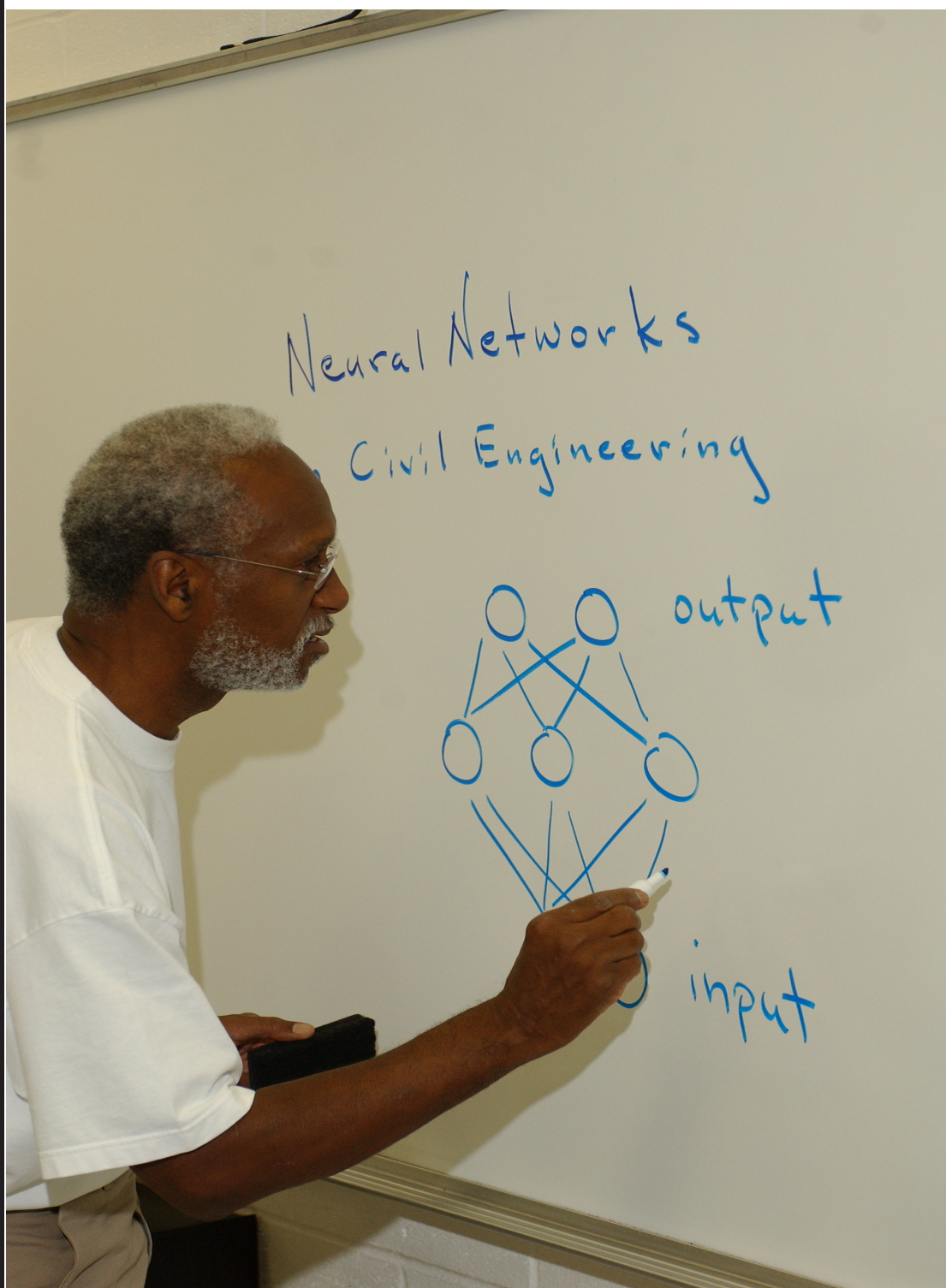
THE SCHOOL OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

DEPARTMENT OF INDUSTRIAL AND SYSTEMS ENGINEERING

DEPARTMENT OF TRANSPORTATION AND INFRASTRUCTURE STUDIES



SCHOOL OF ENGINEERING

Dr. Eugene M. DeLoatch, Dean
Dr. Carl White, Associate Dean, Research & Development/Graduate and Professional Programs

The School of Engineering offers educational programs which ensure that students acquire the ability to master fundamental principles of engineering which may be applied effectively to benefit society. All efforts of the faculty and administration are directed at developing the students' potential and preparing them to assume leadership roles in their chosen profession.

GOALS AND OBJECTIVES

The primary objectives of the School of Engineering are as follows:

1. Establish a School of Engineering of the first rank.
2. Instill in its students the confidence and competence required to meet the challenges associated with careers in engineering.
3. Produce competitive engineers who have negotiated a well-balanced curriculum based on regional and national accreditation guidelines.
4. Exhibit educational leadership in accomplishing the task of increasing the representation of African Americans and others who are underrepresented among engineering professionals.

The School of Engineering awards the Bachelor of Science degree in Civil Engineering, Electrical Engineering, Industrial Engineering, and Transportation Systems. All of the Engineering programs are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Bachelor of Science to Master of Engineering (B.S./M.Eng)

Purpose

The purpose of the Bachelor of Science/Masters of Engineering (B.S./M.Eng.) degree program is to enable well qualified and highly motivated undergraduates students majoring in Engineering to obtain both a bachelor's and master's degree in a minimum of five years. The B.S./M.Eng. program is applicable to the Bachelor of Science (B.S.) degrees in the three engineering disciplines (Civil, Electrical & Computer, and Industrial Manufacturing Information) and the Master of Engineering (M.Eng.) degree within the Clarence M. Mitchell, Jr. School of Engineering. The goal of the B.S./M.Eng. program is to accelerate the production of engineering professionals who are capable of entering into the technology workforce and making significant contributions to society, while safeguarding the environment.

Admission Criteria

The B.S./M.Eng. program allows students to begin graduate study (concurrent with undergraduate work) in the second semester of their junior year. Students are allowed to apply for admission into the program upon completion of 85 credits. For consideration of admission into the B.S./M.Eng. program, a student must:

The application is submitted in the first instance to the graduate coordinator of the prospective engineering department. Applications determined to be eligible, following consideration by the appropriate committee of the (MSU) engineering faculty, shall be forwarded through the Office of the Associate Dean of the School of Engineering to the School of Graduate Studies.

General Requirements

All students who seek candidacy into the B.S./M.Eng. program will be required to complete the B.S. degree requirements of their respective discipline, and a total of 33 acceptable credit hours of graduate coursework inclusive of 2 credit hours of seminar and 4 credit hours of Project Report. Successful completion and oral defense of the Report Project is required in lieu of taking a comprehensive examination.

Program of Study

A core requirement of three interdisciplinary courses (9 credit hours) will be required of all students entering at the B.S./M.Eng program. These courses are carefully designed and coordinated to stress the interdisciplinary nature of the subject matter. The content serves as the philosophical foundation on which all other materials tailored for a specific student are based. The courses are as follows:

CEGR 514	Environ Impact/Risk Assessment	3 Credits
EEGR 505	Advanced Engineering Mathematics with Computational Methods	3 Credits
EGR 512	Advanced Project Management	3 Credits
Total Credit Hours		**9**

Students accepted for candidacy into the B.S./M.Eng. program will begin taking these courses in the second semester of their junior year.

Eighteen credits (excluding the 2 credits of seminars and 4 credits of project reports) are directed toward building an interdisciplinary strength in a sub-discipline. Candidates will complete these courses during the fifth year.

Maintaining Eligibility

Candidates in the B.S./M.Eng. Program are expected to maintain a high level of scholastic achievement. The above constitutes the minimum requirements for consideration for admission into the program. Admitted students must maintain a minimum GPA of 3.00 to remain in good standing as required by the School of Graduate Studies. Candidates who fall below the minimum cumulative grade point average of 3.0 for two consecutive semesters will be removed from the program.

A student may decide to opt out of the B.S./M.Eng. program; however, they must complete all requirements for the traditional B.S. degree program. The B.S./M.Eng. program curriculum is designed such that candidates who successfully complete their coursework through the end of the senior year will automatically qualify them for completion of the B.S. degree requirements. Graduate courses successfully completed up to this time, may be applied to the traditional graduate program. Once a candidate has opted out of the program, the candidate is no longer eligible for the B.S./M.Eng. program degree. In order to receive a Master's Degree at Morgan State University, the student will then have to apply to the traditional two year M.Eng. program.

Candidates who are removed from the program or otherwise opt out of the program are eligible to receive the traditional bachelor's degree in their respective engineering discipline major, on completion of the requirements for the B.S. degree.

Degrees Received

Upon completion of minimum requirements, students receive both the Bachelor of Science and the Master of Engineering degrees. The Bachelor of Science degree will be awarded from the respective departments, that is, the B.S.E.E. from the Electrical and Computer Engineering Department, the B.S.C.E. from the Civil Engineering Department, and the B.S.I.E from the Industrial and Systems Engineering Department. The M.Eng. degree will be awarded from the School of Graduate Studies. A student may elect to receive only a B.S. degree, but must complete the requirements for the traditional B.S. degree program.

CIVIL ENGINEERING

Chairperson of Department: PROFESSOR REGINALD L. AMORY; Samuel P. Massie Chair of Excellence in the Environmental Disciplines: Professor DONALD C. HELM; Associate Professors: IHEANYI ERONINI, JIANG LI, GBEKELOLUWA B. OGUNTIMEIN, Assistant Professors: A. BERT DAVY, INDRANIL GOSWAMI, MANOJ JHA, ROBERT JOHNSON; Lecturer: CHARLES O. OLUOKUN.

THE MAJOR IN CIVIL ENGINEERING

The Civil Engineering Department provides a program of study in the planning, design and management of civil infrastructure and service systems. Specialty areas of study offered include transportation systems, environmental and water resources, structures, geotechnical, and hydrology.

OBJECTIVES

The specific aims of the Civil Engineering Department are to: (1) sponsor courses which provide the broad educational background imperative to engineering; (2) develop in students an appreciation for and understanding of the materials and human resources utilized in designing and constructing civil engineering-related systems that shelter people and equipment, transport people and goods, supply water and dispose of waste, and deliver energy; (3) produce graduates who think logically and orderly when solving engineering problems; and (4) produce students who can communicate and demonstrate confidence in their work.

REQUIREMENTS FOR THE B.S. DEGREE IN CIVIL ENGINEERING

A minimum of 133 credit hours are required to graduate with a B.S. degree in Civil Engineering B.S.C.E. These credit hours are distributed as follows:

General Education & University Requirements	50
Mathematics and Science Requirements	28
Engineering Requirements	55
TOTAL	133

The required courses are listed under the three subgroups below.

A. General Education and University Requirements

Course #	*Course Title*	*Credit*
BIOL 101	Introduction to Biology	4
CEGR 201	Computer-Aided Engineering Graphics and Design	3
CHEM 110	General Chemistry	5
ECON 211	Principles of Economics	3
ENGL 101	Freshman Composition I	3
ENGL 102	Freshman Composition II	3
HEED 100	Health Education	2
HIST 101/105	World History I/History of the U.S. I	3

HIST 102/106	World History II I/History of the U.S. II	3
HIST 350	Introduction to African Diaspora	3
HUMA 201	Introduction to Humanities I	3
HUMA 202	Introduction to Humanities II	3
HUMA XXX	Humanities Elective	3
MATH 241	Calculus I	4
OREN 104	Introduction to Engineering	1
PHEC XXX	Physical Education Elective	1
PHIL 109	Introduction to Logic	3
Total Credits		**50**

B. Mathematics and Science Requirements

Course #	***Course Title***	***Credit***
COSC 230	Object Oriented Programming for Engineers	4
MATH 242	Calculus II	4
MATH 243	Calculus III	4
IEGR 331/ MATH 331	Probability and Statistics	3
MATH 340	Differential Equations	3
PHYS 205	General Physics I	5
PHYS 206	General Physics II	5
Total Credits		**28**

C. Engineering Requirements

Course #	***Course Title***	***Credit***
CEGR 105	Introduction to Civil Engineering	1
CEGR 301	Mechanics of Materials and Lab	4
CEGR 304	Engineering Mechanics	4
CEGR 309	Engineering Geology	3
CEGR 311	Fluid Mechanics and Lab	4
CEGR 314	Structural Analysis I and Lab	4
CEGR 328	Environmental Engineering I and Lab	4
CEGR 332	Hydraulic Engineering	3
CEGR 334	Geotechnical Engineering Fundamentals and Lab	4
CEGR 400	Civil Engineering Project Management	3
CEGR 416	Transportation Engineering	3
CEGR 436	Elementary Structural Design	3
CEGR XXX	Civil Engineering Technical Electives	6
CEGR 490	Senior Design Proposal	1
CEGR 491	Senior Project	2
EEGR 310	Principles of Electronics	3
IEGR 357	Product Design and Engineering Economy	3
Total Credits		**55**

IMPORTANT

The prerequisite requirements will be strictly enforced. Students **MUST** have the prescribed prerequisites before registering for a course.

