	Advanced Engineering Economy	3
ESI 5010C	Forecasting and Demand Management	3
ESI 6455	Advanced Engineering Project Management	3
LAW 5072	Business Law and Intellectual Property for Engineers and Entrepreneurs	3

Graduate Certificate in Enterprise Systems (GCES)

This certificate program is designed for those who are interested in acquiring expertise and skills in the growing discipline of Enterprise Systems (ES). ES software utilizes the computational power with massive data storage and transmission capabilities to support enterprise processes, information flows, reporting, and data analytics within and among complex organizations. Typical Enterprise Systems include Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Customer Relationship Management (CRM). The software architecture aiming at facilitating the flow of information among all business functions inside the boundaries of the organization and to outside stakeholders. Built on a centralized database and business intelligence, ES aims to consolidate all business operations into a uniform, real-time, and enterprise-wide system environment. This certificate program is open to both degree- and non-degree seeking students.

The Graduate Certificate in Enterprise Systems (GCES) program combines the optimal design of enterprise structures and operations with SAP implementation. The Certificate program consists of five required graduate courses.

Admission Requirements

A minimum undergraduate GPA of 2.75 is required for admission. International graduate student applicants whose native language is not English are required to submit a score for the Test of English as a Foreign Language (TOEFL) or for the International English Language Testing System (IELTS). A total score of 80 on the iBT TOEFL or 6.5 overall on the IELTS is required.

Certificate Requirements

Students must take at least 5 required courses and receive an average grade of "B" or higher. In addition, students who attain "B" or better in at least three courses will also earn a SAP certificate. All the credits earned in this Certificate program may be used in the Master of Science in Engineering Management (MSEM) degree program provided the student is admitted to the MSEM degree program prior to the completion of no more than 12 Graduate Certificate credits. Additional courses may be considered, subject to approval of the program director.

EIN 5367	Design of Production Systems	3
EIN 5346	Logistics Engineering	3
ESI 5010C	Forecasting and Demand Management	3

EIN 6336	Advanced Production Planning and Control	3
EIN 6345	Inventory Control Systems	3
EIN 6133	Enterprise Engineering	3
EGS 5620	Enterprise Systems Configuration	3
EGS 5621	Enterprise Systems Collaboration	3
EGS 5622	Enterprise Systems Integration	3
EGS 5623	Enterprise Systems Optimization	3

Course Descriptions

Description of Prefixes

EGN-Engineering, General EGS-Engineering Support; EIN-Engineering, Industrial; ESI-Engineering Systems Industrial

F-Fall semester offering; S-Spring semester offering; SS-Summer semester offering.

EGN 5435 Product Modeling (3). Life cycle product data, geometry and form features, product information models and modeling techniques, product modeling systems, and product data standards. Prerequisites: EGN 3124 or equivalent.

EGN 5540 Quality and EH&S Management Systems (3). Design of management control systems for quality, environmental, and occupational health and safety requirements. Principles and process of auditing. Review of related standards. Prerequisite: EIN 5226C.

EGN 5550 Risk Analysis in Business Concept Development for Engineers and Entrepreneurs (3). It integrates assumptions, risk/forecasting with engineering approach to new business development. The course uses exercises, cases and projects to develop practical experience with course theories.

EGN 5644 Commercializing Innovation (3). Product development/process, innovation, commercialization; needs analysis; market segmentation; value proposition; prototyping, packaging and branding; modeling costs and margins; hands-on practice. Prerequisite: Permission of the instructor.

EGN 6436 Manufacturing Process Design (3). Resources modeling, process plan modeling, and planning methodologies for process selection, operations selection, machining parameters selection, setup planning, and inspection planning. Prerequisite: EGN 5842.

EGN 6437 Manufacturing Systems Design (3). System design for production and process planning, resource management, material handling, process control, and quality control. Prerequisite: Permission of the instructor.

EGN 6438 Manufacturing Engineering (3). Manufacturing functions, product and process design, material processing and control, systems design and operations, resource and technology management, and analytical tools for manufacturing. Prerequisites: EIN 3390 or equivalent. (F)

EGN 6940 Graduate Internship - Orthotics and Prosthetics Clinical Rotation (1-6). To provide graduate students with real world clinical experience in Orthotics and Prosthetics, under approved professional supervision. Prerequisite: Permission of the program director.

EGN 6971 Master's Project (1-3). Individual work culminating in a professional practice-oriented report suitable for the requirements of the Master of Science in Manufacturing Engineering program.

EGS 5620 Enterprise Systems Configuration (3). Enterprise systems overview; major enterprise functions; standard operation procedures; system configuration and parameters; master data; user interfaces and reports; and hands-on experience. Prerequisite: Permission of the instructor.

EGS 5621 Enterprise Systems Collaboration (3). Collaborative engineering and environment; decision processes; changes management; virtual enterprise operation systems; and hands-on experience with a commercial enterprise operation system. Prerequisite: EGS 5622.

EGS 5622 Enterprise Systems Integration (3). Enterprise architectures; work flow modeling and design; systems integration methodology; vertical and horizontal integration; master data analysis and integration; and hands-on experience. Prerequisite: EGS 5620.

EGS 5623 Enterprise Systems Optimization (3). Supply networks overview; interactive supply network planning; optimal systems and process design; optimization techniques and heuristics; master and transaction data transfer; and hands-on experience. Prerequisite: EGS 5622.

EGS 5914 Advanced Research Methods in Engineering and Computing (3). Students will learn to review the literature, develop a research question and hypothesis or objective, design experiments, conduct collaborative research and present results in oral and written form.

EGS 6055 Foundations of Engineering and Computing Teaching and Learning (3). Introduction to learning theory and inclusive, learner-centered, and evidence-based pedagogy and assessment in engineering and computing, using a human-centered design approach to educational design.

EGS 6057 Equity in STEM Education: Research, Policy, and Practice (3). An analysis of diversity and inclusion through research, policy and practice within science, technology, engineering and mathematics (STEM) education for the private and public sectors.

EGS 6080 Essentials of Scientific Proposal Writing (1). This course focuses on scientific proposal writing. Project summary, specific aims, significance, innovation and approaches sections with effective communication and scientific rigor are described. Corequisite: Must be enrolled as a graduate student in a PhD program at FIU.

EIN 5001 Quantitative Foundation for Engineering Managers (3). Topics in operations research, engineering economic analysis and engineering data analysis considered quantitative foundation knowledge for engineering managers.

EIN 5106 Regulatory Aspects of Engineering (3). A survey of the legal and regulatory requirements encountered by engineers. Included will be OSH Act, NIOSH, ADA, EEOC, Worker's Compensation and Product Liability.

EIN 5123 Industrial/Technological Marketing for Engineering (3). Fundamental concepts for industrial

marketing including industrial goods, services, customers, and demands; Industrial procurement and buying behavior; and industrial market segmentation and strategy.

EIN 5226C Total Quality Management for Engineers (3). Study and application of quality management concepts and statistical quality techniques within the framework of continuous improvement methodologies. Prerequisite: EIN 3235 Evaluation of engineering data or equivalent statistics course or permission of instructor (F,S)

EIN 5244 Cognitive Engineering (3). Advanced topics in human factors and cognitive engineering. Theoretical aspects of applied situation awareness and decision making, and applications in a variety of engineering domains. Prerequisite: EIN 4243.

EIN 5249 Occupational Biomechanics (3). Study of the theoretical fundamentals for the mechanics of the body. The link system of the body and kinematic aspects of body movement including applications of biomechanics to work systems. Prerequisites: EIN 4314 Work Design and Industrial Ergonomics or equivalent. (S)

EIN 5256 Usability Engineering (3). The usability aspects of software systems design and testing. The theory of interface design for usability and the methods and techniques for designing and testing technology interfaces. Prerequisite: Permission of Instructor.

