

MARYLAND HIGHER EDUCATION COMMISSION  
ACADEMIC PROGRAM PROPOSAL

PROPOSAL FOR:

- NEW INSTRUCTIONAL PROGRAM  
 SUBSTANTIAL EXPANSION/MAJOR MODIFICATION  
 COOPERATIVE DEGREE PROGRAM  
 WITHIN EXISTING RESOURCES or  REQUIRING NEW RESOURCES

*(For each proposed program, attach a separate cover page. For example, two cover pages would accompany a proposal for a degree program and a certificate program.)*

Morgan State University  
Institution Submitting Proposal

August 2018  
Projected Implementation Date

B.S.  
Award to be Offered

Transportation Systems Engineering  
Title of Proposed Program

099900  
Suggested HEGIS Code

14.0804  
Suggested CIP Code

Transportation & Urban Infrastructure Studies  
Department of Proposed Program

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Signature and Date

2/15/18

President/Chief Executive Approval

Date

Date Endorsed/Approved by Governing Board

## **A. Centrality to institutional mission statement and planning priorities**

### **1. Program Description and Relation to Morgan's Mission**

The Department of Transportation and Urban Infrastructure Studies (TUIS) at Morgan State University is the only academic department in the State of Maryland that is exclusively committed to transportation education and research. Established in 1981 as the Center for Transportation Studies, the Department currently offers programs leading to the B.S. degree in transportation systems, post baccalaureate certificate (PBC) in urban transportation, M.S. degree in urban transportation, and Ph.D. degree in transportation and urban infrastructure systems. The B.S. degree in transportation systems, established in 2009 and fully accredited in 2013 by ABET, Inc. Applied Science Accreditation Commission (ASAC), combines engineering, planning, logistics and management and currently enrolls approximately 65 full-time students. Graduates of the B.S. in transportation systems work in the public and private sectors nationwide as transportation planners, transit engineers, safety specialists, logistics analysts, etc. The success enjoyed by graduates of the existing applied science program and the high level of interest from existing and prospective students have engendered the urgency to expand the undergraduate transportation program to include a B.S. degree program in transportation systems engineering (TSE) which, in contrast to the existing B.S. degree program in transportation systems, will create a pathway for a highly trained and specialized workforce in the field of transportation to pursue the professional engineering (PE) licensure. Specifically, the proposed TSE program will provide students the requisite engineering foundation for eligibility to take the fundamentals of engineering (FE) certification examination which leads to the PE registration while gaining necessary exposure to the core areas of transportation engineering, including planning, design, operations analysis, and management. In contrast to civil engineering programs, which offer limited exposure to transportation at the undergraduate level by requiring only one or two core courses in transportation, the proposed TSE program, akin to the existing transportation systems program, will require more than 12 core transportation courses, covering the major areas of traffic operations, transportation planning, transportation infrastructure management, and distribution logistics.

The proposed TSE program will support the university mission by:

- Providing quality teaching, experiential learning, research, and service for the citizens of the state, with a special emphasis on meeting the needs of culturally diverse and multi-ethnic populations living in urban Baltimore as well as in other urban centers within the state and the nation;
- Enrolling an academically diverse student population, including some who might not otherwise attend a college or university, in a program that is informed by diversity relating to experiences of race, ethnicity, gender, class, sexuality, ability or other markers of identity;
- Increasing the number of minorities in fields in which they are underrepresented; and
- Training the workforce of Baltimore City and Maryland in professions essential to the economic, political, educational, social and/or cultural well-being of the city, state and nation.

## **2. Support of Morgan's Strategic Goals**

The proposed TSE program supports Goals 1 and 5 outlined in the 2011-2021 Strategic Plan for Morgan State University.

**Goal 1 Enhancing Student Success:** This program will enhance student success by creating a pipeline of well-qualified, experienced undergraduate students in transportation who qualify for engineering licensure examination and are poised to pursue advanced studies in engineering.

**Goal 5 Engaging with the Community:** The TUIS Department has been an integral part of the Baltimore community since 1981, having developed a legacy partnership with local and state agencies/companies, including the modal agencies of the Maryland Department of Transportation, Baltimore City Government, Northrop Grumman Corporation, Century Engineering, and Parsons Brinkerhoff, just to mention a few. This partnership offers students and graduates employment/internship opportunities to hone their skills, and renders needed technical and sundry assistance to the Baltimore community. It is anticipated that the proposed TSE program will further reinforce the existing symbiotic partnership with the Baltimore Community.

## **B. Critical and compelling regional or Statewide need as identified in the State Plan**

### **1. Need for the Program as Defined in the State Plan**

Transportation offers employment opportunities in a wide variety of public and private organizations including transportation/engineering consulting firms, colleges/universities, public transportation agencies at all levels of government, regional and city planning commissions, regional planning agencies, airlines, and railroad and shipping companies. The demand for well-trained transportation engineers, planners, and managers continues to grow as the nation emphasizes the development of energy-efficient, economically, and socially and environmentally acceptable transportation systems. Emerging interest in connected and autonomous vehicles and the rejuvenation of the nation's transportation infrastructure have created countless possibilities for future graduates of the proposed TSE program.