CIVIL ENGINEERING COURSE OFFERINGS

OREN 104 INTRODUCTION TO ENGINEERNG (FRESHMAN ORIENTATION FOR SCHOOL OF ENGINEERING) *Two hours lecture; 1 credit.* This course is designed to prepare students for the rigors of earning an engineering degree. It introduces students to the expectations and demands of higher education, to the legacy and traditions of Morgan State University, to college success strategies, and to the broad array of career opportunities in the fields of engineering. Students enrolled in this class are required to attend selected University convocations, School of Engineering programs, and other prescribed activities. They are also required to hold conferences with their faculty advisors. Students transferring 24 or more credits to the University when admitted are exempt from this requirement. (Formerly ORIE 104) (FALL/SPRING)

CEGR 105 INTRODUCTION TO CIVIL ENGINEERING *One hour lecture; 1 credit.* This orientation course will introduce students to the concept of engineering design by exposure to several design problems from various areas of civil engineering including: structural, transportation and environmental engineering. **Prerequisite:** OREN 104. (FALL/SPRING)

CEGR 201 COMPUTER AIDED ENGINEERING GRAPHICS AND DESIGN *Two hours lecture; three hours laboratory; 3 credits.* Introduction to the computer aided engineering design processes. Computer structure, DOS and UNIX operating systems and editors. Graphical techniques. Computer-aided drafting and design (CADD). Design project with students working in teams and using CADD in presentations. Basic computer usage in solving engineering problems including computations and modeling. Spreadsheets and technical word processing programs. **Prerequisite:** None. (FALL/SPRING)

CEGR 301 MECHANICS OF MATERIALS AND LAB *Three hours lecture, three hours laboratory; 4 credits.* Introductory analysis of tension, compression and shear. Analysis of stress and strain, ties, shafts, beams and columns. Related laboratory experiments. Introduction to structural analysis and design. **Prerequisites:** CEGR 304, MATH 242, and PHYS 205. (FALL/SPRING)

CEGR 304 ENGINEERING MECHANICS *Four hours lecture; 4 credits.* Resolution, composition, and equilibrium of forces. Analysis of force systems; center of gravity; and moments of inertia. Motion study; Newton's Laws and work-energy, impulse-momentum, and power. **Prerequisites:** MATH 242 and PHYS 205. (FALL/ SPRING)

CEGR 309 ENGINEERING GEOLOGY *Three hours lecture; 3 credits.* The geology of the earth and how it relates to the environment and the design and construction of engineering works. Practical applications related to the design and construction in the areas of dams, tunnels and other engineering structures. **Prerequisite:** CHEM 110. (FALL/SPRING)

CEGR 311 FLUID MECHANICS AND LAB *Three hours lecture, three hours laboratory; 4 credits.* Laboratory studies of fluid properties; fluid fundamentals and description of fluids, aerohydrostatics, differential equations in environmental quality modeling, integral forms of fluid behavior; and dimensional analysis. **Prerequisites:** MATH 243 and MATH 340. (FALL/SPRING)

CEGR 314 STRUCTURAL ANALYSIS I AND LAB *Three hours lecture, three hours laboratory; 4 credits.* Structural forms; statically determinate structures; reactions, shear and bending moment for determinate beams and frames; truss analysis by joints and sections; influence lines. Computer programming assignments are incorporated into the coursework. **Prerequisites:** CEGR 301, CEGR 304, and COSC 230. (FALL/SPRING)

CEGR 328 ENVIRONMENTAL ENGINEERING I AND LAB *Three hours lecture, three hours laboratory; 4 credits.* Course includes applied environmental chemistry and biology; modeling of effects of discharges on receiving streams; water treatment and waste-water treatment. Computer programming assignments are incorporated into the course work. **Prerequisites:** CEGR 311, CHEM 110, COSC 230 and BIOL 101. **(**FALL/ SPRING)

CEGR 332 HYDRAULIC ENGINEERING *Three hours lecture; 3 credits.* Includes hydrology; open-channel flow; pipe flow; ground water flow; dams and reservoirs. Computer programming assignments are incorporated into the course work. **Prerequisites:** CEGR 311 and COSC 230. (FALL/SPRING)

CEGR 334 GEOTECHNICAL ENGINEERING FUNDAMENTALS AND LAB *Three hours lecture, three hours laboratory; 4 credits.* The application of the basic laws and phenomena on science to particulate matter. Basic physical and mechanical structural characteristics. Equilibrium and movement of water. Flow through porous media. Effective stress. Stress-strain relations. **Prerequisites:** CEGR 301 and CEGR 304. (FALL/ SPRING)

CEGR 400 CIVIL ENGINEERING PROJECT MANAGEMENT *Three hours lecture; 3 credits.* The systems approach to planning, design and operation of civil engineering infrastructure and service systems. Specific topics and analytic methods to include: linear programming; network analysis and related applications to project scheduling and implementation (i.e., PERT-CPM). **Prerequisites:** COSC 230, ECON 211 and IEGR 331/MATH 331. (FALL/SPRING)

CEGR 416 TRANSPORTATION ENGINEERING *Three hours lecture; 3 credits.* Engineering and planning for transportation facilities with emphasis on ground transportation. Topics include: vehicle motion, vehicle flow models, human factors, geometric design, safety, capacity analysis and transportation planning. **Prerequisite:** ECON 211. (FALL/SPRING)

CEGR 436 ELEMENTARY STRUCTURAL DESIGN *Three hours lecture; 3 credits.* Introduction to design principles. Safety factors. Steel and concrete properties. Design of steel and reinforced concrete beams and columns. Design of steel connections. Design of steel trusses. **Prerequisites:** CEGR 301, CEGR 304 and CEGR 314. (FALL/SPRING)

CEGR 450 STRUCTURAL ANALYSIS II *Three hours lecture; 3 credits.* Deflection of statically determinate structures using virtual work and moment area methods; analysis of statically indeterminate structures; approximate methods, stiffness and flexibility matrices, solution by digital computer. Plastic method of analysis. **Prerequisite:** CEGR 314. (FALL/SPRING)

CEGR 451 DESIGN OF REINFORCED CONCRETE STRUCTURES *Three hours lecture; 3 credits.* Structural properties of concrete, building codes; design of beams, columns, slabs, footings, and retaining walls. **Prerequisites:** CEGR 314 and CEGR 436. (FALL)

CEGR 452 DESIGN OF STEEL STRUCTURES *Three hours lecture; 3 credits.* Introduction to steel structures; design of tension members, beams and column connections, plate girders, continuous beams; introduction to computer-aided design. **Prerequisites:** CEGR 314 and CEGR 436. (SPRING)

CEGR 453 RELIABILITY BASED DESIGN IN CIVIL ENGINEERING *Three hours lecture; 3 credits.* Systems reliability and reliability analysis. Includes measures of reliability, reliability index, reliability bounds and other related measurements. **Prerequisite:** MATH 331/IEGR 331. (OFFERED AS NEEDED)

CEGR 454 FOUNDATION ENGINEERING *Three hours lecture; 3 credits.* Application of the principles of soil mechanics to the design of footings, retaining walls, pile foundations, bulkheads, cofferdams, bridge piers and abutments, and underpinnings. **Prerequisite:** CEGR 334. (SPRING)

CEGR 455 SEEPAGE, DRAINAGE, AND GROUNDWATER *Three hours lecture; 3 credits*. Introduction to groundwater hydrology, well hydraulics, permeability, seepage, flow nets, filter criteria, dewatering, slope stabilization, practical applications. **Prerequisite:** CEGR 334. (OFFERED AS NEEDED)

CEGR 456 EARTH STRUCTURES AND SLOPES *Three hours lecture; 3 credits.* Earth dams, embankments and natural slopes. Site investigation, soil properties and compaction. Slope stability analysis and landslide prevention. Earthquake effects. Case studies. **Prerequisite:** CEGR 334. (OFFERED AS NEEDED)

CEGR 457 GEOTECHNICAL ENGINEERING *Three hours lecture; 3 credits.* Analysis of consolidation, settlement, shear strength, seepage. Slope stability analysis. Theory and laboratory. **Prerequisite:** CEGR 334. (FALL)

CEGR 458 BIOLOGICAL WASTEWATER TREATMENT *Three hours lecture; 3 credits.* Theory and application of biological methods for wastewater treatment. Principles of biological treatment; biological lagoons; trickling filter activated sludge process; anaerobic and aerobic digestion of sludge. **Prerequisite:** CEGR 328. (OFFERED AS NEEDED)

CEGR 459 WATER SUPPLY ENGINEERING *Three hours lecture; 3 credits.* Quantity and quality aspects of water supply engineering are discussed. Topics include reservoir sizing, groundwater, distribution systems, treatment processes and chemistry of waters. **Prerequisite:** CEGR 328. (FALL)

CEGR 460 INDUSTRIAL WASTE TREATMENT *Three hours lecture; 3 credits.* The nature of industrial waste generation; industrial waste characteristics; waste measurements; techniques utilized in industrial waste treatment and control; nuclear waste control; reuse of industrial effluents and sewage for industrial wastes and their effects on receiving waters. **Prerequisite:** CEGR 328. (OFFERED AS NEEDED)

CEGR 461 COLLECTION AND PUMPING OF WASTEWATER *Three hours lecture; 3 credits.* Course includes wastewater flows and measurement, design of sewers, sewer appurtenances, infiltration/inflow, pumping systems and pumping stations. **Prerequisite:** CEGR 328. (OFFERED AS NEEDED)

CEGR 463 PHYSICAL AND CHEMICAL WASTEWATER TREATMENT *Three hours lecture; 3 credits*. Theory and application of physical and chemical operation and processes for wastewater treatment. Topics and discussion will include sedimentation; flotation; disinfection; coagulation; flocculation; filtration; carbon absorption; reverse osmosis; ion exchange and thickening. **Prerequisite:** CEGR 328. (SPRING)

CEGR 464 ENVIRONMENTAL ENGINEERING II *Three hours lecture; 3 credits.* Environmental engineering hydrology, hydraulics, and pneumatics; air pollution control; solid waste characteristics, management and control. **Prerequisites:** CEGR 311 and CHEM 110. (FALL)

CEGR 465 TRAFFIC ENGINEERING *Three hours lecture; 3 credits.* The principles of traffic engineering involving the analysis, planning and design of roads, streets and highways, and their related networks. Coverage includes the dynamics of traffic flows; traffic studies and data collection; capacity analysis of freeways and arterials; the analysis and design of traffic control systems, including signalized and unsignalized intersections. **Prerequisite:** CEGR 416. (FALL)

CEGR 466 TRANSPORTATION MODELS AND SIMULATION *Three hours lecture; 3 credits.* The theory, development and application of models and modeling systems commonly used in the planning, design and operational analysis of transportation systems. Students are expected to apply existing software in the analysis of transportation data sets and to develop models using one of the common high level languages. Applications will include: travel demand estimation, modal choice, terminal and servicing phenomena and traffic performance evaluation. **Prerequisites:** CEGR 465, and IEGR 331/MATH 331. (SPRING)

CEGR 467 CIVIL ENGINEERING SYSTEMS *Three hours lecture; 3 credits.* Advanced topics in the systems

approach to civil engineering management. Topics and methods to include: constrained optimization; marginal analysis; linear programming; sensitivity analysis; dynamic programming; multi-objective optimization. **Prerequisite:** CEGR 400 or equivalent. (OFFERED AS NEEDED)

CEGR 490 SENIOR DESIGN PROPOSAL *One hour lecture; 1 credit.* The first semester component of the Senior Design effort will be typically undertaken in the penultimate semester. During this phase, the student will carry out literature studies, establish contacts, collect data and define the scope and outline of the project, in consultation with the academic advisor and an external advisor in industry, if appropriate. The effort will be commensurate with a one credit course and at the end of the semester, the student will be responsible for the development and submission of a project proposal, which will be evaluated and graded. **Prerequisites:** (CEGR 328 for an environment design) or (CEGR 334 for a geotechnical design) or (CEGR 436 for a structural design) or (CEGR 416 for a transportation design). (FALL)

CEGR 491 SENIOR PROJECT *Two hours lecture; 2 credits.* The second semester component will follow up on the approved proposal developed by the end of CEGR 490 and will focus on the actual execution of the proposed analysis and design. Students must address issues related to feasibility, development of alternatives, theoretical background, design issues, adherence to design standards and codes and other relevant issues as defined in the proposal. The design will culminate in the development of a Project Report and an open seminar where the student will have to make a technical presentation to an open audience of the faculty and students of the department. The quality of all components-content, presentation and final report will form the basis of the grade. **Prerequisite:** CEGR 490. (FALL/SPRING)

CEGR 498 TOPICS IN CIVIL ENGINEERING *Three hours lecture; 3 credits.* In-depth study in areas of student/faculty interest. Approval of the faculty course director, faculty advisor and Department chairman required. (FALL/SPRING)