EIN 5322 Engineering Management (3). Organization of engineering systems including production and service organizations. Inputs of human skills, capital, technology, and managerial activities to produce useful products and services. (F,S)

EIN 5332 Quality Engineering (3). This course examines quality control from an engineering standpoint. It covers ways to meet the challenge of designing high-quality products and processes at low cost. Prerequisites: EIN 5226C. (S)

EIN 5346 Logistics Engineering (3). Concepts and tools for effective design and management of supply chain systems. Includes logistics strategies, inventory management, customer service, supply chain integration and logistics network design. Prerequisite: Permission of the instructor.

EIN 5359 Industrial Financial Decisions (3). The use of financial techniques and data in planning, controlling and coordinating industrial activities. This course will familiarize the student with accounting concepts and analytical methods. Prerequisite: EGN 3613. (SS)

EIN 5367 Design of Production Systems (3). The design of an industrial enterprise including feasibility, plant layout, equipment specifications, auxiliary services, economics and scheduling. Prerequisite: EIN 3365.

EIN 5436 Regulatory Compliance in Logistics and Supply Chain Management (3). Cargo security compliance; declaration and fiscal compliance; customs warehouse management; transportation regulatory services; industry program support; government solutions and technology solutions. Prerequisites: Senior or Graduate standing.

EIN 5605 Robotic Assembly Cell (3). Concepts of robot manipulation and sensing, part design for robotic assembly, planning manipulator trajectories, machine vision, robot programming language, cell control, and material transfer. Prerequisite: EIN 3600. (S)

EIN 6105 Technology Policies and Strategies (3). Strategies and policies for managing all aspects of technology. Includes value chain integration, intellectual property, and internal processes and systems.

EIN 6117 Advanced Industrial Information Systems (3). Review of the fundamental and theoretical foundation of industrial information systems. Application of the system design process and information system concepts to develop integrated engineering systems. (F,S)

EIN 6131 e-Systems Design (3). The study and application of engineering analysis and design methods for Internet-based systems. The integration of Internet technologies and applications into engineering information systems. Prerequisites: ESI 5602, EIN 6117.

EIN 6132 Collaborative Engineering (3). Product data management, visualization, collaboration, collaborative product commerce, document management, component supplier management, configuration management, enterprise application integration. Prerequisite: Permission of the instructor.

EIN 6133 Enterprise Engineering (3). Enterprise processes and functions, enterprise engineering methodology and techniques, enterprise scalability, systems and vertical integration, systems design and implementation. Prerequisite: Permission of Instructor.

EIN 6160 Management of Innovation and Technology (3). The course provides an integrated view of management of technology. The combination of theory and practice addresses the challenges of globalization, time compression, and technology integration. Prerequisite: Permission of instructor.

EIN 6179C Advanced Total Quality Management for Engineers (3). Advanced concepts in Quality Management including experimental design for scientific management, QFD, Benchmarking, Measurement Systems, regression analysis in quality, and quality loss functions. Prerequisites: EIN 5226C

EIN 6248 Advance Ergonomics (3). Analysis of human factors in the design of engineering systems, with emphasis on the interphase of man-machine-media and human limitations in relation to equipment design and work environments. Prerequisites: EIN 4314, EIN 4243, and PCB 3702 or equivalent. (F)

EIN 6258 Ergonomic Design of Aerospace Systems (3). Application of ergonomic criteria in design of civil and military aircraft cockpits and control systems. Ergonomic consideration in design of outer space vehicles, stations, and systems. Prerequisite: EIN 6248.

EIN 6319 Advanced Work Design (3). Study of the various human physiologic systems and their responses as it relates to occupational work including endurance, fatigue, recovery, and energy cost of work. Prerequisite: EIN 6248. (S)

EIN 6324 Technology Entrepreneurship (3). Entrepreneurial process, evaluation of technology, startup

operations and strategy, business plans and venture capital, intellectual property and rights, growth and technology management.

EIN 6155 Business Plan Development (3). This course deals with the critical decisions and action steps that entrepreneurs must make in both planning and executing a new venture. It also covers how to develop an effective written plan. Prerequisite: Permission of advisor.

EIN 6327 Entrepreneurship and New Venture Initiation (3). It covers critical factors of initiating new ventures: entrepreneurial networks, venture creation, strategies, evaluation, financing, legal considerations, market strategies, and feasibility analysis.

EIN 6329 Advanced Engineering Business Plan Development (3). This course takes students through the process of writing a plan for a new business venture through to implementation. Heavy emphasis placed on research and case analysis. Prerequisites: EIN 6324 or MAN 6805.

EIN 6336 Advanced Production Planning and Control (3). Analytical and algorithmic planning methodologies, planning and scheduling technologies, sequencing rules, control strategies, and line balancing methods. Prerequisite: EIN 4334.

EIN 6345 Inventory Control Systems (3). Design of non-traditional inventory control systems. Development of several inventory system models. Exploration of methods of collecting appropriate demand and cost data for effective systems analysis. Prerequisite: ESI 3314.

EIN 6357 Advanced Engineering Economy (3). Review of engineering economy and the evaluation of advanced manufacturing systems. Evaluation of alternative capital investments considering income taxes, depreciation, inflation, risk and uncertainty. Prerequisite: EGN 3613. (SS)

EIN 6392 Product Design for Manufacturability and Automation (3). Overview and integration of the design-material-manufacture process. Design considerations for manufacturability, assembly, and economical production. Concurrent engineering systems. Prerequisite: EIN 4395. (S)

EIN 6393 Design and Implementation of Discrete Manufacturing Systems (3). Methodology and techniques for design, planning and implementation of discrete production systems including process/machine selections, material handling and inspection technologies, cell control, etc. Prerequisites: Graduate or seniors with EIN 3365, EIN 3390, and ESI 3523 or equivalent.

EIN 6397 Advanced Topics in Manufacturing Automation (3). Overview of manufacturing systems; evolution of controls and AI, material handling, automation clamps, jigs, and fixtures, cutting sensors, machine vision and autonomous manufacturing. Prerequisites: EIN 6392 and EIN 6398.

EIN 6398 Advanced Manufacturing Process Engineering (3). Non-traditional manufacturing processes. Tool selection, jig and fixture design, material handling, tolerance and dimensioning. Product assembly engineering economics, and manufacturing process planning. Prerequisite: EIN 3390. (F)

EIN 6603 Applied AI/Expert Systems in Industrial Engineering (3). Application of artificial intelligence and expert systems as engineering tools. Exploring the use of PCs and symbolic machine with various AI/Expert Systems software. Several projects are required. Prerequisite: CAP 5680.

EIN 6606 Robotic Systems (3). Basic robotic system principles, functional requirements of robotic systems, simulation of system preliminary design, and physical experimentation of robotic systems.

EIN 6908 Independent Study (1-3). Individual supervised study by a faculty. A study plan and a final report are work required. Prerequisite: Departmental approval.

EIN 6910 Supervised Research (1-9). Advanced research credits under the supervision of the dissertation advisor.

EIN 6916 Master's Project (1-3). Individual work culminating in a professional practice-oriented report suitable for the requirements of the MSEM degree project option. Only three credits are applicable towards the degree. Prerequisite: Departmental approval.

EIN 6932 Graduate Seminar (0). An examination of recent technical findings in selected areas of concern. Emphasis is placed on presentations (oral and written), research activities, readings and discussions among participants. (F,S)

EIN 6936 Design of Industrial Engineering Systems (3). Overview of systems theories. Systems design process including: Problem definition, analysis, generation of alternatives, systems evaluation, selection of preferred system, and implementation. Prerequisites: EIN 6345, ESI 6316, and ESI 6524.

EIN 6940 Industrial and Systems Engineering Internship (1-3). To provide graduate students with work experience under approved industrial supervision. Prerequisite: Departmental approval.

EIN 6950 Engineering Management Masters Project (1-3). Individual work culminating in a professional practice-oriented report suitable for the requirements of the Master of Science in Engineering Management program. Prerequisite: Departmental approval.