The rationale for the proposed program is two-fold:

**1. One, to strengthen the job outlook and career advancement potential for undergraduates in the Transportation and Urban Infrastructure Program at Morgan State University.** This program is built upon feedback from current students, alumni and employers. Current students, particularly those from international backgrounds, expressed the desire to have a transportation-focused program in engineering. Past alumni expressed difficulty in obtaining transportation engineering positions due to Human Resources filtering processes that look for key words such as engineering as opposed to the strength of curriculum. Lastly, employers, though pleased with the transportation rigor offered by the curriculum, want entry-level employees to pass the Fundamental of Engineering exam which requires ABET engineering program accreditation. Thus, notwithstanding their excellent training, the majority of graduates of the existing B.S. program in transportation systems desiring to pursue a career path in engineering are denied such opportunity. The proposed TSE program, which will be accredited by ABET, Inc. Engineering Accreditation

Commission (EAC), will provide graduates unconstrained access to transportation and related jobs.

**2. A second rationale for the proposed program is its importance to minority achievement in Engineering and Applied Science at both national and state levels.** The University leads all other campuses in Maryland in the number of bachelor's degrees awarded to African Americans in Engineering, and consistently ranks among the national leaders in the production of African Americans receiving their degrees in Engineering. In addition, the Department of Transportation and Urban Infrastructure Studies at Morgan State University is the only known academic department nationwide to offer three degrees (B.S., M.S., and Ph.D.) in transportation; and considered a pioneer in offering an ABET, Inc. accredited undergraduate transportation degree. The proposed TSE program will further strengthen the University's position as not only a national leader in transportation education and research but also a one-stop transportation development center.

## **2. Consistency with Maryland State Plan for Postsecondary Education**

The 2013-2017 Maryland State Plan for Postsecondary Education identified six overarching goals addressed, in part, by the proposed BST/MST program in Transportation Systems Engineering:

1. Quality and Effectiveness
2. Access, Affordability, and Completion
3. Diversity
4. Innovation
5. Economic Growth and Vitality
6. Data Use and Distribution

The proposed TSE program addresses the majority of the goals in the Maryland State Plan for Postsecondary Education as demonstrated below.

- *Quality and Effectiveness:* The proposed TSE program (similar to the existing B.S. in transportation systems program) is developed by leveraging over thirty-five years of experience in providing top-notch education and training in urban transportation. Since the inception of the first transportation program (M.S. in urban transportation) at Morgan State University in 1981, over 350 young men and women have received their undergraduate and/or graduate transportation degrees; the majority of them are occupying responsible positions in the private and public sectors nationwide.
- *Access, Affordability, and Completion:* Morgan State University provides one of the most affordable engineering degrees in the state, rendering it accessible to students from historically minority and economically disadvantaged communities.
- *Diversity:* Morgan State University has a proven track record of educating African American youth, the largest racial/ethnic minority in the State. In addition, the university is equipped for the influx in Hispanic and international students by leveraging its decades of experience in educating first-generation college students, and promoting cultural/racial/religious diversity.

- *Innovation:* The proposed TSE program is a novel effort to mainstream the education and training of students in a dynamic, non-traditional undergraduate field of transportation engineering which historically is treated as a graduate-level civil engineering specialty track. With the proposed program, undergraduate students interested in a transportation engineering career will no longer be burdened with pursuing a proxy field like civil engineering that provides students with a rudimentary exposure to transportation engineering.
- *Economic Growth and Vitality:* Science, Technology, Engineering and Mathematics (STEM): The proposed TSE program cultivates a diverse body of transportation engineering and related practitioners to support the State and, indeed, national STEM workforce needs.
- *Data Collection and Distribution:* Pedagogical and student performance data collected will be shared with other academic institutions and transportation engineering professional organizations to advance the body of knowledge.

In summary, the proposed program addresses the critical and compelling statewide, regional and even national need to increase the representation of qualified minorities in a field such as transportation and infrastructure studies through the teaching and career advancement opportunities offered by the curriculum.