MORGAN STATE UNIVERSITY
SCHOOL OF ENGINEERING
CIVIL ENGINEERING
CURRICULUM SEQUENCE

FRESHMAN YEAR (FIRST SEMESTER)

CEGR 201	COMPUTER ENGR GRAPH & DES	3
OREN 104	INTRO TO ENGINEERING I	1
CHEM 110	GENL CHEM FOR ENGR	5
MATH 241	CALCULUS I	4
ENGL 101	FRESHMAN COMPOSITION I	3
		16

FRESHMAN YEAR (SECOND SEMESTER)

CEGR 105	INTRO TO CIVIL ENGR	1
COSC 230	OBJECT ORIENT PROGRAM ENGR	4
PHYS 205	PHYSICS I	5
MATH 242	CALCULUS II	4
ENGL 102	FRESHMAN COMPOSITION II	3
		17

SOPHOMORE YEAR (FIRST SEMESTER)

CEGR 304	ENGINEERING MECHANICS	4
PHYS 206	PHYSICS 1I	5
MATH 243	CALCULUS III	4
ECON 211	PRIN OF ECONOMICS I	3
HIST 101/105	WORLD HISTORY I/ HISTORY OF U. S. I	3
		19

SOPHOMORE YEAR (SECOND SEMESTER)

HIST 102/106	WORLD HISTORY II/ HISTORY OF U. S. II	3
CEGR 301	MECHANICS OF MAT & LAB	4
BIOL 101	INTRO TO BIOLOGY I	4
MATH 340	DIFFERENTIAL EQUATIONS	3
PHEC XXX	PHYSICAL EDUCATION	1
HEED 100	HEALTHFUL LIVING	2
		17

JUNIOR YEAR (FIRST SEMESTER)

CEGR 311	FLUID MECHANICS & LAB	4
CEGR 314	STRUCTURAL ANAL & LAB	4
CEGR 334	GEO ENG FUND & LAB	4
CEGR 416	TRANSPORT ENGR	3
HUMA 201	INTRO TO HUMANITIES I	3
		18

JUNIOR YEAR (SECOND SEMESTER)

CEGR 328	ENVIRON ENG I & LAB	4
HUMA 202	INTRO TO HUMANITIES II	3
CEGR 436	ELEM STRUCTURAL DESIGN	3
IEGR 331/ MATH 331	PROB & STATIS FOR ENG	3
CEGR 332	HYDRAULIC ENGINEERING	3
		16

SENIOR YEAR (FIRST SEMESTER)

CEGR 490	SENIOR DESIGN PROPOSAL	1
CEGR XXX	C. E. TECHNICAL ELECTIVE	3
CEGR 309	ENGINEERING GEOLOGY	3
CEGR 400	C. E. PROJECT MGT	3
EEGR 310	PRIN OF ELECTRON	3
HEGR 357	PROD DES & ENGR ECON	3
		16

SENIOR YEAR (SECOND SEMESTER)

CEGR 491	SENIOR PROJECT	2
CEGR XXX	C. E. TECHNICAL ELECTIVE	3
PHIL 109	INTRO TO LOGIC	3
XXX XXX*	HUMANITIES ELECTIVE	3
HIST 350	INTRO TO AFR DIASPORA	3
		14

TOTAL CREDITS **133**

*See General Education Requirements

TECHNICAL ELECTIVES

CEGR 450	STRUCTURAL ANALYSIS II	3
CEGR 451	DESIGN OF REINFORCED CONCRETE STRUCTURES	3
CEGR 452	DESIGN OF STEEL STRUCTURES	3
CEGR 453	RELIABILITY-BASED DESIGN IN CIVIL ENGINEERING	3
CEGR 454	FOUNDATION ENGINEERING	3
CEGR 455	SEEPAGE, DRAINAGE, AND GROUNDWATER	3
CEGR 456	EARTH STRUCTURES AND SLOPES	3
CEGR 457	GEOTECHNICAL ENGINEERING	3
CEGR 458	BIOLOGICAL WASTEWATER TREATMENT	3
CEGR 459	WATER SUPPLY ENGINEERING	3
CEGR 460	INDUSTRIAL WASTE TREATMENT	3
CEGR 461	COLLECTION AND PUMPING OF WASTEWATER	3
CEGR 463	PHYSICAL AND CHEMICAL WASTEWATER TREATMENT	3
CEGR 464	ENVIRONMENTAL ENGINEERING II	3
CEGR 465	TRAFFIC ENGINEERING	3
CEGR 466	TRANSPORTATION MODELS AND SIMULATION	3
CEGR 467	CIVIL ENGINEERING SYSTEMS	3
CEGR 498	TOPICS IN CIVIL ENGINEERING	3

ELECTRICAL AND COMPUTER ENGINEERING

Chairperson of the Department: PROFESSOR CRAIG SCOTT; Professor: CARL WHITE; Associate Professors: PETER H. ANDERSON, ARLENE COLE-RHODES, KEMI LADEJI-OSIAS, JAMES E. WHITNEY; Assistant Professor: MICHEL REECE; Instructors: YACOB ASTATKE, ERASTUS J. NJAGE; Lecturers: RICHARD A. DEAN, AFEWORK DEMISSE, COREY DICKENS, JEYASINGH NITHIANANDAM, GREGORY M. WILKINS, LAWRENCE WALKER.

THE MAJOR IN ELECTRICAL ENGINEERING

The Department of Electrical and Computer Engineering provides its students the opportunity to apply mathematical and physical concepts to engineering problems early in the curriculum, through laboratory and design experiences. The Department has been following the philosophy of design across the curriculum for some time. In addition to the strong design experience integrated throughout the required courses, the electives offer students the opportunity to enhance their skills with additional open-ended problem solving. These problems are broad-based, incorporating knowledge from specialty areas of communications systems, signal processing, microwave systems, solid state electronics, controls and automation, and computer engineering. The computer engineering emphasis is a special component of the electrical engineering (EE) program, where the Department offers a concentration in this area within its EE program. This rounds out the program by providing the necessary tools to meet the demands of the information age.

OBJECTIVES

The primary objectives of the Department are consonant with those of the School of Engineering. In striving to develop a program of the highest quality, the program seeks to instill in its students the confidence and competence required to meet the challenges associated with careers in electrical and computer engineering. The primary objectives of the Department are to:

1) Develop a challenging and adaptive electrical and computer engineering curriculum which continuously fosters excellence, breadth, and depth in the fundamental principles and applications of mathematics, science, and engineering. The program includes the broader context of global and contemporary issues, and the humanities;
2) Prepare our incoming students, both academically and socially, for the rigors of an engineering education;
3) Provide opportunities for our students to develop skills to analyze and solve challenging and open-ended problems utilizing the latest technology, through hands-on experiences, research, internships and entrepreneurial activities;
4) Provide experiences for our students to professionally document and present problems and solutions;
5) Provide a nurturing environment that promotes individual initiative and team interaction such that lifelong habits of learning and critical thinking challenge students to realize their full potential;
6) Develop in students a disciplined approach to the engineering profession; including time-management, discipline, character, reliability, and integrity; and
7) Encourage the faculty's own development to ensure the continuing introduction of current material into the curriculum.

REQUIREMENTS FOR THE B.S.S.E. DEGREE

A minimum of 132 credit hours are required of students pursuing the Bachelor of Science Degree in Electrical Engineering (B.S.E.E.). These credit hours are distributed as follows:

General Education Requirements	45
University Requirements	2
Mathematics and Science Requirements	27 or 28
Electrical Engineering Core Requirements	43
Electives or Concentration Requirements	15
TOTAL	**132 or 133**

Students must complete all of the requirements in sections A, B, C, D and E or sections A, B, C, D and F.

A. General Education Requirements

Course #	*Course Title*	*Credit*
BIOL 101	Introduction to Biology	4
CHEM 110	General Chemistry for Engrs. (Lecture and Lab)	5
ECON 211	Principles of Economics	3
ENGL 101	Freshman Composition I	3
ENGL 102	Freshman Composition II	3
HEED 100	Health Education	2
HIST 101 or 105	World History I U.S. History I	3
HIST 102 or 106	U.S. History II U.S. History II	3

HIST 350	Introduction to African Diaspora	3
HUMA 201	Introduction to Humanities I	3
HUMA 202	Introduction to Humanities II	3
HUMA XXX	Humanities Elective	3
MATH 241	Calculus I	4
PHIL 109	Introduction to Logic	3
EEGR 161[1]	Intro to C Programming	3(4)
		48(49)

B. University Requirements

Course #	*Course Title*	*Credit*
OREN 104	Introduction to Engineering	1
PHEC XXX	Physical Education Elective	1
		2

C. Math and Basic Sciences Requirements

Course #	*Course Title*	*Credit*
MATH 242	Calculus II	4
MATH 243	Calculus III	4
MATH 340	Differential Equations	3
MATH 331[2]	Applied Probability and Statistics	3
PHYS 205	General Physics I (Lecture & Lab)	5
PHYS 206	General Physics II (Lecture & Lab	5
		24

[1]May be replaced by COSC 230 or an equivalent course (equivalent course replacement requires faculty advisor and Department Chair approval prior to registration. Minimum 3 credits required).

[2]May be replaced by EEGR 331, Probability and Random Processes for Engineers or IEGR 331, Probability and Statistics for Engineers.

D. Engineering Core Requirements

Course #	*Course Title*	*Credit*
CEGR 304	Engineering Mechanics	4
IEGR 305	Thermodynamics	3
EEGR 105	Introduction to Elect. & Comp. Engr.	3
EEGR 202	Electric Circuits	4
EEGR 203	Introduction to Electrical Laboratory	1
EEGR 211	Introduction to Digital Logic	3
EEGR 215	Electronic Materials & Devices	4
EEGR 221	Signals and Systems	4
EEGR 305	Electromagnetic Theory & Applications	4
EEGR 317	Electronic Circuits	4
EEGR 322	Discrete Systems	3
EEGR 390	Principles of Design	2
EEGR 400	Introduction to Professional Practice	1
EEGR 490	Senior Design Project I	1
EEGR 491	Senior Design Project II	2
		43

E. Electrical Engineering Electives Requirements (15 credits)

EEGR 4XX	ECE Electives (4)	12
XXX XXX[3]	Approved Elective	3
TOTAL		**15**

[3]Approved electives are advanced courses listed in the Physics, Chemistry, Mathematics, Computer Science, Industrial and Civil Engineering programs, or other relevant courses deemed appropriate for the student's program of study. **Faculty advisor and Department Chair written approval must be obtained prior to registration.**

F. Electrical Engineering-Computer Engineering Track Requirements (15 credits)

EEGR 243[4]	Computer Architecture	3
EEGR 463	Digital Electronics	3
EEGR 4XX[5]	ECE Electives (3)	9
TOTAL		**15**

[4]May be replaced by COSC 243

[5]Three EEGR electives must be selected from the following: EEGR 409, EEGR 412, EEGR 417, EEGR 419, and EEGR 451. In addition, EEGR-498, EEGR-499 and Engineering Graduate offerings that relate to Computer Engineering and IEGR and COSC electives will be considered on a case by case basis. **ECE Department written approval is required prior to registering for any of these offerings**.

ELECTRICAL AND COMPUTER ENGINEERING COURSE OFFERINGS

OREN 104 INTRODUCTION TO ENGINEERNG (FRESHMAN ORIENTATION FOR SCHOOL OF ENGINEERING) *Two hours lecture; 1 credit.* This course is designed to prepare students for the rigors of earning an engineering degree. It introduces students to the expectation and demands of higher education, to the legacy and traditions of Morgan State University, to college success strategies, and to the broad array of career opportunities in the fields of engineering. Students enrolled in this class are required to attend selected university convocations, School of Engineering programs, and other prescribed activities. They are also required to hold conferences with their faculty advisors. Students transferring 24 or more credits to the University when admitted are exempt from this requirement. (Formerly ORIE 104). (FALL/SPRING)

EEGR 105 INTRODUCTION TO ELECTRICAL AND COMPUTER ENGINEERING *Three hours lecture; 3 credits.* Introduction to the profession. Ethics and

professional behavior. Students are exposed to various specialties and areas which may include an introduction to the computer, programming and computational tools; digital design; communications; laboratory instrumentation; introduction to probability and statistics and other general topics. **Prerequisite:** OREN 104 and MATH 106. **Corequisite:** MATH 113 or higher. (SPRING).

EEGR 161 INTRODUCTION TO C PROGRAMMING *Three hours lecture; 3 credits.* Topics include computer components, algorithm design with flowcharts and pseudocode; algorithm implementation in the C programming language. Students will apply programming, documentation, debugging/ testing techniques to problem solving and data analysis. The course will include the selection and application of library programs and routines with application to engineering. **Prerequisite:** MATH 113 or higher. (FALL).

EEGR 202 ELECTRIC CIRCUITS *Four hours lecture; 4 credits.* Includes Ohm's and Kirchhoff's laws; VI laws of RLC elements, Analysis techniques including Thevenin's and Norton's Theorem; Phasor concepts, Two-port and magnetically coupled networks. **Prerequisites:** MATH 242 and PHYS 205. **Corequisites:** MATH 340 and PHYS 206. (FALL/SPRING).