EIN 6971 Master's Thesis (1-3). The students following the thesis option should work on his/her thesis through this course. (F,S,SS)

EIN 7980 Ph.D. Dissertation (1-12). Doctoral research leading to Ph.D. dissertation in Industrial and Systems Engineering. Prerequisites: Doctoral Candidacy and permission of Graduate Director.

ESI 5010C Forecasting and Demand Management (3). Forecasting overview. Times series methods. Regression methods. Advanced forecasting models. Demand planning. Pricing and revenue optimization with capacity constraints. Case studies. Prerequisite: Permission of the instructor.

ESI 5456 Productivity Management in the Global Organization (3). Analysis of productivity management strategies. Major issues in performance and productivity management, domestic and global outsourcing, international labor standards and trade policies. Prerequisites: EIN 4214 or equivalent.

ESI 5522 Simulation Models of Engineering Systems (3). Simulation Methodology; design and implementation of models of engineering systems using computer software; case studies. Prerequisite: STA 3033 or EIN 3235 or equivalent and COP 3175 or equivalent.

ESI 5602 Engineering Data Representation and Modeling (3). The course will cover the life cycle of designing, developing, and implementing engineering database systems by applying the IDEFx methodology. Prerequisite: Permission of Instructor.

ESI 5603 Advanced Software Tools for ISE (3). Algorithms and principles to integrate heterogeneous tools. Principles of XML, ASP, and other tools. Development of programming projects.

ESI 6316 Applications of OR in Manufacturing (3). Overview of OR techniques. Manufacturing system and product selection. Shop loading, resource allocation, production scheduling, job sequencing, and plant layout problems. System performance evaluation. Prerequisite: ESI 3314. (F)

ESI 6319 Operations Research and Information Technology (3). Principles and paradigms for the design and implementation of OR models, which may be integrated into an organization's existing information system and technologies. Prerequisite: ESI 6316.

ESI 6324 Advances in Logistics Technology (3). Emerging logistics technology in financial transactions, communications, and material handling, scanning, tracking, monitoring, production, transportation, warehousing and distribution. Prerequisites: Permission of the instructor.

ESI 6440 Integer Programming (3). Formulating and solving decision-making problems with discrete decision variables. Methods to solve large-scale integer/mixed-integer models. Prerequisite: ESI 6316.

ESI 6455 Advanced Engineering Project Management (3). This course covers entire phases of project management including selection, planning, budgeting, scheduling, monitoring, and control. It focuses on the management of engineering projects through case studies and independent research assignment. Prerequisite: Permission of the instructor. (S,SS)

ESI 6460 Methods for Algorithm Development for Industrial Engineering Applications (3). Methods for algorithm development for Industrial Engineering applications, with emphasis on powerful optimization techniques and analysis tools. Prerequisites: ESI 3314 or permission of instructor.

ESI 6470 Stochastic Optimization (3). Formulating and solving decision-making models with uncertain data. Exact and approximation techniques for large-scale stochastic models. Prerequisite: ESI 6316.

ESI 6524 Advanced Industrial Systems Simulation (3). Advanced simulation techniques with a focus on practical systems modeling using several user-oriented simulation languages. Projects involving design of high-performance simulation programs are required. Prerequisite: ESI 5522 or equivalent. (S)

ESI 6528 Advanced Topics in Simulation Modeling (3). An examination of the role of artificial intelligence, object oriented programming, and databases as enabling technologies in the simulation modeling process. Review of the literature and case studies. Prerequisites: ESI 6524 or equivalent.

ESI 6546 Network Flow Analysis (3). Deterministic and stochastic network flow analysis; minimal cost flow, shortest route, max-flow, and out-of-kilter algorithms; constrained network analysis; and stochastic queuing networks. Prerequisite: ESI 3314.

ESI 6547 Stochastic Models of Industrial Systems (3). Applications of models from gaming, decisions analysis, queueing, inventory and scheduling to assess the performance level of industrial systems operating under random conditions. Prerequisite: ESI 6316.

ESI 6601 Data Warehousing and Mining (3). Knowledge discovery for effective design of data storage. Discussion of the difficulties associated with data warehousing and mining. Literature review and case studies.

Research, Development and Training Centers

Advanced Materials Engineering Research Institute (AMERI)

Arvind Agarwal, *Distinguished Professor, Chairperson and Director Mechanical and Materials Engineering*

The Advanced Materials Engineering Research Institute provides an open access equipment infrastructure to support materials research and engineering over a broad range of technology and capabilities. The Institute provides analytical instrumentation, materials characterization, and process development laboratories to support faculty and industry in the development and characterization of new materials over the continuum from the nanoscale to bulk materials.

The Analytical Instrumentation Laboratory contains two field emission scanning electron microscope (FESEM), a 200 kev Transmission Electron Microscope (TEM), Focused Ion Beam (FIB), Atomic Force Microscope (AFM), X-ray diffraction, thermal (DSC, TGA, DMA, dilatometer flush diffusion, and mechanical testing (uniaxial/biaxial Instron). Process Development laboratories for ceramic processing (sol-gel, tape casting, milling), and thermal processing (air, vacuum, hydrogen, controlled atmosphere furnaces) are available to support faculty and student researchers.

The Institute consists of the **Motorola Nanofabrication Facility** which is supported by a class 100 clean room and nanofabrication capabilities including e-beam lithography and optical photolithography. Fabrication of nano/micro electromechanical systems (N/MENS) can be accomplished by a combination of nanolithography, focused ion beam (FIB) micro machining, nano imprinting, reactive ion etching, and thin film deposition by a variety of techniques (e-beam, sputtering, filament evaporation, cvd).

In addition to supporting research within the graduate program in materials science within the Department of Mechanical and Materials Engineering, the Institute supports faculty across all departments (physics, chemistry, geology, biology, electrical and computer

engineering and biomedical engineering) in materials based research.

Research and Support Staff

Arvind Agarwal, *Distinguished, Professor, Chairperson and Director, Mechanical and Materials Engineering*
Chunlei (Peggy) Wang, *Professor and Dissertation Advisor Mechanical and Materials Engineering*
Benjamin Boes*l, Associate Professor, Assistant Director, Graduate Faculty and Dissertation Advisor, Mechanical and Materials Engineering*
Zhe Cheng, *Dissertation Advisor and Graduate Faculty, Mechanical and Materials Engineering*
Jiuhua Chen, *Dissertation Advisor and Graduate Faculty, Mechanical and Materials Engineering*
Alexander Franco, *Research Faculty and Electron Microscopy Specialist*
Jin He, *Associate Professor, Physics*
W. Kinzy Jones, *Professor Emeritus, Mechanical and Materials Engineering*
Wenzhi Li, *Professor, Physics*
Norman Munroe, *Professor and Dissertation Advisor, Mechanical and Materials Engineering*
Daniela Radu, *Associate Professor, Director NASA-CRE2DO, Dissertation Advisor and Graduate Faculty, Mechanical and Materials Engineering*
P.M. Raj, *Associate Professor, Dissertation Advisor and Graduate Faculty, Biomedical Engineering*
Surendra Saxena, *Professor Emeritus, Mechanical and Materials Engineering*
Shekhar Bhansali, *Professor and Chairperson, Electrical and Computer Engineering*
Sakhrat Khizroev, *Courtesy Professor, Electrical and Computer Engineering and College of Medicine*
Nezih Pala, *Associate Professor, Dissertation Advisor and Graduate Faculty Electrical and Computer Engineering*
Yuriy Vlasov, *Instructor*
Patrick Roman, *AMERI Manager*

Applied Research Center (ARC)

Ines R. Triay, Ph.D. *Center Director*
Leonel Lagos, Ph.D., PMP *Director of Research and Workforce Development*
Dwayne McDaniel, Ph.D., *Principal Scientist*
David Roelant, Ph.D. *Principal Scientist, Leads FIU Interdisciplinary Nuclear Research Program*
Himanshu Upadhyay, Ph.D., *Principal Scientist*
Gloria Dingeldein, *Associate Director of Administrative Services*

ARC's **mission** is to be the leading international university-based research institution providing value-driven, real-world solutions, which will enable Florida International University to acquire, manage, and execute educationally relevant and economically sound research programs.