## **C. Quantifiable & reliable evidence and documentation of market supply & demand in the region and State**

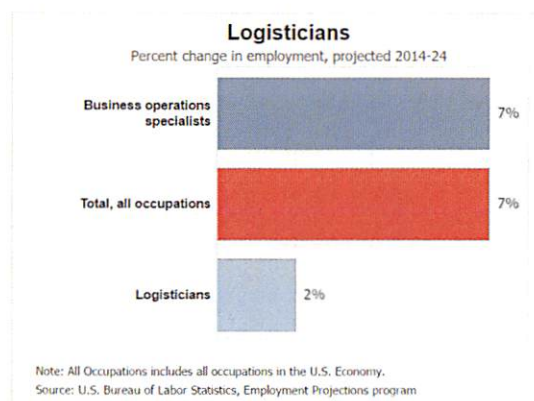
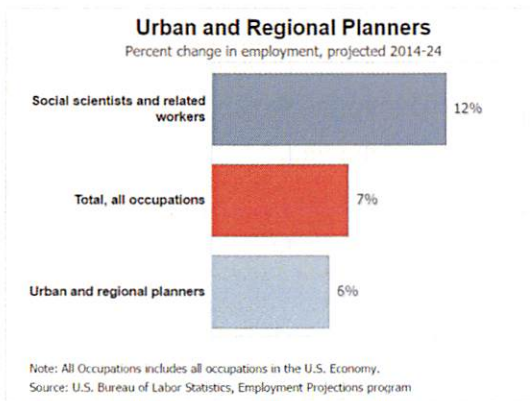
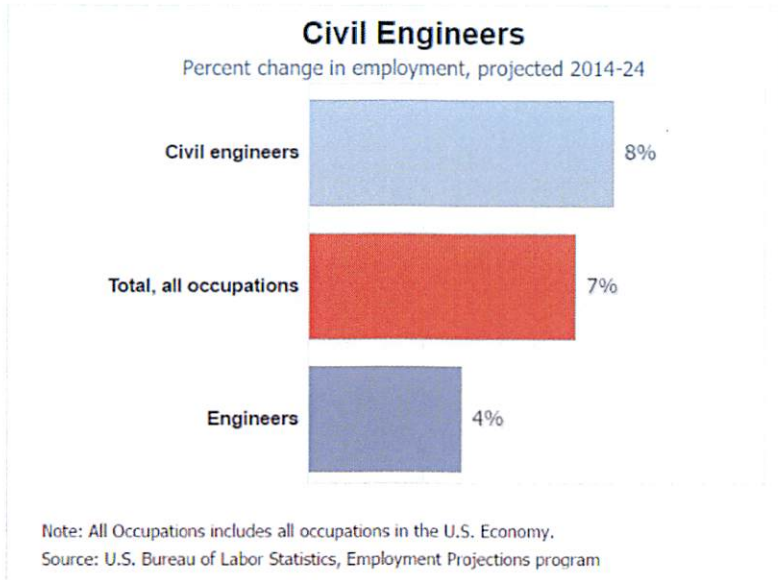
### **1. Market Demand and Availability of Job Openings**

According to the 2014 U.S. Labor Statistics, transportation constitutes approximately 9 percent of the total U.S. workforce. In other words, 9 out of every 100 jobs in the U.S. is transportation related. The recently passed Fixing America's Surface Transportation (FAST) Act has reinforced the importance of transportation for national vitality and security. The Trump administration has pledged to uphold the critical importance of transportation to the nation's economic viability by promising to invest heavily in transportation infrastructure, which has garnered bipartisan support. Thus, employment opportunities in transportation and related areas, including civil engineering, urban and regional planning, and logistics, appear very solid even in the current economic situation (see Exhibit 1).

A prevailing belief is that as long as there is a need to safely and efficiently move people and goods from points of origin to points of destination, there will be employment opportunities in transportation. In addition, the transportation industry is historically not vulnerable to the large-scale outsourcing prevalent in several U.S. industries, and depends mostly on the domestic workforce.

Exhibit 1: Bureau of Labor Statistics Job Outlook Summary for Transportation Related Fields

Field	Median Salary	Number of Jobs in 2014	2014-2024 growth rate
Civil Engineers <sup>1</sup>	\$82,220	281,400	8%
Urban & Regional Planning <sup>2</sup>	\$68,220	38,000	6%
Logisticians <sup>3</sup>	\$74,260	130,400	2%



<sup>1</sup> Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Civil Engineers, on the Internet at <https://www.bls.gov/ooh/architecture-and-engineering/civil-engineers.htm> (visited February 24, 2017).

<sup>2</sup> Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Urban and Regional Planners, on the Internet at <https://www.bls.gov/ooh/life-physical-and-social-science/urban-and-regional-planners.htm> (visited February 24, 2017).

<sup>3</sup> Bureau of Labor Statistics, U.S. Department of Labor, *Occupational Outlook Handbook, 2016-17 Edition*, Logisticians, on the Internet at <https://www.bls.gov/ooh/business-and-financial/logisticians.htm> (visited February 24, 2017).



According to Recruiter<sup>4</sup>, “the overall job outlook for Transportation Engineers has been positive since 2004, and the demand is expected to go up with an expected 96,780 new jobs filled by 2018, representing an annual increase of 4.86 percent over the next few years.” Moreover according to Career Trends<sup>5</sup>, transportation engineering employment will grow by 8.4 percent by 2024, and the current average annual salary of \$87,940 places it in the top 25 percent of careers by salary.