EEGR 203 INTRODUCTION TO ELECTRICAL LABORATORY *One hour lecture, three hours laboratory; 1 credit*. Involves report writing and the use of laboratory instruments and experiments relative to Kirchhoff's laws, circuit linearity, transient response, and operational amplifiers. Prerequisite PHYS 205. Corequisite: EEGR 202. (FALL/SPRING)

EEGR 211 INTRODUCTION TO DIGITAL LOGIC *Three hours lecture, one hour laboratory; 3 credits.* Covers number systems, Boolean algebra, logic functions and gates, minimization techniques, decoders, encoders, multiplexers, arithmetic circuits, latches, flip-flops, counters, and shift registers. Laboratory section includes design and implementation of combinatorial and sequential circuits. **Prerequisites:** EEGR 202 and EEGR 203. (FALL/SPRING).

EEGR 215 ELECTRONIC MATERIALS AND DEVICES *Four hours lecture, one hour laboratory; 4 credits*. Includes semiconductor physics, PN-junction transistors, junction field effect transistors, metal oxide FETs. Laboratory consists of experiments related to the analysis and design of circuits employing diodes, transistors and integrated circuits. **Prerequisites:** EEGR 202 and EEGR 203. (FALL/SPRING).

EEGR 221 SIGNALS AND SYSTEMS *Four hours lecture; 4 credits.* Includes manipulation of continuous signals; singularity functions, differential equations and continuous convolution; Fourier series and transforms; Complex frequency; Laplace transform, state variables; Frequency analysis. **Prerequisites:** MATH 340 and EEGR 202. (FALL/SPRING).

EEGR 243 COMPUTER ARCHITECTURE *Three hours lecture, one hour laboratory; 3 credits.* Examines the basic principles and techniques used in the design and evaluation of computer systems. Includes assembly language programming techniques, data path and control design of computers, and computer performance relative to computer design. Stresses the principle design concepts that are embodied in modern computer architectures. **Prerequisites:** EEGR 203, EEGR 202, EEGR 211, and EEGR 161 (or COSC 230). (FALL/SPRING).

EEGR 305 ELECTROMAGNETIC THEORY AND APPLICATIONS *Four hours lecture; 4 credits*. This course introduces the student to the principles and applications of electromagnetics. Topics include: review of vector calculus, electric and magnetic fields, Maxwell's equations in integral and differential form, Poisson's equation, Laplace's equation, uniform plane waves, transmission lines and waveguides. **Prerequisites:** MATH 243, PHYS 206 and EEGR 202. (FALL/SPRING).

EEGR 310 PRINCIPLES OF ELECTRONICS *Three hours lecture; 3 credits*. Presents the fundamental principles of electronic devices, circuits, and digital systems. **Closed to Electrical Engineering Majors. Prerequisites:** MATH 340 and PHYS 206. (FALL/ SPRING)

EEGR 317 ELECTRONIC CIRCUITS *Four hours lecture, one hour laboratory; 4 credits.* Analysis and de sign of electronic circuits employing diodes and active components such as Bipolar Transistors, FETs and Op-Amps. Includes an applications-oriented design laboratory. **Prerequisites:** EEGR 202, EEGR 203 and EEGR 215. (FALL/SPRING).

EEGR 322 DISCRETE SYSTEMS *Three hours lecture; 3 credits*. Manipulation of discrete signals, Fourier analysis of discrete signals, z-transform, Discrete Fourier Transform, Fast Fourier Transform, Digital filter design, state variables. **Prerequisite:** EEGR 221. (FALL/ SPRING).

EEGR 331 PROBABILITY AND RANDOM PROCESSES FOR ELECTRICAL ENGINEERS *Three hours lecture; 3 credits*. Topics covered include sample spaces, combinatorial methods, probabilities, random variables, discrete and continuous distributions, specific probability laws and their interpretation, introduction to random processes, practical EE examples and applications. **Prerequisites:** MATH 242 and EEGR 202. (OFFERED AS NEEDED)

EEGR 390 PRINCIPLES OF DESIGN *Two hours lecture, two hours laboratory; 2 credits*. Applies design principles and methods to analog and digital circuits. Students work in teams to design small systems. **Prerequisites:** EEGR 211, EEGR 221 and EEGR 317. (FALL/ SPRING).

EEGR 400 INTRODUCTION TO PROFESSIONAL PRACTICE *One hour lecture; 1 credit.* Discusses the role of the engineer in the larger world, professional ethics and behavior, and techniques for a rewarding career and life, emphasizing life long learning. **Prerequisites:** EEGR 211, EEGR 221, and EEGR 317. **This course is offered only for graduating seniors in the next to last semester of enrollment.** (FALL/SPRING).

EEGR 409 C PROGRAMMING APPLICATIONS *Three hours lecture, one hour laboratory; 3 credits*. Data types, operators and expressions, structures, pointers, arrays and complex data structures. Program documentation, development tools and administration of large software development. **Prerequisites:** EEGR 202, EEGR 211, EEGR 215, EEGR 221, and COSC 230 (or its equivalent). (FALL/SPRING).

EEGR 412 COMPUTER ORGANIZATION *Three hours lecture*, *two hours laboratory; 3 credits.* Consists of computer organization, machine and assembly language programming techniques, interfacing, schema, microprogramming concepts, advanced systems utilization, and project design. **Prerequisites:** EEGR 211 and EEGR 243. (OFFERED AS NEEDED)

EEGR 417 MICROPROCESSORS APPLICATIONS *Three hours lecture, one hour laboratory; 3 credits*. Provides an overview of microprocessors and peripherals. Teaches use of basic tools and confidence to evaluate the suitability of microcomputer technology applied to engineering problems and to effectively design microcomputer software and hardware to satisfy a variety of needs. **Prerequisite:** EEGR 211. (SPRING).

EEGR 419 INSTRUMENTATION CONTROL AND SENSORS *Three hours lecture, one hour laboratory; 3 credits*. Design of processor based systems to interface with real world perepherals for control and measurement and data acquisition. Includes interfacing of inputs, output drivers, isolation, digital to analog, and analog to digital conversion and such protocols as the Philips 12C, Motorola SPI, Dallas 1-wire and asynchronous serial RS232. **Prerequisite:** EEGR 409. (FALL).

EEGR 424 ELEMENTS OF POWER SYSTEM ANALYSIS *Three hours lecture; 3 credits*. Treats system network equations, load flow computations, and symmetrical and asymmetrical faults. Swing equation. **Prerequisite:** EEGR 202. *credits*. (OFFERED AS NEEDED)

EEGR 431 LINEAR CONTROL SYSTEMS *Three hours lecture; 3 credits.* Analysis of time and frequency response of closed loop systems, Routh-Hurwitz and Nyquist criteria for stability, root-locus method, and system specifications. **Prerequisite:** EEGR 221; **Corequisite:** EEGR 322. (FALL)

EEGR 440 INDUSTRIAL EXPERIENCE *Nine hours; 3 credits*. Credit awarded based on faculty evaluation of work performed by students in the Cooperative Education Program. **Prerequisite:** Departmental approval before registration.

EEGR 443 INTRODUCTION TO MICROWAVES *Three hours lecture; 3 credits.* Deals with wave types, transmission lines and waveguides. Smith chart, S-parameters, active and passive components, and measurement techniques: **Prerequisite:** EEGR 304 or EEGR 305. (FALL).

EEGR 444 SPECIALIZED TOPICS IN MICROWAVES *Three hours lecture; 3 credits.* Specialized topics and design relating to high frequency devices, circuits and systems. **Prerequisite:** EEGR 443. (SPRING).

EEGR 451 DIGITAL SIGNAL PROCESSING *Three hours lecture; two hours laboratory; 3 credits*. Covers discrete Fourier Transform, Fast Fourier Transform, Sampling, Quantization, Digital filter design. Emphasis is placed on the applications of digital signal processing. **Prerequisite:** EEGR 322. (SPRING).

EEGR 453 COMMUNICATIONS THEORY *Three hours lecture; 3 credits*. Includes probability theory, analog and digital modulation techniques, noise in modulating systems, digital data transmission, optimum receivers. **Prerequisites:** EEGR 322 and MATH 331 (or its equivalent). (FALL).

EEGR 454 COMMUNICATIONS ELECTRONICS *Three hours lecture, one hour laboratory; 3 credits*. Covers spectrum and noise measurements, design of AM and ASK detectors, FM and FSK modulators, and phase lock loops. **Prerequisites:** EEGR 317 and EEGR 453. (OFFERED AS NEEDED)

EEGR 460 ELECTRO-OPTICS *Three hours lecture; 3 credits*. The study of Geometrical optics which includes light rays, plane and spherical surfaces, thin and thick lenses, effects of stops, ray tracing and lens aberrations; physical optics which includes lightwaves, superposition of waves, interferences of two light beams. Frauhofer diffraction by a single opening, double slits; and diffraction grading and coherent optics which discuss the diffraction theory and lens-less holography. **Prerequisites:** EEGR 304 or EEGR 305; EEGR 317. (OFFERED AS NEEDED)

EEGR 461 SOLID STATE ELECTRONICS I *Three hours lecture, one hour laboratory; 3 credits*. Treats semiconductor properties, valence bands, energy bands, equilibrium distribution of electrons and non-equilibrium transport of charges. **Prerequisite:** EEGR 215. (OFFERED AS NEEDED)

EEGR 462 SOLID STATE ELECTRONICS II *Three hours lecture, one hour laboratory; 3 credits.* Examines the theory and analysis of basic semiconductor building block devices. These structures include: PN junctions, metal-semiconductor diodes, MOSFETs, bipolar junction transistors, and metal-semiconductor field effect transistors. **Prerequisite:** EEGR 461. (OFFERED AS NEEDED)

EEGR 463 DIGITAL ELECTRONICS *Three hours lecture; 3 credits*. Deals with the analysis, design, simulation, and applications of digital micro-electronic systems. These include TTL, CMOS, and ECL logic families, A/D and D/A converters, semiconductor memory devices such as RAM, ROM, EPROM, EEPROM, and programmable logic devices. Design projects are an integral part of this course. **Prerequisites:** EEGR 211 and EEGR 317. (SPRING).

EEGR 465 PHYSICAL ELECTRONICS *Three hours lecture, two hours laboratory; 3 credits.* Analysis of semiconductor device characteristics. Includes homojunction and heterojunction materials, MESFET devices, HEMT FETs, heterojunction bipolar transistors and quantum well structures. **Prerequisites:** EEGR 304 and EEGR 317. (OFFERED AS NEEDED)

EEGR 471 DESIGN OF INTEGRATED CIRCUITS *Three hours lecture, one hour laboratory; 3 credits.* Includes microelectronic circuit design and silicon integrated device characteristics and fabrication. **Prerequisite:** EEGR 317. (OFFERED AS NEEDED)

EEGR 481 INTRODUCTION TO NEURAL NETWORKS AND FUZZY LOGIC *Three hours lecture, one hour laboratory; 3 credits.* The course is designed to introduce students to the theory of neural networks and fuzzy logic. Students will simulate the operation of the various types of neural networks and fuzzy logic schemes on the computer. **Prerequisite:** EEGR 409 (or equivalent proficiency as approved by the instructor). (OFFERED AS NEEDED)

EEGR 487 TELECOMMUNICATIONS *Three hours lecture; 3 credits.* Consists of telecommunications systems design for point-to-point and mass data distribution, modulation techniques, propagation modes, and control methods. **Prerequisite:** EEGR 453. (OFFERED AS NEEDED)

EEGR 489 CELLULAR WIRELESS COMMUNCATIONS *Three hours lecture; 3 credits*. Includes the basic concepts of wireless and RF systems; global system for mobile communications (GSM); code division multiple access (CDMA); and GPRS data protocols. **Prerequisites:** EEGR 221 and EEGR 322. (OFFERED AS NEEDED)

EEGR 490 SENIOR DESIGN PROJECT I *Five hours; 1 credit*. This is the first part of a two-part sequence capstone design project. In the first part, students will select their project advisor and develop a written proposal for their major design, which indicates how the design will be executed. Students will also learn project planning and the design cycle, and consider engineering standards as the proposal is developed. This is a practicum where the minimum level of effort required is five hours per credit. A copy of the proposal, with appropriate signatures, must be submitted to the Department. **Prerequisite:** EEGR 317; **Corequisite:** EEGR 390. **This course is offered only for graduating seniors in the next to last semester of enrollment. Department approval required.** (FALL/SPRING).

EEGR 491 SENIOR DESIGN PROJECT II *Ten hours; 2 credits*. This is the second part of a two-part sequence capstone design project. Individual or team design, development, and analyzing of projects. Students are required to present their work in an open forum to faculty, peers and invited guests. A final technical report is required which professionally documents the design project. A copy of the report, with appropriate signatures, must be submitted to the Department office.

This is a practicum where the minimum level of effort required is five hours per credit. **Prerequisite:** EEGR 490. **This course is offered only for graduating seniors in the last semester of enrollment. Faculty advisor and Department approval required.** (FALL/SPRING).