ARC's **vision** is to lead, integrate, and deliver multidisciplinary research and development solutions in environment, energy, and information technology to meet customer commitments on time and at cost. In carrying out this mission, the ARC is committed to providing training opportunities to the University's uniquely diverse student body under the mentorship of the Center's internationally recognized engineers and scientists.

Environment & Energy – ARC has been performing research and technology development for the environmental cleanup of the U.S. Department of Energy (DOE) nuclear weapons complex sites since 1995. ARC engineers, scientists and students apply specialized knowledge and skills in state-of-the-art research facilities to understand the underlying science and develop and deploy technology solutions to complex environmental challenges while training the environmental workforce of tomorrow. For energy research, ARC collaborates with FIU's College of Arts, Sciences, and Education to develop R&D and support the growth of: the radiochemistry and health physics academic programs; and the FIU Nuclear Scholars and Nuclear Fellows programs for students.

Green & Sustainable Technologies: ARC is researching ways to improve technologies to use less electric energy and natural resources in production and in operations while reducing waste and pollution. ARC is developing green buildings by improving technologies for heating and cooling buildings, a major source of energy usage in buildings. Improvements in heating, cooling and ventilation (HVAC) is one area of research. Another area is sustainable remediation which seeks to lower the greenhouse gas footprint of operations while also reducing electrical energy use and other resources.

Soil & Groundwater Remediation: Increasing concentrations of heavy metals and radionuclides in the global environment require a focus on contaminant fate, transport, and persistence in soils and groundwater. ARC carries out research and development of applications with a focus on soil and groundwater remediation. For the last twenty years ARC has developed programs and trained outstanding engineers and scientists to conduct advanced and applied research in areas that are vital to national and international needs in the areas of environmental engineering and soil and groundwater remediation. ARC's projects incorporate biogeochemical cycling, fate and transport of contaminants, and water and wastewater treatment. Researchers use data for testing, evaluation, and validation for new and innovative technologies to support DOE and industry.

Water Resources: ARC's water resources research is established to address key issues in hydrology at local and regional scales, primarily through the development and implementation of state-of-the-art integrated, data assimilating hydrological/transport models. The aim is to create hydrological models that are scalable to the regional, national and global extents which serve as effective tools for water resources management and monitoring.

Geographic Information Systems: Geographic information systems (GIS) technology is an integral part of many of ARC's research and development activities as an analysis tool, its application spanning various areas of applied research including water resources management; soil and groundwater remediation; environmental assessment; nutrient, chemical and radioactive contaminant fate and transport; assessment of renewable energy resources; assessment and impacts of land use change; and climate change analysis. ARC researchers have extensive experience utilizing GIS for mapping and geospatial analysis; geodatabase development; integrated surface and groundwater modeling; air dispersion modeling; storm water modeling; geospatial data and

metadata development; web-based and mobile application development; conversion of computer-aided design and drafting (CADD) data; and development of waste information management systems applications.

Radiochemistry and Nuclear Power: Nuclear research and education was launched in 1990 at FIU. FIU developed a radiochemistry PhD track which launched in Aug. 2015 and a health physics specialty under the BS in Physics launched in Aug. 2016. Over this period, many new faculty, staff and students have engaged in nuclear related R&D. Presently over 110 faculty and staff and 75 students are active in nuclear research.

Deactivation & Decommissioning: ARC has over 20 years of experience in performing research in the area of D&D of nuclear facilities, having participated in over 300 projects since 1995 in support of the DOE's Office of Environmental Management (DOE EM). As part of this support, ARC has evaluated baseline and innovative technologies for D&D applications; to date, over 150 technologies have been assessed at ARC's facilities in Miami, at DOE sites, and at technology vendors' facilities.

Cyber Security & Data Science

ARC performs applied and advanced research in the areas of enterprise systems, cyber security and data science. The solutions are tailored to deliver critical information to federal, state, and local governments and private sector clients, keeping them well informed, connected and secure. ARC shares the commitment and responsibility to securing information and information networks with integration of people, operations, and technology.

Data Science: ARC performs extensive research in the area of data science to provide analytical solutions in the area of nuclear and cybersecurity to federal / state governments and national research laboratories. Current research is focused on machine learning, data analytics and visualization.

Cyber Security: ARC performs sponsored research in the areas of cyberspace architecture and framework, virtualization, memory forensics, ethical hacking and cyber analytics to support the Department of Defense (DOD) – Test Resource Management Center (TRMC) and the Department of Energy (DOE) – Office of Environmental Management. Cyber research allows for the training of FIU STEM (science, technology, engineering, and math) undergraduate and graduate students with diverse technical background through the Cyber Fellows (Cyberspace Work Force Development) program. ARC also participates as an active member of the core team of *Cybersecurity@FIU*, which has been designated by FIU as an emerging preeminent program with high potential to demonstrate extraordinary success in providing unique learning opportunities, pioneering research and engagement while expanding FIU's financial base.

Enterprise Solutions: ARC has extensive experience in building custom enterprise systems in the areas of waste management, knowledge management, database management, content management and mobile systems, using the latest technologies for various clients like DOE-EM and DOD-TRMC.

Aerospace & Defense

At ARC, both applied and basic research are being conducted in areas of mechanical and materials engineering that provide support and solutions to a number of industries including aerospace and defense. Some of the fundamental efforts that include computational mechanics and composites can impact other disciplines as well, including energy, biomedical, marine and nuclear.

Robotics: Advancement in computer, material and design technologies has provided an avenue for robotic systems to be utilized in a number of engineering applications that includes manufacturing, inspection, and even simple household functions. At ARC, robotic systems are being developed to provide a means to inspect areas that may be difficult to obtain access to or unsafe for people to enter. These tools are being designed with sensor systems that can provide valuable information including the health of structures or the status of the area's environment.

Composites: Use of composite materials continues to increase in today's engineering applications due to improved strength to weight ratios, its resistance to corrosion and the reductions in repair and maintenance costs. ARC engineers have focused research efforts on understanding how composite structures can be joined using adhesive bonding. In particular, ARC is investigating quality control procedures for bonding, the durability of the bonds and how contamination may affect bonds.

Computational Mechanics: Advances in simulation software will improve the ability for engineers to effectively simulate engineering processes without having to develop and test systems with costly experimental facilities. Engineers at ARC utilize finite element analysis to aid in the design of complex structures, and computational fluid dynamics software to assist in addressing complex challenges related to simulating fluid flow processes that further expand the capability of the simulation software. Some issues currently being addressed include modeling of mixing processes of multi-phase flows and using reduced-order models to efficiently capture the salient features of the flow.

Workforce Development and Training – The DOE-FIU Science and Technology Workforce Development program is an innovative program to create a "pipeline" of FIU STEM underrepresented students specifically trained and mentored to enter the DOE workforce in technical areas of need. The main objective of the program is to provide a unique integration of FIU course work, DOE field work, and "hands on" training and mentoring at ARC. It is envisioned that once the DOE Fellows graduate from this program they will enter DOE-EM's Professional Development Corps Program and/or work for DOE's contractor firms. To date, over 153 FIU underrepresented students have joined the program. The students are officially inducted into the program and vested with the name of DOE Fellows in a special induction ceremony celebrated during the fall semester. DOE Fellows also have internship opportunities at DOE national research laboratories and DOE sites around the country. Since the program's initiation in 2007, DOE Fellows have participated in over 136 research internships at locations such as Oak Ridge National Laboratory, Idaho National Laboratory, Pacific Northwest National Laboratory, and DOE-HQ in Washington DC. In addition, DOE Fellows directly support DOE contractors performing environmental remediation around the DOE Complex. DOE Fellows have presented over 210 technical research posters and oral talks at the Waste Management Symposia and other national/international conferences. Furthermore, this program enables undergraduate

students to pursue M.S. and Ph.D. degrees by providing research assistantships.