The success enjoyed by the graduates of Morgan’s transportation program serves as anecdotal evidence of the solid market demand for well-trained transportation specialists. For example, approximately 80 percent of the graduates of the applied science undergraduate program in transportation systems received transportation-related job offers within the first year of graduation despite their difficulty accessing some aspects of transportation engineering jobs because of human resource practices that use degree type as opposed to training received to screen applicants for transportation engineering jobs. It is anticipated that graduates of the proposed TSE (transportation systems engineering) program will achieve a rate higher than the 80 percent first-year employment rate enjoyed by graduates of the applied science program in transportation systems, as they will have access to a broader market segment, including transportation engineering jobs that exclude non-engineers.

## **2. Educational and Training Needs and Anticipated Vacancies**

The Transportation Systems Engineering Program trains a high-caliber cadre of students interested in transportation engineering. Unlike civil engineering programs, this program trains students in an array of transportation applications including engineering, planning, logistics and management while providing a general engineering foundation. The combination of specialized transportation training coupled with a broad engineering foundation allows graduates to sit for the Fundamental of Engineering and Professional Engineering examinations.

Many students have expressed an interest in the program. Our undergraduate Transportation Systems program has seen an increase in enrollment, and similar trends are expected in the Transportation Systems Engineering program. This program will train students in a variety of transportation technology. Such software includes ArcGIS, Highway Capacity Software (HCS), Synchro, Matlab, and TransCAD. In addition, the students will also gain familiarity with the Microsoft Office Suite including Word and Excel.

The success enjoyed by the graduates of the transportation program serves as anecdotal evidence of the solid market demand for well-trained transportation specialists. According to department records, nearly 80 percent of Morgan’s transportation graduates are either employed in transportation-related sectors or in graduate school. It is anticipated that graduates from the program will enjoy an even higher rate of success in employment by virtue of their increased ability to obtain professional engineering licensure.

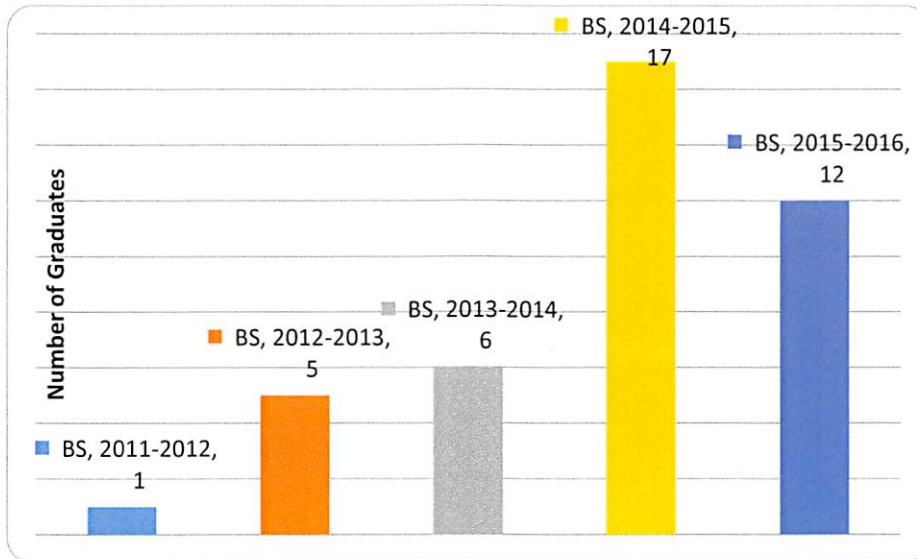
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<sup>4</sup> Recruiter, Career Outlook for Transportation Engineers, <https://www.recruiter.com/careers/transportation-engineers/outlook/> (visited March 5, 2017)

<sup>5</sup> Career Trends, Transportation Engineers, <http://career-profiles.careertrends.com/l/161/Transportation-Engineers> (visited March 5, 2017)

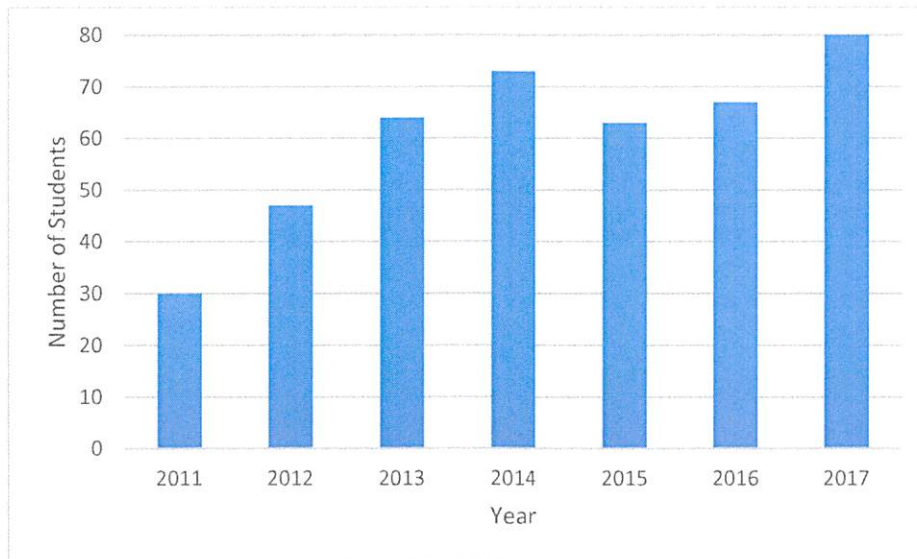
### 3. Current and Projected Supply of Prospective Graduates