EEGR 498 INDEPENDENT PROJECT *Two hours lecture, three hours laboratory; 3 credits.* Individual student study performed under faculty supervision. The level of effort and subject matter must be equivalent to a 400 level Department course. **Prerequisite:** Departmental approval before registration required. (OFFERED AS NEEDED)

EEGR 499 SPECIAL TOPICS IN ELECTRICAL ENGINEERING *Three hours lecture; 3 credits.* Special courses not offered on a regular basis. **Prerequisite:** Departmental approval before registration. (OFFERED AS NEEDED)

MORGAN STATE UNIVERSITY
SCHOOL OF ENGINEERING
ELECTRICAL AND COMPUTER ENGINEERING
CURRICULUM SEQUENCE

FRESHMAN YEAR (FIRST SEMESTER)

CHEM 110	CHEMISTRY FOR ENGINEERS	5
MATH 241	CALCULUS I	4
ENGL 101	FRESHMAN COMPOSITION I	3
HIST 101/105	HISTORY I	3
OREN 104	INTRO TO ENGINEERING I	1
PHEC XXX	PHYSICAL EDUCATION	1
		17

FRESHMAN YEAR (SECOND SEMESTER)

PHYS 205	PHYSICS I	5
MATH 242	CALCULUS II	4
ENGL 102	FRESHMAN COMPOSITION II	3
HIST 102/106	HISTORY II	3
EEGR 105	INTRO TO ELECT & COMP ENGR	3
		18

SOPHOMORE YEAR (FIRST SEMESTER)

PHYS 206	GENERAL PHYSICS II	5
MATH 340	DIFFERENTIAL EQUATIONS	3
EEGR 202	ELECTRIC CIRCUITS	4
EEGR 203	INTRO TO ELECTRICAL LAB	1
EEGR 161[1]	INTRO TO C PROGRAMMING	3
HEED 100	HEALTH EDUCATION	2
		18

SOPHOMORE YEAR (SECOND SEMESTER)

MATH 243	CALCULUS III	4
EEGR 221	SIGNALS & SYSTEMS	4
EEGR 215	ELECTRONIC MATERIALS & DEVICES	4
EEGR 211	INTRO TO DIGITAL LOGIC	3
HUMA 201	INTRO TO HUMANITIES I	3
		18

JUNIOR YEAR (FIRST SEMESTER)

EEGR 305	ELECTROMAGNETICS	4
EEGR 322	DISCRETE SYSTEMS	3
EEGR 317	ELECTRONIC CIRCUITS	4
XXX XXX[2]	APPROVED ELECTIVE/ EEGR 243	3
HUMA 202	INTRO TO HUMANITIES II	3
		17

JUNIOR YEAR (SECOND SEMESTER)

MATH 331[3]	APPLIED PROB & STATS	3
EEGR 390	PRINCIPLES OF DESIGN	2
CEGR 304	ENGINEERING MECHANICS	4
EEGR 4XX[4]	ECE ELECTIVE	3
ECON 211	PRINCIPLES OF ECONOMICS	3
		15

SENIOR YEAR (FIRST SEMESTER)

EEGR 490	SR. DESIGN PROJECT I	1
EEGR 400	INTRO TO PROFESSIONAL PRACTICE	1
EEGR 4XX[4]	ECE ELECTIVE	3
EEGR 4XX[4]	ECE ELECTIVE	3
IEGR 305	THERMODYNAMICS	3
BIOL 101	BIOLOGY	4
		15

SENIOR YEAR (SECOND SEMESTER)

EEGR 491	SR. DESIGN PROJECT II	2
EEGR 4XX[4]	ECE ELECTIVE	3
HIST 350	INTRO TO AFR DIASPORA	3
PHIL 109	INTRO TO LOGIC	3
HUMA XXX	HUMANITIES ELECTIVE	3
		14

TOTAL CREDITS **132**

[1] See section A for approved replacement course.
[2] See sections E and F for approval specification. EEGR 243 is required for the computer engineering track.
[3] See section C for approved replacement courses.
[4] See sections E and F for approved electives.

INDUSTRIAL AND SYSTEMS ENGINEERING

Chairperson of Department: Associate Professor: TRIDIP K. BARDHAN; Professor: SEONG W. LEE; Associate Professor: GUANG-MING CHEN; Assistant Professor: RICHARD A. PITTS, JR; Lecturers: BHEEM KATTEL, MASUD SALIMIAN; Research Associate Professor: LEEROY BRONNER.

THE INDUSTRIAL AND SYSTEMS ENGINEERING PROGRAM

The Industrial and Systems Engineering Program provides students withthe knowledge, skills and tools to design and improve processes, and apply the basic factors of production (people, machines, materials, information, and energy) to make products and deliver goods and services. The program seeks to provide students with a broad array of talents and experiences that would enable them to work in multi-disciplinary and diverse teams to solve a wide variety of problems. At the same time, the program allows for some focus in a concentration area, such as engineering management, manufacturing systems, information and systems engineering, and human engineering systems.

Because industrial production is a critical part of national prosperity and strength, today's industrial engineers are expected to be creative in problem solving, and to work with new and improved production machinery, robots and automation systems, computers, and in general, new technology, to produce high quality goods and services at low cost and/or for the maximum benefit to society.

The technical, socio-economic and cultural nature of industrial engineering problems requires the industrial engineer to be highly skilled in the basic sciences, computers, engineering, and analytical methods, and to have a broad training that encompasses the behavioral sciences, economics and management, human relations, as well as consciousness of the environment.

OBJECTIVES

The objectives of the ISE department are to prepare future leaders in Industrial Engineering with the knowledge, skills and tools:

1. To prepare students to apply an exemplary foundation in the basic sciences, computer technology and engineering methods to solving industrial as well as manufacturing engineering problems.
2. To provide students with the skills to perform industrial engineering design, product design, and analysis, using traditional methods of mechanical, energy and manufacturing engineering.
3. To prepare and train students to work in multi-disciplinary and diverse teams to solve a wide variety of both technical and non-technical problems.
4. To educate students in methods and skills that incorporate proven techniques in human engineering and ergonomics in developing engineering solutions.
5. To prepare students to apply new tools and techniques of computer and information technology to the solution of industrial engineering as well as manufacturing engineering problems.
6. To prepare students to readily communicate complex technical information to a wide variety of audiences in both written and oral form.
7. To provide students with tools to continue their professional development and life-long learning.

REQUIREMENTS FOR THE B.S. DEGREE IN INDUSTRIAL ENGINEERING

All students pursuing the Bachelor of Science degree in Industrial Engineering are required to have earned a minimum of **134** academic credit hours or equivalent, at the completion of their program of study in the Industrial and Systems Engineering (ISE) Department. The minimum required credit-hour breakdown is as follows:

Category	*Credits*
General Education Requirements	49
Science and Mathematics Requirements	30
Industrial Engineering Core Requirements	46
Track Requirements	9
TOTAL	**134**

GENERAL EDUCATION AND UNIVERSITY REQUIREMENTS

Course #	*Course Title*	*Credits*
BIOL 101	Introduction to Biology I	4
CHEM 110	General Chemistry for Eng. Students	5
ECON 211	Principles of Economics I	3
ENGL 101	Freshman Composition I	3
ENGL 102	Freshman Composition II	3
HEED 100	Healthful Living	2
HIST 101	World History I	3
HIST 102	World History II	3

HIST 350	Introduction to the African Diaspora	3
HUMA 201	Introduction to Humanities I	3
HUMA 202	Introduction to Humanities II	3
IEGR 204	Intro to IE & Computers	2
MATH 241	Calculus I	4
OREN 104	Introduction to Engineering I	1
PHEC XXX	Physical Education	1
PHIL 109	Introduction to Logic	3
PHIL 220	Ethics and Values	3
TOTAL		**49**

SCIENCE AND MATHEMATICS REQUIREMENTS

Course #	*Course Title*	*Credits*
CEGR 304	Engineering Mechanics	4
IEGR 251[1]	Probability and Statistics for Engineers-I	3
IEGR 304	Introduction to Programming for IE	3
IEGR 361	Introduction to Linear Programming	3
MATH 242	Calculus II	4
MATH 340	Differential Equations	3
PHYS 205	General Physics I	5
PHYS 206	General Physics II	5
TOTAL		**30**

INDUSTRIAL ENGINEERING CORE REQUIREMENTS

Course #	*Course Title*	*Credits*
IEGR 305	Thermodynamics	3
IEGR 309	Materials Engineering	3
IEGR 317	Solid Modeling and Design-I	3
IEGR 350	Engineering Economy	3
IEGR 351	Probability and Statistics for Engineers-II	3
IEGR 360	Ergonomics and Workplace Design	3
IEGR 363	Manufacturing Processes	3
IEGR 367	Production and Operations Management	3
IEGR 402	Software and Database Design	3
IEGR 410	Simulation of Industrial Systems	3
IEGR 451	Design of Experiments and Introduction to Quality Control	3
IEGR 461	Operations Research, Deterministic Models	3
IEGR 467	Production Analysis and Manufacturing Systems	4
IEGR 480	Product Design	3
IEGR 496[2]	Senior Design I	1
IEGR 498[2]	Senior Design II	2
TOTAL		**46**

[1]May be substituted by MATH 331: Applied Probability and Statistics with the approval of the advisor and department chair.

[2]Consent of project advisor(s) and approval of Department chair are required prior to registration.

INDUSTRIAL AND SYSTEMS ENGINEERING COURSE OFFERINGS

OREN 104 INTRODUCTION TO ENGINEERNG (FRESHMAN ORIENTATION FOR SCHOOL OF ENGINEERING) *Two hours lecture; 1 credit.* This course is designed to prepare students for the rigors of earning an engineering degree. It introduces students to the expectation and demands of higher education, to the legacy and traditions of Morgan State University, to college success strategies, and to the broad array of career opportunities in the fields of engineering. Students enrolled in this class are required to attend selected University convocations, School of Engineering programs, and other prescribed activities. They are also required to hold conferences with their faculty advisors. Students transferring 24 or more credits to the University when admitted are exempt from this requirement. (Formerly ORIE 104). (FALL/SPRING).

IEGR 204 INTRODUCTION TO INDUSTRIAL ENGINEERING AND COMPUTERS *One hour lecture, two hours laboratory; 2 credits*. This course introduces students to the basics of computer usage for engineering problem solving. Topics include: computer internal representation, computer mathematics, Microsoft Office Applications (including Word, Excel, PowerPoint, OneNote and Access), and computer-aided design (CAD). In addition, the course includes an introduction to industrial engineering (IE) as a career, an overview of the IE curriculum at Morgan State University, and an introduction to IE research. **Prerequisite:** Engineering Major. (SPRING).

IEGR 251: PROBABILITY AND STATISTICS FOR ENGINEERS-I - *Three hours lecture; 3 credits.* Includes introduction to statistics and data analysis, importance of probability and statistics to engineers, descriptive statistics, inferential statistics, introduction to probability, probability laws, discrete and continuous random variables and probability distributions, and mathematical expectations. **Prerequisite:** MATH 241 (SPRING).

IEGR 304: INTRODUCTION TO PROGRAMMING FOR IE - *Two hours lecture, two hours laboratory; 3 credits.* This course introduces students to computer-based problem solving and program development fundamentals through the use of a current computer programming environment (e.g., C++, JAVA, C#, etc.). Skills developed in program development include problem/process/program formulation and design, program debugging and pro-

gram implementation. Emphasis is placed on developing applications which utilize engineering/mathematics principles. The final project allows the students to work in teams (as performed in industry) to solve a large, complex problem while employing all skills learned throughout the course. **Prerequisite:** IEGR 204 (FALL).

IEGR 305 THERMODYNAMICS *Three hours lecture, one hour laboratory; 3 credits*. Fundamental thermodynamic concepts, zeroth law of thermodynamics and temperature measurements; work and heat; First law of thermodynamics; properties of pure substances; First Law analysis of some thermodynamic systems; and power and refrigeration systems. **Prerequisites:** PHYS 206 and MATH 242. (FALL/SPRING).

IEGR 309 MATERIALS ENGINEERING *Three hours lecture, two hours laboratory; 3 credits*. Fundamentals of materials including the structure of metals, mechanical behavior, testing, manufacturing properties, and physical properties. Metal alloys including their structure and strengthening by heat treatment. Production, general properties, and use of steels, nonferrous metals, polymers, ceramics, graphite, diamond, and composite materials. **Prerequisites:** CHEM 110 and Junior Standing. **Corequisite:** PHYS 205 (SPRING).

IEGR 317 SOLID MODELING AND DESIGN *Three hours lecture, two hours laboratory; 3 credits*. Introduction to solid modeling and computer-aided design for manufacturing. Students will be exposed to the rudiments of CAD and CAE, and to their applications in the design of products. Extensive discussions on modeling and design to equip students with state-of-the-art tools for product and systems design. **Prerequisite:** IEGR 304. (SPRING).