ARC has also developed a Cyberspace Workforce Development Program as part of our support to the DOD to perform cyberspace technology research. This program trains FIU STEM undergraduate and graduate students with diverse technical backgrounds to develop and integrate new cyberspace systems for DOD test applications. The Cyberspace Workforce Development Program actively recruits top minority and underrepresented students at FIU to perform research, attend summer internships, and apply for job opportunities at DOD.

ARC is committed to the education and development of FIU students and has developed a Student Steering Committee (SSC) that oversees the academic and research progress of each student. This committee also conducts interviews and evaluates applicants for the workforce development program.

Doing Business with the Applied Research Center – ARC's employees are drawn from a wide segment of the commercial, government, and academic arenas to collectively utilize their experience and expertise to support the needs of FIU's clients. ARC's operating philosophy recognizes and accommodates the critical performance characteristics of government and commercial activities, while exercising the benefit of its cost structure in a way that serves both client interests and those of the University and its students. Our staff is fully engaged in the project and program activities assigned. The critical difference in the ARC's structure is the project management and administrative processes and structures that have been put in place to serve its clients. The Center has executed work for federal agencies, state and local governments, and commercial entities. For more information on FIU's ARC, please visit **www.arc.fiu.edu** or call (305) 348-4238.

Bioinformatics Research Center (BioRG)

Giri Narasimhan, *Director and Professor, School of Computing and Information Sciences*

The mission of this research group is to work on problems from the fields of Bioinformatics and Biotechnology. The group's research projects includes Pattern Discovery in sequences and structures, micro-array data analysis, primer design, probe design, phylogenetic analysis, image processing, image analysis, and more. The group builds on tools and techniques from Algorithms, Data Mining, Computational Statistics, Neural Networks, and Image Processing.

Center for Advanced Technology and Education (CATE)

Malek Adjouadi, *Professor and Dissertation Advisor Director and Electrical and Computer Engineering*

Mission

The mission of the NSF-funded CATE center at FIU is to foster cross-disciplinary research as a catalyst for our students to train and develop their creative thinking by bringing in synergy the fields of image and signal processing with application to neuroscience and assistive technology research. In the merging of these technologies, we see a productive ground for the development of new methodologies and designs that (1) meet the impending needs in neuroscience as we elicit both the functional mapping of the brain, and the causality of key brain disorders; and (2) design assistive technology tools that address effectively the issue of "Universal Accessibility", focusing on visual impairment and motor disability. The premise is to translate new theoretical findings into the realm of real-world applicability.

Major Research Themes

- Image and signal processing
- Neuroimaging
- Machine learning
- Brain Mapping
- Informatics and big data
- Web interfaces
- Brain Stimulation for Therapeutic/Curative interventions

Major Activities of the CATE Center

Establish a research platform image processing, machine learning and the cohesive study of the human brain, with a focus on epilepsy and Alzheimer's disease, by bringing together several hospitals and academic institutions in a consortium that will consolidate multi-site collaborative studies with a large number of patients in accordance to standardized protocols with the following objectives:

- Create an environment that supports cross-disciplinary initiatives, joint collaborations and programs with access to modern equipment and computing facilities of unprecedented sophistication and integration.
- Extend the scientific reach of these interdisciplinary efforts to overcome the primary barriers in identifying the different factors that influence the functional organization of the brain, as new paradigms and new findings will come to benefit the scientific community as a whole, and to provide critical help to hundreds of patients yearly.
- Provide a consolidated infrastructure for image processing, neuroimaging and machine learn that will come in support of a new cohort of Ph.D. students and to a well-trained and skilled workforce able to bridge engineering and computing know-how to the fields of medicine and the biosciences.

Faculty and Co-Principal Investigators

Mercedes Cabrerizo, *Associate Professor, CATE Co-Director for the epilepsy program, Electrical and Computer Engineering*

Armando Barreto, *Professor, Director of the Digital Signal Processing Lab, Electrical and Computer Engineering*

Angela R Laird, *Professor, Director of the Director, Center for Imaging Science, Physics.*

Naphtali D Rishe, *Eminent Scholar and Professor, School of Computing and Information Sciences. Director of the High Performance Database Research Center at FIU (HPDRC) and of the NSF Industry-University Cooperative Research Ctr. for Adv. Knowledge Enablement (I/UCRC)*

Raul Gonzalez, *Professor, Psychology, Center for Children and Families. director of the Substance Use and HIV Neuropsychology Lab.*

Joseph S. Raiker, *Associate Professor, Psychology,*

Director, Program for Attention, Learning, and Memory
Shanna L. Burke, *Assistant Professor, School of Social Work*

Laboratory and Infrastructure Manager
Niovi Rojas, *Research Specialist and Manager of the Computational Infrastructure*

Consultants
Ranjan Duara, *Medical Director, Wien Center for Alzheimer's Disease and Memory Disorders, Mount Sinai Medical Center*
David Loewenstein, *Director of the Center for Cognitive Neuroscience and Aging and Professor of Psychiatry and Behavioral Sciences, University Miami Miller Med School.*
Prasanna Jayakar, *Founding Chair, Brain Institute, Nicklaus Children Hospital*
William D. Gaillard, *Children's National Medical Center, George Washington Univ., and Georgetown Univ. Director of the Comprehensive Pediatric Epilepsy Program and the Associate Director of the Children's Research Institute's Center for Neuroscience Research at CNMC*
Ilker Yaylali, Associate Professor, *Neurology, Oregon Health and Science University.*
Alberto Pinzon, *Director, Epilepsy Program at Baptist Hospital*
Sarah Hug, *Program Evaluator, Director at Colorado Evaluation & Research Consulting, Boulder, Colorado.*

Center for Diversity and Student Success in Engineering and Computing (CD-SSEC)

Andres Tremante, *Director and University Instructor, Mechanical & Materials Engineering*
Andrew Green, *Associate Director*
Francisco Fins, *Program Director, ENLACE*
Julieta Vallejos, *Program Coordinator*
Kristian Cosculluela, *Program Assistant, ENLACE*

South Florida's distinction as a multi-cultured, multi-lingual region has long been a diverse source of talent for FIU, particularly in the College of Engineering and Computing. In response to the challenge of attracting this diverse community to science and engineering, the College of Engineering and Computing has created a special center for Diversity in Engineering and Computing.

The mission of the Center for Diversity and Student Success in Engineering and Computing (CD-SSEC) is to provide prospective and current students of the college with opportunities and services that will enhance their academic experiences and increase their rate of success in the school and their future careers. The Center will support the college through recruitment, retention and enrichment programs, such as mentorship and peer-to-peer tutoring, undergraduate research opportunities, dual enrollment, and pre-college outreach activities. Currently the Center is actively engaged in a number of special programs as a service to the community and the University:

Florida Action for Minorities in Engineering (FLAME) This is a cooperative program between Miami Coral Park Senior High School and Florida International University aimed at introducing the profession of engineering to high school students, and to identify, select, enroll, and retain minority students in the engineering field. High School students participate in their senior year, and also register for dual enrollment classes at FIU.

Florida/Georgia Louis Stokes Alliance for Minority Participation (FGLSAMP) This is a National Science Foundation funded program in association with Florida Agricultural and Mechanical University (FAMU), the leading institution. This program focuses on engineering, math chemistry, biology, physics, and computer science undergraduate students. Participants receive scholarships, during the entire academic year based on high GPA and being a full time student. Opportunities for summer internships are available.

ENLACE/MIAMI The Children Trust This program is funded by The Children Trust and provide after school and summer programs for 650 children (ages 7-17) residing in the Sweetwater, Doral and West Kendall areas. The after school program will offer literacy support through individualized software-based increasing intervention, social skills development, and health fitness education. The summer program will offer students the unique opportunity to attend classes on a university campus.