Historically, transportation engineering is offered as a graduate specialty within the civil engineering program, considered a surrogate for training transportation engineers. Most undergraduate civil engineering programs require only one course in transportation engineering, and provide interested students the option of taking one or two additional elective courses to support their interest in transportation. The proposed TSE program, in contrast to civil engineering, is one of a kind nationwide and will offer a curriculum akin to a graduate transportation specialty track in a civil engineering program. It will require in excess of 12 core transportation courses covering the areas of traffic and highway engineering, transportation planning, infrastructure asset management, and distribution logistics, and an additional three technical courses to support a concentration area within transportation engineering. There is no data showing the current supply of undergraduate transportation engineering graduates. However, the existing applied science degree program in transportation systems at Morgan State University graduated its first undergraduate student in Spring 2012, and has flourished with 17 students graduating in the 2014-2015 school year. Over the past four years, there have been approximately 70 students enrolled in the B.S. in Transportation Systems program. We expect the B.S. in Transportation Systems program to continue to grow and maintain 15-20 graduates per year. Based on the performance of the existing B.S. program in transportation systems, the average graduation rate for the proposed TSE program is estimated to be approximately 16-18 graduates per year by the end of the fifth year of inception.



*Exhibit 2: Transportation Systems Graduates*





*Exhibit 3: Transportation Systems Enrollment*

## **D. Reasonableness of program duplication**

### **1. Similar Programs in Region**

This program is most closely related to the Transportation Systems degree also offered in the Department of Transportation and Urban Infrastructure Studies at Morgan State University. The existing B.S. in Transportation Systems is an applied science program ideally suited for a non-engineering workforce. In contrast, the proposed B.S. in Transportation Systems Engineering will target individuals interested in pursuing the professional transportation engineering career track. The Transportation Systems Engineering program requires more advance math and broader general engineering foundation. A description of each course is provided in the 3999.

Morgan State University and the University of Maryland at College Park offer ABET/EAC undergraduate programs in Civil Engineering which provide students the opportunity to take courses in transportation to satisfy technical electives. Additionally, the University of Maryland offers an undergraduate Supply Chain Management program through the School Business which focuses primarily on accounting, economics, finance, logistics and supply chain management and operations research.

#### ***Morgan State University Civil Engineering Transportation Track<sup>6</sup>***

- CEGR 416 – Transportation Engineering (3 credits, required for all CE students)
- CEGR 465 – Traffic Engineering (3 credits)
- CEGR 466 – Transportation Models and Simulation (3 credits)
- CEGR 467 – Civil Engineering Systems (3 credits)

<sup>6</sup> [http://www.morgan.edu/Documents/ACADEMICS/academic\\_catalog/undergrad/2016-2018/ucat\\_SOE.pdf](http://www.morgan.edu/Documents/ACADEMICS/academic_catalog/undergrad/2016-2018/ucat_SOE.pdf)

***University of Maryland Civil Engineering Transportation/Project Management Track<sup>7</sup>***

- ENCE 320 – Intro to Project Management (3 credits)
- ENCE 370 – Intro to Transportation Engineering & Planning (3 credits)
- ENCE 402 – Simulation & Design of Experiments (3 credits)
- ENCE 422 – Project Cost Accounting & Economics (3 credits)
- ENCE 423 – Project Planning, Estimation & Scheduling (3 credits)
- ENCE 466 – Design of Civil Engineering Systems (3 credits)
- ENCE 470 – Highway Engineering (3 credits)
- ENCE 472 – Transportation Engineering (3 credits)
- Electives (6 credits from other tracks, 6 credits free electives)

***University of Maryland Supply Chain Management Major Requirements<sup>8</sup>***

Required courses

- BMGT370 – Intro to Transportation in Supply Chain Management (3 credits)
- BMGT372 – Intro to Logistics and Supply Chain Management (3 credits)
- BMGT477 – International Supply Chain Management (3 credits)

Plus 2 courses (6 credits) from:

- BMGT373 – Supply Chain Management Internship
- BMGT470 – Carrier Management
- BMGT471 – Seminar in Supply Chain Management: An Executive Perspective
- BMGT472 – Purchasing and Inbound Logistics
- BMGT475 – Supply Chain Strategy and Network Design
- BMGT476 – Technology Applications in Supply Chain Management
- BMGT478 – Special Topics in Supply Chain Management

And 1 course (3 credits) from:

- BMGT302 – Business Computer Application Programming
- BMGT332 – Operations Research For Management Decisions
- BMGT385 – Operations Management
- BMGT455 – Sales Management
- BMGT461 – Entrepreneurship
- BMGT484 – Digital Marketing
- BMGT490 – QUEST Practicum