IEGR 335 INTRODUCTION TO SYSTEMS ENGINEERING AND ANALYSIS *Three hours lecture; 3 credits*. Introduction to systems engineering concepts. Systems structure, open-loop and closed-loop systems, positive and negative feedback. Applications to production and inventory systems, population and physical systems. Analytical foundation of systems engineering, calculus of finite differences, Fourier analysis,and use of transform techniques in linear systems analysis. **Prerequisite:** Math 242. (FALL).

IEGR 350: ENGINEERING ECONOMY - *Three hours lecture; 3 credits.* Concepts of Equivalency. Economic analysis including time value of money, equivalence concept, present, future & annuity concepts with rate of return method, cost/benefit ratios & payback period as tangible methods of project/venture evaluation, Project Priority Ranking, introduction to replacement analysis and depreciation & Tax Influence. **Prerequisites:** IEGR 204, ECON 211 and MATH 241 (FALL/SPRING).

IEGR 351: PROBABILITY AND STATISTICS FOR ENGINEERS-II - *Three hours lecture; 3 credits.* Includes concept of random variables, discrete probability distributions, continuous probability distributions, point estimation, one and two sample hypothesis testing, analysis of variance, completely randomized experiments, randomized complete block experiments, and regression analysis. **Prerequisites:** IEGR 251, MATH 242 and Junior Standing (FALL)

IEGR 360 ERGONOMICS AND WORKPLACE DESIGN *Three hours lecture, one hour laboratory; 3 credits*. This introductory course mainly focuses on occupational as pects of ergonomics. Human motor capabilities and limitations are addressed in the context of work and workplace design. Topics of discussion include anthropometry, work physiology, biomechanics, psychophysics, work methods/standards, time and motion study, the analysis and design of work, tools/equipment, musculoskeletal disorders, and environmental stressors such as noise, vibration, illumination and heat stress. **Prerequisites:** IEGR 251 and PHYS 205. **Corequisite:** IEGR 351 (FALL).

IEGR 361: INTRODUCTION TO LINEAR PROGRAMMING - *Three hours lecture; 3 credits.* Essentials of linear algebra including vectors and matrices manipulations & definitions; matrix operations, determinant of square matrix, inverse of a matrix; quadratic forms, principal minor; convex and concave functions and convex sets. Solving systems of linear equations; plotting linear equations and inequalities, graphical solutions, extreme points and feasible region; introduction to linear programming and formulation of LP models, objective functions and constraints and optimal solutions; Principles of the simplex method; standard form, simplex method in tableau form, finding feasible solutions and performing iterations; computer solutions of LP. **Prerequisite:** MATH 241 and Junior Standing (SPRING).

IEGR 363 MANUFACTURING PROCESSES *Two hours lecture, three hours laboratory; 3 credits*. Defining the role of manufacturing processes in product development and manufacturing. Review of elements of materials engineering as related to manufacturing processes. Introduction of different processes including how they are done, when they are done, what are the tools and equipment required, design considerations, safety, product applica-

tions, and future trend and research interests for each process. Processes covered include casting, rolling, forging, extrusion, and CNC machining (mill & lathe). Other discussions include heat treatment, powder metallurgy, sheet metal forming, plastic and composite processing technology and welding and joining processes. Brief introduction to nontraditional manufacturing processes including mechanical, electrical, thermal and chemical processes. Review of common aspects of manufacturing such as metrology and instrumentation, quality assurance, testing and inspection, human factors engineering, safety, and product liability. **Prerequisite:** IEGR 309. (FALL).

IEGR 367: PRODUCTION AND OPERATIONS MANAGEMENT – *Three hours lecture; 3 credits.* Concepts of design and control of production systems, including organization, plant layout, economic analysis, work methods and measurements, and time and motion study. Design of physical manufacturing systems; integrating material handling systems, site and plant location. Project planning, control and network analysis including PERT/CPM, Crashing and stochastic models. **Prerequisites:** IEGR 350 & IEGR 360 (FALL).

IEGR 401 DESIGN AND ANALYSIS OF EXPERIMENTS *Three hours lecture; 3 credits*. This course covers advanced topics in experimental skills with emphasis on the design and statistical analysis aspects. It addresses single-factor experimental design, analysis of variance (ANOVA), contrasts and orthogonal contrasts, blocks and latin squares, and factorial experiments. It also discusses confounding, 2f and 3f factorial design and fractional factorial design, introduction to orthogonal arrays and Taguchi method. **Prerequisite:** IEGR 251. (FALL).

IEGR 402 SOFTWARE AND DATABASE DESIGN *Three hours lecture, one hour laboratory; 3 credits*. Introduction to the principles of Software and Data-Base Engineering which is applied to the development of Application Software Systems. Systems analysis and design theory will be introduced using Object-Oriented Analysis and Design (OOAD) methodologies. Using the OOAD methodology in conjunction with use-case methods, software applications will be analyzed, modeled and simulated. Emphasis will be placed on students understanding how to diagram system components and their complex relationships. Numerous case studies will be used. **Prerequisite:** IEGR 304. (FALL).

IEGR 406 INDUSTRIAL SAFETY AND HEALTH *Three hours lecture; 3 credits*. Survey of procedures and practices in industrial safety including government regulations (OSHA), life safety, electrical safety, air contamination, noise, radiation, ventilation, illumination, toxicology, and safety engineering organization. **Prerequisite:** Junior or Senior Standing. (FALL).

IEGR 410 SIMULATION OF INDUSTRIALSYSTEMS *Three hours lecture, two hours laboratory; 3 credits*. Introduction to analytic modeling and discrete event simulation of queuing systems with associated statistical concepts. Applications to industrial system modeling include production systems, inventory analysis and other aids to decision making. One simulation language is covered in detail and several others are discussed with animation demonstrated. **Prerequisites:** IEGR 304. **Corequisite:** IEGR 451. (SPRING.)

IEGR 420 INFORMATION SYSTEMS DESIGN *Three hours lecture, one hour laboratory; 3 credits*. Study of information systems development to include design, implementation, evaluation and management based on a standard development of life cycle methodology. Structured analysis and design techniques are introduced. **Prerequisites:** IEGR 304 and Senior Standing. (SPRING).

IEGR 431 QUALITY CONTROL AND RELIABILITY *Three hours lecture; 3 credits*. Introduction to quality control. Review of statistics. Control charts for variables, control charts for attributes. Lot-by-lot acceptance sampling. Economic aspects of quality control. Quality assurance and quality engineering. Introduction to reliability engineering. Failure functions, Weibull distribution, life expectancy and reliability testing. **Prerequisites:** IEGR 350 and IEGR 351. (SPRING).

IEGR 432 INTRODUCTION TO QUALITY ENGINEERING *Three hours lecture; 3 credits*. Engineering and Robust Design. Description: Off-line quality control. Build high quality into products in the design and development stages. Design high-quality products at low production cost by using quality loss function, experimental design, fractional factorial design as well as response surface methods. The objective is to design a product that is robust or less sensitive to manufacturing variations, environmental conditions and deterioration over time. **Prerequisite:** IEGR 431. (FALL).

IEGR 439 ENVIRONMENTAL MANAGEMENT ISSUES *Three hours lecture; 3 credits*. Introduction to major environmental problems in industry. Discussions in environmental ethics/ecology, development of environmental concerns, public policy and the environment, responses to environmental problems including strategies for business/society. Environmental impact in energy conversion/utilization. Case studies include hazardous waste disposal, air and water pollution. **Prerequisite:** Senior Standing. (SPRING).

IEGR 441 STOCHASTIC MODELS OF OPERATIONS RESEARCH *Three hours lecture; 3 credits*. Basic concepts and techniques of stochastic operations research modeling. Topics include Markov chains, queuing theory, inventory systems, reliability, forecasting, decision analysis and introduction to simulation. Applications to engineering problems including the use of computer codes are also covered. **Prerequisite:** IEGR 351 and IEGR 361. (SPRING).

IEGR 446 INTRODUCTION TO SOFTWARE ENGINEERING *Three hours lecture, one hour laboratory; 3 credits*. This course introduces software engineering principles, which includes the body of knowledge, soft ware design, user interface issues, software requirements analysis, software construction, code reuse, software development life cycle, team-based software development, assessing design quality, design reviews and code inspections, software testing, and basic support tools. **Prerequisite:** IEGR 304 and Junior standing. (FALL).

IEGR 450 INTRODUCTION TO MECHATRONICS *Three hours lecture, one hour laboratory; 3 credits*. Introduction to hybrid and integrated systems. Dynamics of mechanical, electrical and electronic, electromechanical, fluid, thermal, and process engineering systems. Modeling and simulation of behavior of mixed systems using math software. Introduction to sensing, actuation and control of industrial systems. **Prerequisites:** CEGR 304 and Senior standing; **Corequisite:** MATH 340. (FALL).

IEGR 451: DESIGN OF EXPERIMENTS AND INTRODUCTION TO QUALITY CONTROL - *Three hours lecture; 3 credits*. Includes Single Factor Experimental Design, Introduction to Factorial Experiments, Blocks and Latin Squares and related Designs, Introduction to Quality Control, Control Charts for Variables and Attributes, The DMAIC Process, Process and Measurement System Capability Analysis, and Different Statistical Process Monitoring and Control Techniques. **Prerequisites:** IEGR 351 and Junior Standing (SPRING).

IEGR 452 PROJECT MANAGEMENT *Three hours lecture and laboratory; 3 credits*. The concept of project planning and organization, project life cycle, project scheduling, organizational forms and conflict resolution will be addressed. The concept of cost, time value of money, rate of return, benefit/cost ratio will be used in project ranking and acceptance. The use of schedule and technical planning and control methods such as WBS and network models as AOA, AON, and CPM/PERT will be stressed. Proposal writing and the use of project management software tools for creating a typical project plan will be explored. **Prerequisites:** IEGR 350, IEGR 351 and IEGR 367. (SPRING).

IEGR 455 MULTIMEDIA INSTRUCTIONAL DESIGN *Three hours lecture, two hours laboratory; 3 credits*. The materials covered include: Delivery technologies, multimedia platforms, peripherals (sound cards, video cards, CDROM, Photo CD, Writeable and Re-writeable CDROM), multimedia in Windows environment, networking, planning, design, content provisions, and production media management, compression data standards (sound, video, image, text), data capture (text, sound, etc.), data administration, software development, authoring tools, pedagogical issues, intellectual property rights, copyright, licensing production, Internet navigation via World Wide Web (Internet Explorer & Netscape), FTP, email, HTML, JAVA, VRML, presentation software, learning styles, teaching methodologies, effective communication, multimedia-based learning, image/sound/ video capturing and manipulation, constructing movies (combining image, video, and sound), story boards, 3-D animation tools (Truespace, 3-D Studio), creating multimedia projects (Director, Premier), authoring tools (Authorware, Toolbook), CD-ROM production, and identification of learning styles. **Prerequisites:** IEGR 304, Junior standing and permission of instructor. (FALL).

IEGR 459 INTRODUCTION TO LOGISTICS MANAGEMENTAND SUPPLY CHAIN *Three hours lecture; 3 credits*. A study on the discipline and philosophy of logistics and supply chain management with the high level strategy design and concepts utilizing the analytical and mathematical tools to solve simultaneous cost reduction and service enhancement problems. Within the strategic framework of supply chain and logistics management, topics like inventory, transportation information and facility oriented philosophies and techniques will be explored as knowledge integration of logistics and supply chain methodologies. **Prerequisites:** IEGR 350 and IEGR 351. **Corequisite:** IEGR 461. (FALL).

IEGR 460 ERGONOMICS AND HUMAN FACTORS *Three hours lecture, one hour laboratory; 3 credits*. This course focuses on human sensory, control, decision and motor systems in the context of auditory, visual, cognitive, and manual task design. Issues with noise, illumination, climate, motion, eye-hand coordination and human control of systems are presented. The principles applied to system, computer display, workplace and vehicle

design are discussed. **Prerequisite:** IEGR 360. (FALL).

IEGR 461: OPERATIONS RESEARCH, DETERMINISTIC MODELS - *Three hours lecture; 3 credits.* Review of simplex method; sensitivity analysis, duality theory and applications in LP; parametric programming, integer programming, goal programming; transportation and assignment problems, network models. **Prerequisite:** IEGR 361; **Corequisite:** IEGR 451 (FALL).

IEGR 467 PRODUCTION ANALYSIS AND MANUFACTURING SYSTEMS *Four hours lecture, one hour laboratory; 4 credits*. Principles and concepts of the design, planning and control of production and manufacturing systems, including Process Technology Design, Manufacturing Lead Time (MLT) Analysis, Process Planning and Design, ComputerAided Process Planning (CAPP), Group Technology (GT) Analysis, Assembly Line Balancing Techniques, Lean Production and Synchronous Manufacturing, Material Requirements Planning (MRP) & Manufacturing Resource Planning (MRP II) concepts, Flow Manufacturing & Just-in-Time (JIT) Concepts, and introduction to Material Handling Systems (MHS) and Facilities Planning. **Prerequisites:** IEGR 360 and IEGR 367. **Corequisite:** IEGR 461. (SPRING).