Opportunities for Undergraduate Research and Scholarship (OURS) Coordinated and overseen by the Center for Diversity and Student Success within the College of Engineering and Computing, the Opportunities for Undergraduate Research and Scholarship (OURS) program serves as the umbrella organization for all undergraduate research within the college. OURS' mission is to foster a culture of research excellence within the College of Engineering and Computing that is committed to promoting opportunities for all students, especially those from underrepresented populations and disadvantaged backgrounds. A tiered program model with financial incentives encourages curriculum-related work opportunities and greatly reduces the need for students to find off campus jobs that do not align with their long-term career goals.

Engineers on Wheels (EOW) The Engineers on Wheels program is an initiative which brings FIU engineering students to South Florida K-12 schools. EOW provides students with hands-on activities and engineering experiments while exposing them to career opportunities in STEM (science, technology, engineering and math).The program features grade-appropriate, interactive lessons and presentations led by FIU students and overseen by FIU faculty. Subjects include mechanical and materials engineering, computer science and information technology, biomedical engineering, civil and environmental engineering, construction and engineering management, and electrical and computer engineering.

Engineering Expo In its 20th year, the Engineering Expo is the college's premiere community outreach event. In 2020, the college welcomed more than 1,606 K-12 students from Miami-Dade and Broward County schools (elementary, middle, and high schools) to the FIU Engineering Center to engage FIU student organizations, researchers, and staff, and to discover the endless possibilities of pursuing a degree in engineering or computer science. In 2020, 25 labs and 24 student organizations represented each major within the college, and provided K-12 students with tours, demonstrations, and hands-on activities.

Center for the Study of Matters at Extreme Conditions (CeSMEC)

Jiuhua Chen, *Director and Professor, Mechanical and Materials Engineering*
Zhe Cheng, *Associate Professor, Mechanical and Materials Engineering*
Vadym Drozd, *Research Assistant Professor*
Andriy Durygin, *Research Engineer*
Chunlei (Peggy) Wang, *Professor, Mechanical and Materials Engineering*

Mission: The Center for the Study of Matter at Extreme Condition is a multidisciplinary center that integrates physics, chemistry, geosciences with materials engineering. The center is committed to facilitation of fundamental research through convergence related to materials properties at extreme environments, *i.e.* high temperature (thousands of degrees) and high pressure (millions of atmospheres), and to delivery of quality research and education.

All materials are subject to three fundamental variables – chemical composition, temperature and pressure, which alter all states of matter. CeSMEC offers experimental infrastructure enabling research and education of materials by tuning the variables separately or simultaneously. Materials are studied under such conditions with x-ray, spectroscopy as well as different processing techniques.

Areas of research at CeSMEC include, minerals, superhard materials, electronic materials, ceramics, energy storage materials, metals/alloys, etc.

Distributed Multimedia Information Systems Laboratory (DMIS)

Shu-Ching Chen, *Director and Professor, School of Computing and Information Sciences*

The mission of the Distributed Multimedia Information System Laboratory (DMIS) is to conduct leading edge research in multimedia database systems, data mining, networking and wireless, GIS and Intelligent Transportation Systems. Other research areas of this effort include Multimedia Communications and Networking, Digital Library, 3D Animation, and Distributed Computing.

Division of External Programs (DEP)

Natalie Nunez*, Program Director*
Kang K. Yen, *Director of International Programs, Business Development and Professor of Electrical and Computer Engineering*
Khokiat Kengskool, *Director of International Programs, Southeast Asia and Professor of Practice, Civil and Environmental Engineering*

The **Division of External Programs (DEP)** develops, promotes and manages academic programs offered under the rubric of international programs, professional graduate programs, and continuing education all within the **College of Engineering and Computing**.

The program director and staff of DEP work with department chairs and faculty members to identify global partners and institutions interested in providing their undergraduate and/or graduate students an opportunity to complete their studies at FIU; manage continuing education courses that are taught by experts in their respective fields; develop, promote and manage professional graduate programs; as well as identify any new markets or opportunities that contribute to the overall credit and non-credit enrollment for the College of Engineering and Computing.

International Programs

The international dual-degree program allows undergraduate students from foreign universities to complete approximately 75% of their curriculum at their home institution and the remaining 25% at FIU and receive their undergraduate degree from both institutions. All participants in the program proceed as a cohort through a lock-step curriculum of the selected courses. The local faculty from the host country is also involved in teaching to enrich the program by integrating the economic, cultural, social, political and legal issues of the host country in the curriculum.

Graduates from international partner universities interested in pursuing a graduate degree from FIU may apply to the graduate pipeline program. Students complete anywhere between 30 – 36 credit hours (depending on the program) and upon completion of the degree requirements, receive a master's degree from FIU.

The overseas programs focus on the demonstrated educational needs of selected industrial sector(s) in the host country. These programs are offered in collaboration with a sponsor which is a reputed university or institution that can support the delivery of the program by providing appropriate infrastructure facilities like classrooms, library and computer laboratories. The programs are designed in consultation with the faculty of the sponsor and the industry representatives in the host country. The goal of the overseas programs is to complement the existing academic programs offered by the sponsoring institution.

Continuing Education Courses

Our continuing education courses are designed to meet the licensing and certification needs of individual professionals in the engineering and construction fields. The programs are delivered on-campus and/or at corporate sites. Currently, the College offers the following courses and programs: "Lean Six Sigma", "Six Sigma Green Belt", "Six Sigma Black Belt", "Supply Chain Management", and "Florida General Contractor's Exam (GC) Review Course".

Professional Graduate Programs

DEP offers professionals the ability to complete their master's degrees in the fields of Engineering and Computing. Our programs are offered online and in-person. Our programs are specifically designed for working professionals who aspire to a graduate degree without interrupting their careers.

Engineering Information Center (EIC)

Steven Luis, *Executive Director*

Create a technology that will help save lives or create your own website, simulate an electronic circuit, design a bridge, or just browse the Internet. The possibilities are endless at Engineering Information Center.

EIC helps faculty, scientists, researchers, and students to conduct cutting edge research and work on system

designs, networking, scientific visualization, 3D Modeling, simulations, virtual reality, computer animation, and other computer and software applications.

The Center manages an array of Novell, Windows, and UNIX network servers that provide faculty, staff and students with the capacity to share valuable resources; therefore, fostering an atmosphere where collaboration and instruction grow with a synergy that is unique. Beyond the college community, EIC participates in sponsoring special outreach programs for the Miami-Dade County Public Schools by exposing young minds to latest technologies.

EIC is also home to The Graphic Simulation Laboratory with focus on Scientific Visualization, 3D Computer Modeling, and Virtual Reality, which have helped researchers to develop a wide array of technologies, strategies, and information designs. GSL has collaborated with NASA, The Center for Super Computing Applications, National Science Foundation, Computational Science Institute, Shodor Organization, Macromedia, and Kellogg Foundation, just to mention a few. From hardware to software support to 3D modeling of a heart valve, EIC delivers exceptional services with a personal touch.

Engineering Manufacturing Center (EMC)

Ibrahim Tansel, *Director and Professor, Mechanical and Materials Engineering*
Mario Sanchez, *Senior Engineer and Manager*
Richard Zicarelli, *Senior Engineer II and Coordinator*

The Engineering Manufacturing Center provides technical expertise in manufacturing to anyone in need of assistance. Typically the Center supports researchers, graduate and undergraduate students with projects requiring high-precision quality fabrication and requiring expert technical guidance. Undergraduate engineering students represent the largest group served. Students of all academic departments benefit directly through help with class projects, such as Senior Design (capstone) courses, critical components of all ABET accredited Engineering programs in the College. Other major undergraduate projects supported include the Mini-Baja, Mini-Submarine and Robot Competitions. Graduate students regularly request fabrication assistance with experimental devices, tools and fixtures. The Center's main facility supports the College's academic departments' general fabrication needs, including equipment repair, assembly, fixturing, installation, etc. An auxiliary EMC-supervised machine shop is available for student hands-on project work.