Both Morgan State and University of Maryland's Civil Engineering programs allow students to take approximately three courses (9 credit hours) in transportation courses to satisfy technical electives. Similar to all engineering programs at Morgan, there is overlap in the foundational

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<sup>7</sup> <http://www.ence.umd.edu/sites/default/files/GEN%20ED%20Curriculum%202012%20%20102015.pdf>

<sup>8</sup> <https://www.rhsmith.umd.edu/files/Documents/Programs/Undergraduate/SupplyChain/scm2016.pdf>

general education and math and science courses. Of the 50 credits of major courses offered in the transportation track in Civil Engineering, up to 9 credit hours (3 courses) may be duplicated in the Transportation Systems Engineering track dependent on the chosen electives. We believe that the Transportation Systems Engineering program will have minimal impact on the transportation-track in Civil Engineering.

The supply chain management program at the University of Maryland College Park is predominantly business focused and students do not have the background to obtain Professional Engineering licensure. The proposed TSE program requires 54 credits of transportation courses spanning the fields of engineering, planning, logistics and management while providing the foundation required for graduates to become licensed professional engineers.

**2. Justification**

Offering both degrees (applied science and engineering) in transportation systems will position the University to be a national leader in catering to the needs of a diverse and dynamic transportation workforce.

**E. Relevance to high-demand programs at Historically Black Institutions (HBIs)**

HBIs are vital to the mission of adding more minority representation in engineering; see Exhibit 3. Half of the top 10 producers of Bachelor’s degrees come from HBIs. Morgan State University is a leader in awarding Bachelor’s degrees to African Americans in the United States<sup>9</sup>. The proposed TSE program should help to increase the number of engineering degrees awarded from Morgan’s Transportation Program and further elevate the University’s state and, indeed, national standing in producing minority engineers.

*Exhibit 4: Bachelor's Degrees Awarded to African-Americans by School in Engineering (2014-2015)<sup>1</sup>*

<b>Rank</b>	<b>Bachelor’s School</b>
<b>1</b>	<b>North Carolina A&amp;T</b>
2	Georgia Institute of Technology
<b>3</b>	<b>MORGAN STATE UNIVERSITY</b>
4	University of Central Florida
<b>5</b>	<b>Prairie View A&amp;M</b>
<b>6</b>	<b>Howard University</b>
7	University of Maryland, College Park
8	Florida International University
<b>9</b>	<b>Alabama A&amp;M University</b>
9	University of Florida

<sup>9</sup> Source: <https://www.asee.org/papers-and-publications/publications/college-profiles/15EngineeringbytheNumbersPart1.pdf>

## **F. Relevance to the identity of Historically Black Institutions (HBIs)**

Historically Black Institutions (HBIs) share the common mission of providing affordable and accessible top-notch education to a diverse student population, with a special interest in catering to the specific needs of a historically disadvantaged cohort. Morgan State University, an HBI, produces the majority of African American engineering graduates in Maryland and is a national leader in producing African American transportation professionals. The University is the only known institution nationwide with an academic transportation department that offers three degrees (B.S., M.S., and Ph.D.) in transportation. The implementation of the proposed TSE program will add to the accolades of Morgan State University as a trailblazer in mainstreaming undergraduate transportation engineering education, and further solidify Morgan's role in boosting the labor participation rate of African Americans in the transportation field.

## **G. Adequacy of curriculum design and delivery to related learning outcomes consistent with Regulation .10 of this chapter**

### **1. Program Overview**

The proposed B.S. in Transportation Systems Engineering (TSE) satisfies the following criteria: (1) 120 credit hours required for graduation including the general education curriculum outlined by Morgan State University, (2) ABET, Inc. Engineering Accreditation Commission (EAC/ABET) criteria, and (3) Preparation and eligibility to register for professional engineering licensure examinations. All students pursuing the B.S. in TSE are required to have earned a minimum of 120 academic credit hours of course work which includes 42 credits in general education, 2 credits in University requirements, an additional 22 credits in mathematics and science, and 54 credits in core transportation requirements, including 9 credits of approved technical electives to strengthen a particular area of concentration (e.g., intelligent transportation systems, infrastructure asset management, travel demand modeling and network planning, and logistics, etc.).

### ***Courses***

The curriculum sequence for the B.S. in TSE is provided below. All courses listed are 3 credit hours unless noted otherwise.