IEGR 468 ADVANCED MATERIAL HANDLING SYSTEMS *Three hours lecture, one hour laboratory; 3 credits*. Provide the basic understanding of design and control issues involving material handling systems (MHS). Develop a keen awareness for identifying potential cost saving opportunities in material handling applications. Relate material handling systems design requirements for automated manufacturing and warehouse systems. Topics include the following: Facility Location problems, Unit Load Analysis, Automated Guided Vehicle (AGV) Analysis, Robotic Applications, Automated Storage Retrieval System (ASRS) Analysis, Conveyer Analysis, Automated Identification System, and Process Control using Programmable Logic Controllers (PLCs). **Prerequisite:** IEGR 350. (FALL).

IEGR 470 INDUSTRIAL ROBOTICS *Three hours lecture, two hours laboratory; 3 credits*. Principal concepts are the organization and operation of microcomputer-controlled manipulators. Experiments include kinematics, manipulation, dynamics, and trajectory planning and programming language for robots. Applications of computer-controlled robots in manufacturing and programmable automation. **Prerequisites:** IEGR 363 and IEGR 367. (SPRING).

IEGR 478 COMPUTER AIDED MANUFACTURING *Three hours lecture, two hours laboratory; 3 credits*. Introduction to the use of CAM systems, including integration of Computer Aided Design (CAD) in part-design specification and intermediate analysis, Concurrent Engineering (CE), Design for Manufacturing (DFM), Process Engineering, Fixed Automation, Group Technology (GT), Computer Aided Process Planning (CAPP)/Computer Managed Process Planning (CMPP), NC Programming, Computer Numerical Control (CNC), and introduction to electronics manufacturing. **Prerequisites:** IEGR 317, IEGR 350 and IEGR 363. (SPRING).

IEGR 479 ASSEMBLY DESIGN AND PLANNING *Three hours lecture, one hour laboratory; 3 credits*. A study of various topics related to design, planning and fabrication of mechanical assemblies. This includes design for assembly (DFA) principles, joining processes, design of weldments and mechanical fasteners, design for assembly jigs and fixtures, part feeding principles, assembly sequencing and process planning, and planning and control of manual and automated assembly systems. Various format of standard data exchange between assembly phase and total life cycle data and the assembly design principles will be explored. **Prerequisites:** IEGR 317, IEGR 350 and IEGR 363. (FALL).

IEGR 480 PRODUCT DESIGN *Three hours lecture, two hours laboratory; 3 credits*. Dynamics of converting ideas to marketable products. The use of programming skills and numerical tools to support design/redesign of products, in a 3-D solid modeling computer workstation environment. Course covers the trajectory from product idea to design and prototype development and production. Course involves several design experiments, and requires the team design and rapid production of prototypes. **Prerequisites:** IEGR 317 and IEGR 363. (FALL).

IEGR 485 ADVANCED MULTIMEDIA INSTRUCTIONAL DESIGN *Three hours lecture, one hour laboratory; 3 credits.* Internet Navigation via World Wide Web; FTP, E-mail, HTML. JAVA, VRML. Presentation software, teaching methodologies; effective communication; multimedia-based learning. Image/sound/video capturing and manipulation, constructing movies (combining image, video, and sound), story boards, 3-D animation tools (Truespace, 3-D Studio), creating multimedia projects (Director, Premier), authoring tools Authorware, Toolbook, Simple), CD-ROM production, and identification of learning styles. **Prerequisites:** IEGR 455 and Senior standing and/or permission of instructor. (SPRING).

IEGR 488 FLEXIBLE MANUFACTURING SYSTEMS *Three hours lecture, one hour laboratory; 3 credits.* Introduction of Flexible Manufacturing systems (FMS), including manufacturing cells, physical planning, human resources, Just-In-Time (JIT) manufacturing, processing and quality assurance equipment and systems, system support equipment, FMS computer hardware, software, and communication network and FMS installation and implementation aspects. **Prerequisites:** IEGR 317, IEGR 350 and IEGR 363 (SPRING).

IEGR 496: SENIOR DESIGN I - *One hour lecture; 1 credit.* A capstone design course emphasizing analysis and design in a specific industrial engineering problem area under the guidance of a faculty advisor. Students are expected to devote at least six unscheduled hours for each scheduled credit hour for this course. During this phase the student or student team is to identify the problem and analyze optional solutions and submit a written proposal describing how the project is to be executed during the follow-on course IEGR 498. **Prerequisite:** Project Advisor's consent and Department chair's approval (FALL/SPRING).

IEGR 498: SENIOR DESIGN II - *Two hours lecture; 2 credits.* This course is a follow-on execution of the project proposed in course IEGR 496. Students are expected to devote at least six unscheduled hours for each scheduled credit hour for this course. A final written report is required of the students. If a team of students executed the project, each student is required to submit a report describing the special aspects of the project executed by the student. An oral presentation of the project and its results is also required. The report should contain a summary of data and analysis that led to the design recommendation. *Students are also required to pass an IE comprehensive exam*. **Prerequisites:** IEGR 496, and project advisor's consent and Department chair's approval. (FALL/SPRING).

IEGR 499 SPECIAL TOPICS *3 hours lecture, 0-3 hours laboratory (as needed); 3 credits*. In-depth study of recent advances in specific areas of student/ faculty interest. **Prerequisites:** Advisor's consent and Department chair's approval. (FALL/SPRING)

MORGAN STATE UNIVERSITY
SCHOOL OF ENGINEERING
INDUSTRIAL ENGINEERING
CURRICULUM SEQUENCE

FRESHMAN YEAR (FIRST SEMESTER)

BIOL 101	INTRODUCTION TO BIOLOGY	4
ENGL 101	FRESHMAN COMPOSITION I	3
HEED 100	HEALTHFUL LIVING	2
HIST 101	WORLD HISTORY I	3
MATH 241	CALCULUS I	4
OREN 104	INTRO TO ENGINEERING I	1
		17

SOPHOMORE YEAR (FIRST SEMESTER)

CHEM 110	GENERAL CHEMISTRY FOR ENGINEERS	5
IEGR 300	INTRO TO PROGRAMMING FOR IE	3
PHEC XXX	PHYSICAL EDUCATION	1
ECON 211	PRINCIPLES OF ECONOMICS I	3
PHYS 206	GENERAL PHYSICS II	5
		17

JUNIOR YEAR (FIRST SEMESTER)

HUMA 201	INTRO TO HUMANITIES	3
IEGR 350	ENGINEERING ECONOMY	3
IEGR 351	PROBABILITY AND STATS FOR ENGINEERS II	3
IEGR 360	ERGONOMICS AND WORKPLACE DESIGN	3
IEGR 363	MANUFACTURING PROCESSES	3
MATH 340	DIFFERENTIAL EQUATIONS	3
		18

SENIOR YEAR (FIRST SEMESTER)

PHIL 220	ETHICS AND VALUES	3
IEGR 367	PRODUCTION AND OPERATIONS MANAGEMENT	3
IEGR 461	OPERATIONS RESEARCH, DETERMINISTIC MODELS	3
IEGR 480	PRODUCT DESIGN	3
IEGR 496	IE SENIOR DESIGN I	1
IEGR XXX	IE CONCENTRATION REQUIREMENT	3
		16

FRESHMAN YEAR (SECOND SEMESTER)

ENGL 102	FRESHMAN COMPOSITION II	3
HIST 102	WORLD HISTORY II	3
IEGR 200	INTRO TO COMPUTERS & INDUSTRIAL ENGINEERING	2
MATH 242	CALCULUS II	4
PHYS 205	GENERAL PHYSICS I	5
		17

SOPHOMORE YEAR (SECOND SEMESTER)

CEGR 304	ENGINEERING MECHANICS	4
IEGR 309	MATERIALS ENGINEERING	3
IEGR 361	INTRODUCTION TO LINEAR PROGRAMMING	3
IEGR 305	THERMODYNAMICS	3
IEGR 251	PROBABILITY AND STATS FOR ENGINEERS I	3
		16

JUNIOR YEAR (SECOND SEMESTER)

HUMA 202	INTRO TO HUMANITIES II	3
IEGR 317	SOLID MODELING & DESIGN	3
IEGR 402	SOFTWARE AND DATABASE DESIGN	3
IEGR 410	SIMULATION OF INDUSTRIAL SYSTEMS	3
IEGR 451	DESIGN OF EXPERIMENTS & INTRODUCTION TO QUALITY CONTROL	3
PHIL 109	INTRODUCTION TO LOGIC	3
		18

SENIOR YEAR (SECOND SEMESTER)

HIST 350	INTRO TO THE AFR DIASPORA	3
IEGR 467	PROD ANALYSIS & MANUFACTURING SYSTEMS	4
IEGR 498	IE SENIOR DESIGN II	2
IEGR XXX	IE CONCENTRATION REQUIREMENT	3
IEGR XXX	IE CONCENTRATION REQUIREMENT	3
		15

TOTAL CREDITS **134**

INDUSTRIAL ENGINEERING TRACK REQUIREMENTS

INDUSTRIAL & MANAGEMENT SYSTEMS TRACK

Any ***three*** courses from the following with advisor's approval:

COURSE #	COURSE TITLE	CREDITS
IEGR 335	Intro Systems Engineering & Analysis	3
IEGR 401	Design and Analysis of Experiment	3
IEGR 406	Industrial Safety and Health	3
IEGR 432	Introductions to Quality Engineering	3
IEGR 439	Environmental Management Issues	3
IEGR 441	Stochastic Models of Operations Research	3
IEGR 452	Project Management	3
IEGR 455	Multimedia Instructional Design	3
IEGR 468	Advanced Material Handling Systems	3
IEGR 470	Industrial Robotics	3
IEGR 499	Special Topics	3

MANUFACTURING SYSTEMS TRACK

Any ***three*** courses from the following with advisor's approval:

COURSE #	COURSE TITLE	CREDITS
IEGR 452	Project Management	3
IEGR 470	Industrial Robotics	3
IEGR 478	Computer Aided Manufacturing	3
IEGR 479	Assembly Design and Planning	3
IEGR 488	Flexible Manufacturing Systems	3
IEGR 499	Special Topics	3

INFORMATION AND SYSTEMS ENGINEERING TRACK

Any ***three*** courses from the following with advisor's approval:

COURSE #	COURSE TITLE	CREDITS
IEGR 335	Introduction to Systems Engineering and Analysis	3
IEGR 420	Information Systems Design	3
IEGR 446	Introductions to Software Engineering	3
IEGR 452	Project Management	3
IEGR 455	Multimedia Instructional Design	3
IEGR 485	Advanced Multimedia Instructional Design	3
IEGR 499	Special Topics	3

HUMAN ENGINEERING SYSTEMS TRACK

COURSE #	COURSE TITLE	CREDITS
Any ***three*** courses from the following with advisor's approval:		
IEGR 335	Introduction to Systems Engineering and Analysis	3
IEGR 406	Industrial Safety and Health	3
IEGR 439	Environmental Management Issues	3
IEGR 452	Project Management	3
IEGR 460	Ergonomics and Human Factors	3
IEGR 499	Special Topics	3

TRANSPORTATION AND URBAN INFRASTRUCTURE STUDIES

Chairperson of Department: PROFESSOR ANTHONY A. SAKA; Associate Professor: YOUNG-JAE LEE; Assistant Professor MANSOUREH JEIHANI.

THE MAJOR IN TRANSPORTATION SYSTEMS

The Department of Transportation and Urban Infrastructure Studies provides a program of study designed to provide a curriculum that will adequately prepare the students for entry-level professional positions or for pursuing advanced studies in transportation engineering, planning, management, and distribution logistics.

The B.S. degree program in Transportation Systems is uniquely structured to provide applied science and experiential training that encompasses transportation planning, management, engineering, and distribution logistics. The program is designed to produce graduates with a broad technical background suitable for pursuing advanced studies in transportation-related fields or tackling the interdisciplinary technical challenges facing today's transportation professionals. The program differs from the traditional undergraduate engineering track by requiring fewer core courses in mathematics and general engineering, and more courses in econometrics, planning, management, and systems analysis.