The Center also provides technical services to the outside community such as entrepreneurial consulting in product design and development and sub-contract fabrication work. Companies served by the EMC range from entrepreneurial to the well-established, some of which include aerospace, automotive, marine, medical and consumer product manufacturers. The Center runs state-of-the-art CAD/CAM software and operates a diverse array of rapid prototyping equipment combined with CNC capabilities providing a wide variety of fabrication processes. In addition, the Center can perform inspection, measurement and reverse engineering capabilities through its automated measurement equipment.

For more information, contact the EMC by calling Mr. Richard Zicarelli (305) 348-6557 or Mr. Mario Sanchez (**sanchem@fiu.edu**), or refer to the center's website at **http://www.eng.fiu.edu/emc/**.

Florida Center for Cyber Infrastructure Education and Research for Trust and Assurance

S. S. Iyengar, *Director and Ryder Distinguished University, Professor, School of Computing and Information Sciences*

Cyberspace, the ubiquitous collection of interconnected IP networks and hosts that has proliferated over the last two decades, has become the nervous system of the country. Healthy functioning of Cyberspace is essential for the proper operation of numerous critical infrastructures, such as telecommunication, energy and transportation. It is also necessary to support the ever-expanding business infrastructure, including commerce and banking. The increasing reliance on Cyberspace has been paralleled by a corresponding increase in the variety, frequency and impact of attacks from a range of assailants. Both commercial companies and government agencies face continuous and increasingly more sophisticated cyber-attacks ranging from data exfiltration and spear phishing to sophisticated worms and logic bombs. The targets include not only computer information systems, but also the network communication infrastructure and power grids. Moreover, commercial companies and government agencies are themselves engaging in information gathering whose implications for privacy are disturbing.

Therefore, there is an increasing need of a concerted and cooperative effort on the part of the government and the private sector to address these attacks and threats. Research and education are the main ways to help detect, react, and reduce the impact of cyber threats and attacks. There is a dearth of educational cyber security programs at universities, despite a very strong demand for qualified graduates. Moreover, Miami's status as a gateway for international commerce, tourism, and immigration, especially with Latin America, makes it a particularly appropriate host location for a research and education consortium focusing on cyber infrastructure.

Our goal of this center is two-fold—first, to inspire a new generation of cyber research warriors and cyber savvy intelligence agents to take up the torch, to better understand our need for smart intelligence, and to defend the homeland. Since their work cannot be done alone, our second goal is to advance technology through the concept of subliminal contextual information in the production of subliminal contextual intelligence.

High Performance Database Research Center (HPDRC)

Naphtali Rishe, *Director and Professor, School of Computing and Information Sciences*

One of our research efforts is the High-Performance Database Research Center (HPDRC). HPDRC conducts research on such theoretical and applied issues as Internet-distributed heterogeneous databases, database design methodologies, database design tools, information

analysis, multi-media databases, database languages, data compression, spatial databases, and data visualization. The Center also designs specific database systems for highly complex applications.

Industry-University Cooperative Research Center (I/UCRC) Center for Advanced Knowledge Enablement (CAKE)

Naphtali Rishe, *Director and Professor, School of Computing and Information Sciences*

The National Science Foundation's (NSF) FIU-FAU-Dubna Industry/University Cooperative Research Center for Advanced Knowledge Enablement (CAKE) was established to develop long-term partnerships among industry, academe and government. The Center is supported primarily by industry center members, with NSF taking a supporting role in its development, evolution, and core funding. The Center hosts the NSF "AIR" Ecosystem to Pipeline Research at FIU.

The Center's mission is to conduct industry-relevant studies and deployments in the representation, management, storage, analysis, search and social aspects of large and complex data sets, with particular applications in geospatial location-based data, disaster mitigation, healthcare, transportation, and town planning.

Lehman Center for Transportation Research (LCTR)

Mohammed Hadi, *Director and Professor, Civil and Environmental Engineering*
Albert Gan, *Deputy Director and Professor, Civil and Environmental Engineering*
Fabian Cevallos, *Transit Program Director*
Xia Jin, *Associate Professor, Demand Forecasting and Discrete Choice Analysis*
Priyanka Alluri, *Associate Professor, Traffic Safety*

The Lehman Center for Transportation Research (LCTR) at Florida International University was established in 1993 in honor of Congressman Bill Lehman and his tireless efforts to make South Florida a better place for all of us. The center's vision is to become a 'state-of-the-art' transportation research and training facility. LCTR is committed to serve and benefit our society by conducting research to improve mobility, hence the quality of life issues, develop partnerships in the transportation industry, and educate a multidisciplinary workforce to plan, manage and implement transportation systems.

Faculty, staff and students at LCTR are involved in research related to the planning, design, operation and maintenance of transportation systems, including intelligent transportation systems, transportation system management and operation (TSM&O), multi-resolution modeling and simulation, connected and automated vehicles, decision support systems, signal control, transportation system safety, shared mobility, electric vehicles, micro-mobility, public transportation, freight; as well as public policy, air pollution, and the application of geographic information systems and other advanced technologies such as machine learning/data mining, statistical analysis, optimization, and scientific visualization in transportation.

Motorola Nanofabrication Research Facility

Arvind Agarwal, *Distinguished Professor, Chairperson and Director, Mechanical and Materials Engineering*
Patrick Roman, *Lab Manager*

The first centralized facility of its kind in Florida, the Motorola Nanofabrication Research Facility is an open-access initiative in support of nano-scale devices, systems and materials research that encompasses a broad range of technologies and capabilities. The facility provides nanofabrication, analytical instrumentation, materials characterization and process-development laboratories for students, faculty and industrial researchers. This $15 million Research Facility is an integral part of the Advanced Materials Engineering Research Institute (AMERI), FIU's broader materials research program.

Harnessing the synergy inherent in the study and development of nanoscale technologies, the facility boasts:

- Specialized equipment required to develop new and novel fabrication techniques unique to the creation of functional materials and devices that are no greater than 100 nanometers (1,000 times smaller than the diameter of a human hair);
- A full complement of standard semiconductor processing equipment to leverage the capabilities of robust and proven techniques; and
- State-of-the-art analytical tools to study, and characterize these nano-sized devices, as well as the materials and processes used to make them.

The Nanotechnology Faculty Team
Arvind Agarwal, *Distinguished Professor, Chairperson and Director, Mechanical and Materials Engineering*
George Dulikravich, *Professor, Mechanical and Materials Engineering*
Jin He, *Associate Professor, Physics*
W. Kinzy Jones, *Emeritus Professor, Mechanical and Materials Engineering*
Cheng-Yu Lai, *Associate Professor, Mechanical and Materials Engineering*
Grover Larkins, *Professor, Electrical and Computer Engineering*
Chenzhong Li, *Professor, Biomedical Engineering*
Wenzhi Li, *Professor, Physics*
Anthony McGoron, *Associate Dean and Professor, Biomedical Engineering*
Daniela Radu, *Associate Professor, Director NASA-CRE2DO, Mechanical and Materials Engineering*
P.M. Raj, *Associate Professor, Biomedical Engineering*
Surendra Saxena, *Emeritus Professor, Mechanical and Materials Engineering*
Frank Urban, *Associate Professor, Electrical and Computer Engineering*
Yuriy Vlasov, *Instructor*
Chunlei (Peggy) Wang, *Professor, Mechanical and Materials Engineering*
Shekhar Bhansali, *Professor and Chairperson, Electrical and Computer Engineering*

***Nezih Pala**, Associate Professor, Electrical and Computer Engineering*

Science and Technology Center on Real-Time Functional Imaging (STROBE)

Jessica Ramella-Roman, FIU Site *Director*
Margaret Murnane, PI, University of Colorado Boulder

The STROBE NSF Science and Technology Center on Real-Time Functional Imaging is developing new functional imaging microscopes that enable functional multi-scale characterization of complex samples — from low-dimensional materials, nanostructured systems and devices, to emergent phenomena in quantum materials. These capabilities contrast with current single-mode, mostly static, approaches to imaging, which are too slow and inaccessible to close the loop between design, characterization and optimization of materials science and technology. STROBE is also integrating different photon- and electron-based imaging modalities with underpinning technologies – advanced algorithms, fast detectors, big data manipulation and hybrid/adaptive imaging.