#### **A. General Education (42 credits)**

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- CEGR 107: Computer Aided Engineering Graphics, Analysis & Design or approved comparable course
- ECON 211: Principles of Economic I or
- ECON 212: Principles of Economics II
- ENGL 101: Freshmen Composition I
- ENGL 102: Freshmen Composition II
- HEED 103: Human & Social Determinants or approved comparable course
- HIST 350: Introduction to the African Diaspora
- HUMA 201: Introduction to Humanities I or approved comparable course
- MATH 241: Calculus I (4 credits) or approved comparable course



- MHTC 103: Introduction to Group Dynamics or approved comparable course
  - PHIL 109: Introduction to Critical Thinking
  - PHIL 220: Ethics and Values
  - PHYS 205 + 205L: University Physics I + Lab (5 credits)
  - TRSS 301: Introduction to Transportation Systems
- B. University Requirements (2 credits)**
- 
- OREN 104: Freshmen Orientation for Engineering Majors(1 credit)
  - PHEC XXX: Physical Education (1 credit)
- C. Math and Science Requirements (22 credits)**
- 
- CHEM 110 + 110L: General Chemistry for Engineering + Lab (4 credits)
  - MATH 242: Calculus II (4 credits)
  - MATH 312: Linear Algebra
  - MATH 331: Applied Probability and Statistics
  - IEGR 251: Probability and Statistics for Engineers I
  - MATH 340: Differential Equations
  - PHYS 206+ 206L: University Physics II + Lab (5 credits)
- D. Transportation Engineering Requirements (54 credits)**
- 
- Two courses (6 credits) of the following:
    - CEGR 202: Statics
    - CEGR 212: Mechanics of Materials and Laboratory
    - CEGR 302: Dynamics
    - IEGR 305: Thermodynamics
    - PHYS 301: Analytical Mechanics I
    - PHYS 302: Analytical Mechanics II
    - PHYS 308: Heat and Thermodynamics
    - PHYS 312: Properties of Materials
  - ENGL 357: Business Writing or approved Technical Writing course
  - TRSS 105: Seminar on Professional Practice (1 credit)
  - TRSS 307: Freight Transportation Systems & Logistics
  - TRSS 318: Transportation Planning & Policy
  - TRSS 319: Geographic Information Systems
  - TRSS 399: Transportation Practicum
  - TRSS 406: Public Transportation Systems
  - TRSS 410: Management of Transportation Systems or approved Project/Operations/Construction/Asset Management Course
  - TRSS 414: Traffic Engineering
  - TRSS 415: Highway Engineering
  - TRSS 417: Intelligent Transportation Systems
  - TRSS 420: Transportation Systems Evaluation or approved Engineering Economy course
  - TRSS 497: Senior Transportation Seminar (1 credit)
  - TRSS 498: Fundamentals of Engineering Exam Seminar (1 credit)
  - TRSS 499: Senior Transportation Project
  - XXXX XXX: Technical Electives (9 credits in total)

*Technical Electives*

The following courses are suggested to fulfill the transportation electives requirement. The technical electives cover the program specialty areas of intelligent transportation systems, infrastructure asset management, travel demand modeling and network planning, and logistics. Others courses may be used pending approval.

- CEGR 466: Transportation Model & Simulation
- CEGR 475: Fundamentals of Construction Engineering and Management
- EEGR 453: Communications Theory
- EEGR 480: Introduction to Cyber Security
- EEGR 481: Introduction to Network Security
- IEGR 417: Systems Engineering Principles and Techniques
- IEGR 432/SEGR 435: Quantitative Methods in Systems Engineering
- IEGR 459: Introduction to Logistics Management and Supply Chain
- IEGR 461: Operations Research, Deterministic Models
- TRSS 402: Transportation Economics
- TRSS 408: Advanced Logistics Systems
- TRSS 412: Transportation Infrastructure/Asset Management
- TRSS 416: Microcomputer Applications in Transportation
- TRSS 418: Advanced Transportation Planning

*New Course Description*

A description of existing courses offered in the Transportation Systems Engineering Program is provided in the Appendix. Only one new course is required for the Transportation Systems Engineering Program, TRSS 489 Fundamentals of Engineering Exam Seminar.

TRSS 498 FUNDAMENTALS OF ENGINEERING EXAM SEMINAR – This seminar prepares student for taking the Fundamentals of Engineering Examination. Prerequisite: Senior status. *1 credit*

*Sample Curriculum Sequence*

**Freshmen Year (1<sup>st</sup> Semester)**

ENGL 101	Freshmen Composition I	3
CEGR 107	Computer-Aided Engineering	3
MHTC 103	Intro to Group Dynamics	3
OREN 104	Freshmen Orientation	1
MATH 241	Calculus I	4
		14

**Freshmen Year (2<sup>nd</sup> Semester)**

ENGL 102	Freshmen Composition II	3
ECON 212	Principles of Economics II	3
HEED 103	Human & Social Determinants	3
MATH 242	Calculus II	4
TRSS 105	Professional Practice	1
PHEC XXX	Physical Education Elective	1
		15

**Sophomore Year (1<sup>st</sup> Semester)**

PHYS 205	Univ Physics I	4
PHYS 205L	Univ Physics I Lab	1
HUMA 201	Intro to Humanities I	3
MATH 312	Linear Algebra	3
PHIL 109	Intro to Critical Thinking	3
TRSS 301	Intro to Transp. Systems	3
		17