REQUIREMENTS FOR THE B.S. DEGREE IN TRANSPORTATION SYSTEMS

A minimum of 129 credit hours are required to graduate with a B.S. degree in Transportation Systems (B.S.T.S.) These credit hours are distributed as follows:

General Ed & University Requirements	48
Mathematics & Science Requirements	19
Transportation Requirements	62
TOTAL	**129**

A. General Education and University Requirements

Course #	*Course Title*	*Credits*
BIOL 101	Introduction to Biology	4
CHEM 110	General Chemistry for Engineers	4
ECON 212	Principles of Economics II	3
ENGL 101	Freshman Composition I	3
ENGL 102	Freshman Composition II	3
GENL 201	Computer Literacy, Technology, Society & Human Values	2
HEED 100	Healthful Living	2
HIST 101/105	World History I/US History I	3
HIST 102/106	World History II/ US History II	3
HIST 350	Intro to African Diaspora	3
HUMA 201	Intro to Humanities I	3
HUMA 202	Intro to Humanities II	3
MATH 113	Intro to Math Analysis I	4
OREN 104	Intro to Engineering	1
PHEC XXX	Physical Ed Elective	1
PHIL 109	Introduction to Logic	3
PHIL 220	Ethics and Values	3
Total Credits		**48**

B. Mathematics and Science Requirements

Course #	*Course Title*	*Credits*
MATH 118	Finite Mathematics	3
MATH 114	Intro to Math Analysis II	4
INSS 220 or MATH 205	Anal Dec Making Bus Mgmt or Statistics & Discrete Math	3
MATH 241	Calculus I	4
PHYS 205	Physics I	5
Total Credits		**19**

C. Major Requirements

Course #	*Course Title*	*Credits*
ENGL 355/357	Technical or Business Writing	3
GEOG 309	Urban Land Use	3
TRSS 105	Seminar on Professional Practice I	1
TRSS 205	Seminar on Professional Practice II	1
TRSS 301	Intro to Transportation Systems	3
TRSS 307	Freight Transportation Systems & Logistics	3
TRSS 318	Transportation Planning & Policy	3
TRSS 319	Geographic Information Systems	3
TRSS 399	Transportation Practicum	3
TRSS 402	Transportation Economics	3
TRSS 406	Public Transportation Systems	3
TRSS 408	Advanced Logistics Systems	3
TRSS 410	Management of Transportation Systems or	
MGMT XXX	Approved Management Elective	3
TRSS 412	Transportation Infrastructure/Asset Management	3
TRSS 414	Traffic Engineering	3
TRSS 415	Highway Engineering	3
TRSS 416	Microcomputer Applications in Transportation	3
TRSS 417	Intelligent Transportation Systems	3
TRSS 418	Advanced Transportation Planning	3
TRSS 420	Transportation Systems Evaluation	3
TRSS 499	Senior Transportation Project	3
XXX	Approved Elective	3
Total Credits		**62**

OREN 104 – INTRODUCTION TO ENGINEERING – *One hour lecture, 1 credit.* This course is designed to prepare students for the rigors of earning an engineering degree. It introduces students to the expectation and demands of higher education, to the legacy and traditions of Morgan State University, to college success strategies, and to the broad array of career opportunities in the fields of engineering. Students enrolled in this class are required to attend selected University convocations, School of Engineering programs, and other prescribed activities. They are also required to hold conferences with their faculty advisors. Students transferring 24 or more credits to the University when admitted are exempt from this requirement. (Formerly ORIE 104). (FALL/SPRING).

TRSS 105/205 SEMINAR ON PROFESSIONAL PRACTICE – *One hour lecture; 1 credit each.* This is a seminar arrangement intended to continually arouse the interest of first-year students in transportation and maintain their interaction with the transportation faculty and transportation professionals as they take the majority of courses outside the department to satisfy the general education requirement. The seminar will involve presentations on professional ethics, current and future state of the transportation profession, and roles of the different transportation modal agencies by invited guests from the public and private sectors. (OFFERED AS NEEDED).

TRSS 301 INTRODUCTION TO TRANSPORTATION SYSTEMS – *Three hours lecture; 3 credits.* This is the introductory course for transportation systems. It will discuss the basic concepts and strategies in the study of systems, key issues pertaining to the different areas of transportation including planning, engineering, management, and logistics. The historical, physical, economic, social, and environmental aspects of transportation will be covered. (OFFERED AS NEEDED).

TRSS 307 FREIGHT TRANSPORTATION SYSTEMS AND LOGISTICS – *Three hours lecture; 3 credits.* The course will provide basic concepts of supply chain management, including customer service, transportation, inventory, location theory, etc. The relationship between components of supply chain management is also examined. **Prerequisite**: TRSS 301 or permission of the instructor. (OFFERED AS NEEDED).

TRSS 318 TRANSPORTATION PLANNING AND POLICY – *Three hours lecture; 3 credits.* This course will cover the relationship between land use and transportation, landmark transportation planning-related policies, traditional four-step planning process and the respective mathematical models and algorithms, noise and air quality issues, and transportation systems capacity analysis. **Prerequisite**: TRSS 301 or permission of the instructor. (OFFERED AS NEEDED).

TRSS 319 GEOGRAPHIC INFORMATION SYSTEMS (GIS) – *Three hours lecture; 3 credits.* This course will expose the student to the concept of spatial analysis using GIS tools. Topics covered will include GIS need assessment, mapping of spatial entities, linear referencing, development of a GIS-based decision support system, and applications in asset management and planning. **Prerequisite**: GENL 201 or higher. (OFFERED AS NEEDED).

TRSS 399 TRANSPORTATION PRACTICUM – *Nine hours; 3 credits.* This course will provide practical experience in the field of transportation by placement with a transportation agency or a faculty mentor. The student will have the opportunity to work on and complete a real project under the direct supervision of a transportation planner, engineer, manager, or faculty for a minimum period of three months. **Prerequisite**: Junior status. (OFFERED AS NEEDED).

TRSS 402 ECONOMICS OF TRANSPORTATION – *Three hours lecture; 3 credits.* This course reinforces the microeconomic tools necessary for understanding, analyzing, and managing transportation firms and industries. The subjects covered will include costs, pricing behavior, inter-modal competition, and strategic decision making. **Prerequisite**: ECON 212. (OFFERED AS NEEDED).

TRSS 406 PUBLIC TRANSPORTATION SYSTEMS – *Three hours lecture; 3 credits.* The role of the various types of public transportation systems including bus, rail, and other new modes will be examined. The technology, planning, operation, management, and policy aspects of public transportation will be covered. **Prerequisite**: TRSS 301 or permission of the instructor. (OFFERED AS NEEDED).

TRSS 408 ADVANCED LOGISTICS AND SUPPLY CHAIN MANAGEMENT – *Three hours lecture; 3 credits.* This course will offer in-depth analytical tools for supply chain management, including linear programming, manufacturing procedures, network analysis, inventory management, location theory, etc. The course will comprise computer applications, case studies and seminars.

Prerequisite: TRSS 307. (OFFERED AS NEEDED).

TRSS 410 MANAGEMENT OF TRANSPORTATION SYSTEMS – *Three hours lecture; 3 credits.* This course will discuss managerial issues and problems in the transportation industries, including economic, marketing, operational, financial, labor relations, and institutional components.

TRSS 412 TRANSPORTATION INFRASTRUCTURE/ASSET MANAGEMENT – *Three hours lecture; 3 credits*. This course will be designed to discuss the use of geo-spatial analytical tools, inventory control and equipment replacement models to develop decision support systems for making informed decisions in maintaining and replacing transportation infrastructure and assets. **Prerequisite:** TRSS 319. (OFFERED AS NEEDED).

TRSS 414 TRAFFIC ENGINEERING – *Three hours lecture; 3 credits.* This course will cover the basic concept of traffic flow theory, collection and analysis of traffic data, level of service concept, capacity analysis of interrupted and uninterrupted flows, traffic control devices, accident analysis and countermeasures, traffic impact studies, and pedestrian and parking facilities analysis. **Prerequisite:** MATH 241. (OFFERED AS NEEDED).

TRSS 415 HIGHWAY ENGINEERING – *Three hours lecture; 3 credits*. This course will be designed to provide the basic concept of highway systems performance analysis and design. Topics covered will include human factors; vehicle and roadway characteristics; engineering properties of highway materials; highway geometric, structural and drainage design; and capacity analysis of freeway, multilane and two-lane highways. **Prerequisite:** MATH 241. (OFFERED AS NEEDED).

TRSS 416 MICROCOMPUTER APPLICATIONS IN TRANSPORTATION – *Three hours lecture; 3 credits*. This course will discuss a collection of state-of-the-art software packages that are commonly used in the different transportation professional areas including the Highway Capacity Software (HCS), and software for traffic engineering, transportation planning and distribution logistics. **Prerequisite:** TRSS 301. (OFFERED AS NEEDED).

TRSS 417 INTELLIGENT TRANSPORTATION SYSTEMS – *Three hours lecture; 3 credits.* This course will be designed to expose the student to the role of new technology in transportation, particularly in the areas of travel information, traffic and incident management, public transportation, freight transportation, and inventory control. The history and cross cutting issues in intelligent transportation systems deployment in the U.S. will be examined. **Prerequisite:** TRSS 301. (OFFERED AS NEEDED).

TRSS 418 ADVANCED TRANSPORTATION PLANNING – *Three hours lecture; 3 credits.* The course will reinforce the subjects covered in the Transportation Planning course with case studies and hands-on applications. Discussions will include the 3-C process, travel demand simulation, transportation plan development and project programming, noise and air quality analysis, and environmental justice. **Prerequisite:** TRSS 318. (OFFERED AS NEEDED).

TRSS 420 TRANSPORTATION SYSTEMS EVALUATION – *Three hours lecture; 3 credits.* This course will focus on analytical methods commonly used in transportation planning. Discussions will include transit, highway and traffic-intersection capacity analysis, the transportation planning process, benefit-cost analysis, and environmental impact assessment process. **Prerequisite:** TRSS 301 and junior standing. (OFFERED AS NEEDED).

TRSS 499 SENIOR TRANSPORTATION PROJECT – *Three hours lecture; 3 credits.* This course will provide the student the opportunity to apply engineering, planning, and management tools in defining and solving a credible transportation problem, and presenting a final report to a panel of faculty members and invited transportation professionals. Prerequisite: senior status. (OFFERED AS NEEDED).

MORGAN STATE UNIVERSITY
SCHOOL OF ENGINEERING
TRANSPORTATION SYSTEMS
CURRICULUM COURSE SEQUENCE

FRESHMAN YEAR (FIRST SEMESTER)

ENGL 101	FRESHMAN COMPOSITION I	3
BIOL 101	INTRODUCTION TO BIOLOGY	4
HIST 101/105	WORLD HISTORY/US HISTORY I	3
OREN 104	INTRO TO ENGINEERING	1
MATH 113	INTRO TO MATH ANALYSIS I	4
PHEC XXX	PHYSICAL EDUCATION	1
		16

SOPHOMORE YEAR (FIRST SEMESTER)

ECON 212	PRINCIPLES OF ECONOMICS II	3
MATH 114	FINITE MATHEMATICS	3
CHEM 110	GEN CHEM FOR ENGINEERS	4
HUMA 201	INTRO TO HUMANITIES I	3
PHIL 109	INTRODUCTION TO LOGIC	3
		16

JUNIOR YEAR (FIRST SEMESTER)

MATH 241	CALCULUS I	4
TRSS 406	PUBLIC TRANSPORTATION SYS	3
TRSS 318	TRANSP PLANNING & POLICY	3
TRSS 319	GEOGRAPHIC INFO SYSTEMS	3
HIST 350	INTRO TO AFR DIASPORA	3
		16

JUNIOR YEAR (SUMMER)

TRSS 399	TRANSPORTATION PRACTICUM	3
		3

SENIOR YEAR (FIRST SEMESTER)

TRSS 403	TRANSPORTATION ECONOMICS	3
TRSS 415	HIGHWAY ENGINEERING	3
TRSS 408	ADVANCED LOGISTICS SYS	3
TRSS 410 or	MGMT OF TRANSP SYS or	
MGMT XXX	APPROVED MGT ELECTIVE	3
ENGL 355 or	TECHNICAL WRITING or	
ENGL 357	BUSINESS WRITING	3
		15

FRESHMAN YEAR (SECOND SEMESTER)

TRSS 105	SEMINAR PROF PRACTICE I	1
ENGL 102	FRESHMAN COMPOSITION II	3
HIST 102/106	WORLD HISTORY/US HISTORY II	3
MATH 114	INTRO TO MATH ANALYSIS II	4
XXX	APPROVED ELECTIVE	3
HEED 100	HEALTHFUL LIVING	2
		16

SOPHOMORE YEAR (SECOND SEMESTER)

INSS 220 or	ANAL DEC MAKING BUS/MGMT or	
MATH 205	PROBABILITY, STATISTICS & DISCRETE MATHEMATICS	3
TRSS 301	INTRO TO TRANSP SYSTEMS	3
HUMA 202	INTRO TO HUMANITIES II	3
GEOG 309	URBAN LAND USE	3
GENL 201	COMPUTER LITERACY	2
TRSS 205	SEMINAR ON PROFESSIONAL PRACTICE II	1
		15

JUNIOR YEAR (SECOND SEMESTER)

TRSS 414	TRAFFIC ENGINEERING	3
TRSS 307	FREIGHT TRANSPORTATION SYSTEMS & LOGISTICS	3
TRSS 417	INTELLIGENT TRANS SYS	3
PHIL 220	ETHICS AND VALUES	3
PHYS 205	PHYSICS I	5
		17

SENIOR YEAR (SECOND SEMESTER)

TRSS 418	ADV TRANS PLANNING	3
TRSS 416	COMPUTER APPS/TRANSP	3
TRSS 412	TRANSP INFRA./ASSET MGMT	3
TRSS 420	TRANS SYSTEMS EVALUATION	3
TRSS 499	SENIOR TRANSP PROJECT	3
		15

TOTAL CREDITS **129**