The Vision of STROBE is to transform imaging science and technology of functioning nano-systems. The Mission of STROBE is to create powerful and broadly-applicable real-time nano-to-atomic scale imaging modalities to advance imaging science and increase access, that can be used to address grand challenges in science and technology, while building a diverse STEM workforce.

STROBE is part of the 2016 class of National Science Foundation Science & Technology Centers awarded in October 2016. STROBE brings together scientists and students from the University of Colorado at Boulder, the University of California at Los Angeles, the University of California at Berkeley, Fort Lewis College, Florida International University, and the University of California at Irvine. Several national laboratories, industries and international institutions are also partnering with STROBE.

Core Faculty
Jessica Ramella-Roman, *Biomedical Engineering*
Jin He, *Physics*
Andres Tremante, *Director of Education and Outreach*
Andrew Green, *Education and Outreach*

The Precise Advanced Technologies and Health Systems for Underserved Populations (PATHS-UP)

Jessica Ramella-Roman, FIU Site Director
Gerry Cote, Texas A&M Director

The goal of all NSF-ERC programs is to integrate engineering research and education with technological innovation to transform national prosperity, health and security.

The specific vision of our PATHS-UP ERC is to change the paradigm for the health of underserved populations by developing revolutionary and cost-effective technologies and systems at the point-of-care. The initial PATHS-UP technologies and systems are designed to help with chronic diseases, such as diabetes and cardiovascular disease, which are leading causes of morbidity and mortality world-wide. Chronic diseases are particularly devastating in underserved communities in the United States where they are contracted at a higher rate than the national average. In these underserved communities, chronic diseases are increasingly a major cause of disability, even for younger people, and lead to poor quality of life and high health care expenditures. Thus, the burden of chronic disease is a grand challenge that requires cost-effective technologies to reduce mortality rates, emergency room visits and hospitalizations, which disproportionately drive-up healthcare costs. Technologies are also needed to help prevent or delay the disease, reducing the incidence of secondary complications and enhancing life quality.

Thus, to accomplish our vision, the PATHS-UP mission is:
1) to engineer transformative, robust, and affordable, technologies and systems to improve healthcare access, enhance the quality of service and life, and reduce the cost of healthcare in underserved populations and
2) to recruit and educate a diverse group of scientists and engineers who are ready to lead the future in developing enabling technologies to improve health in underserved communities.

Our PATHS-UP ERC team is led by Texas A&M University, with partners from the University of California at Los Angeles, Rice University, and Florida International University. At Florida International University, the research focus will be concentrated on biochemical marker for cardiovascular disease, novel approach to enabling wearable technologies for individuals experiencing disability within the PATHS-UP communities, as well as novel wearable sensors for diagnosis of cardiovascular disease and diabetes.

Core Faculty
Peggy Wang, *Mechanical Engineering, Thrust 3*
Josh Hutchinson, *Biomedical Engineering, Thrust 1*
Nezhi Pala, *Electrical Engineering, Thrust 3*
Andres Tremante, *Director of Education and Outreach*
Andrew Green, *Education and Outreach*

Titan America Structures and Construction Testing Laboratory

Atorod Azizinamini, *Director*, *Vasant Surti Professor of Civil Engineering and Director, Moss School of Construction, Infrastructure and Sustainability.,*
David Garber, *Deputy Director and Associate Professor, Civil and Environmental Engineering,*
Armin Mehrabi, *Associate Professor, Civil and Environmental Engineering,*

The Titan America Structures and Construction Testing Laboratory was established in the Department of Civil and Environmental Engineering to provide hands-on educational experience for students; to research and development of innovative hurricane-resistant and durable construction materials, structural systems and components; to serve the construction industry; to contribute to the engineering community in South Florida, and to advance the safety, durability, and economy of our civil infrastructure.

The Titan America Structures and Construction Testing Laboratory was built through the help of a consortium of 21 industry partners who donated materials, services, and cash in excess of $250,000. It is one of the largest

facilities in the State of Florida and is equipped with a full-scale structural testing system (FSST). The FSST consists of a 15 ft tall testing frame that stands above a 35 ft × 65 ft strong concrete floor with 4 ft thickness and 100,000 lbs capacity tie-downs on a 3 ft × 6 ft pattern. The steel frame is capable of testing full-scale structural members, such as a 65 ft bridge girder. The applied load is replicated using a fatigue rated tension/compression actuator that is capable of performing cyclic loading. In addition to the FSST, the SCL is also equipped with other material testing systems, including a universal testing machine, compression machine, and small-scale load frames.

Telecommunications and Information Technology Institute (IT2)

Niki Pissinou, *Director and Professor, School of Computing and Information Sciences*

Florida International University (FIU) recognizes the need to nurture highly trained personnel for the nation's industry and business, develop research to support the rapidly expanding high-tech industry and become proactive in technology transfer. Thus, ensuring continued economic growth and prosperity in the region. In order to fully meet today's technological demands, FIU has established the Telecommunications and Information Technology Institute (IT^2). IT^2 promotes advanced multidisciplinary education and research focused on telecommunications and information technologies. IT^2's mission is to:

1. Deliver high quality telecommunications and information technology education and training.
2. Conduct and promote research to enhance Florida's role as a leader in telecommunications and information technology.
3. Offer training that is needed to foster business development and workforce preparedness.
4. Promote technology transfer to enhance the enabling technologies of the telecommunication and information technology industries.

In fulfilling its mission, IT^2 promotes multidisciplinary collaboration and serves as the catalyst to promote intellectual cross-fertilization among disciplines. This effort results in the synergistic enhancement of teaching and research, so critical in the telecommunications and information technology fields, where disciplinary barriers are falling and lines are blurred. An objective of the Institute is to infuse telecommunications and information technology content into the curriculum at all appropriate levels. To fill the urgent demand of industry, the institute is developing interdisciplinary telecommunication programs that provide certificate programs, Bachelors, Masters and Ph.D. degrees.

IT^2 constitutes an infrastructure that is viable for cutting edge research activities. Researchers at the institute conduct funded research and development targeted at solving complex problems conducive to the early identification of high impact opportunities. Of particular importance to the institute's research efforts is the emerging global wireless, optical and personal communications infrastructure and the ability to represent, store and access information to perform a variety of information related tasks. To provide an effective forum for original research results and to foster communication among researchers, industry leaders can collaborate on education, training, and re-engineering the telecommunications workforce of the future. The alliance provides effective ways to educate the workforce of the 21st century. In accordance, the institute provides technical assistance and applied research services to transfer acquired knowledge and technologies to the commercial sector. The IT^2 team can work with industrial organizations to tap into some technological innovations that drive the industry to its strategic advantage.

For more information, contact Dr. Niki Pissinou, the director of the Telecommunications and Information Technology Institute, at (305) 348-3987 or visit our Website at **www.it2.fiu.edu**.

Core Faculty

Niki Pissinou, *Director and Eminent Scholar Professor*
Deng Pan, *Associate Professor*

Affiliated and Research Faculty

Kang Yen, *Director and Professor, Electrical and Computer Engineering*
Jean Andrian, *Associate Chair and Associate Professor, Electrical and Computer Engineering*
Shih-Ming Lee, *Professor of Practice, Engineering Management Program*
Osama Mohammed, *Associate Dean and Distinguished University Professor, Electrical and Computer Engineering*