**Sophomore Year (2<sup>nd</sup> Semester)**

PHIL 220	Ethics & Values	3
IEGR 251	Prob & Statistics I	3
PHYS 206	Univ Physics II	4
PHYS 206L	Univ Physics II Lab	1
TRSS 318	Transp. Planning & Policy	3
		14

<b>Junior Year (1<sup>st</sup> Semester)</b>			<b>Junior Year (2<sup>nd</sup> Semester)</b>		
CEGR 202	Statics	3	CEGR 212	Mechanics of Materials + Lab	3
CHEM 110	General Chemistry I	3	ENGL 357	Business Writing	3
CHEM 110L	General Chemistry I Lab	1	HIST 350	Intro to African Diaspora	3
TRSS 307	Freight & Logistics	3	MATH 340	Differential Equations	3
TRSS 319	Geographic Info. Systems	3	TRSS 420	Transportation Sys. Evaluation	3
		<u>13</u>			<u>15</u>
<b>Senior Year (1<sup>st</sup> Semester)</b>			<b>Senior Year (2<sup>nd</sup> Semester)</b>		
TRSS 399	Transportation Practicum	3	TRSS 410	Management of Transportation	3
TRSS 406	Public Transportation	3	TRSS 417	Intelligent Transportation	3
TRSS 414	Traffic Engineering	3	TRSS 498	F.E. Exam Seminar	1
TRSS 415	Highway Engineering	3	TRSS 499	Senior Project	3
TRSS 497	Senior Trans. Seminar	1	XXXX xxx	Technical Elective	3
XXXX xxx	Technical Elective	3	XXXX xxx	Technical Elective	3
		<u>16</u>			<u>16</u>

## 2. Educational Objectives

The program will allow motivated undergraduate students to obtain a bachelor's of science degree in Transportation Systems Engineering in four years. The specific objective of the proposed program is to accelerate the production of diverse, well-trained transportation professionals who are skilled in the field of transportation engineering, exposed to the related fields of planning, management and logistics, and capable of pursuing senior-level positions by having the skills necessary to obtain professional licensure. The program graduate will:

- Utilize a system approach to articulate, study, and mitigate transportation problems
- Apply the latest technology and sustainability paradigm to efficiently plan, implement, analyze, evaluate, and manage components of the transportation systems
- Utilize effective communication, team, leadership, and management skills to work productively within their professions and communities
- Pursue professional development and advanced studies to meet the emerging and evolving demands, and increasing responsibilities of a successful career
- Conduct themselves as responsible professionals and citizens.

### *Learning Outcomes*

Upon completion of the program, students will have gained a broad technical and interdisciplinary background that will have enhanced their skills in identifying and tackling critical transportation and urban infrastructure problems. Aligned with the undergraduate in transportation systems program objectives, the eleven student outcomes are:

- a. an ability to apply knowledge of mathematics, science, and engineering
- b. an ability to design and conduct experiments, as well as to analyze and interpret data
- c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- d. an ability to function on multidisciplinary teams
- e. an ability to identify, formulate, and solve engineering problems

- f. an understanding of professional and ethical responsibility
- g. an ability to communicate effectively
- h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- i. a recognition of the need for, and an ability to engage in life-long learning
- j. a knowledge of contemporary issues
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### **3. General Education Requirement**

This program satisfies the general education requirements outlined by Morgan State University. The course(s) which satisfies each general education requirement is provided below:

- 1. Information, Technological and Media Literacy (3 credits) – CEGR 107
- 2. English Composition (6 credits) – ENGL 101, ENGL 102
- 3. Critical Thinking (3 credits) – PHIL 109
- 4. Mathematics and Quantitative Reasoning (3 credits) – MATH 241
- 5. Arts and Humanities (6 credits) – HUMA 201, PHIL 220
- 6. Biological and Physical Sciences (7 credits, at least one course lab based) – PHYS 205, PHYS 205L, TRSS 301
- 7. Social and Behavior Sciences (6 credits) – ECON 211 or 212, MHTC 103
- 8. Health and Healthful Living (3 credits) – HEED 103
- 9. Contemporary and Global Issues, Ideas and Values – HIST 350

### **4. Accreditation and Certification**

#### ***ABET Accreditation***

The proposed program will be accredited by ABET, Inc. under the Engineering Accreditation Commission (EAC). The existing program, B.S. in Transportation Systems, is accredited by ABET's Applied Science Accreditation Commission (ASAC). In order to gain ABET, Inc. EAC accreditation, the following will occur:

- 1. Evaluation of student performance,
- 2. Review of the program educational objectives outlined above,
- 3. Systematic documentation of student progress using student learning outcomes,
- 4. Documentation for assessing and evaluating continuous improvement,
- 5. Development of program curriculum that is consistent with the outcomes and objectives of the program and Morgan State University including
  - a. One year (minimum of 30 credits) of college level mathematics and basic sciences: CHEM 110/110L (4 credits), MATH 241 (4 credits), MATH 242 (4 credits), MATH 312 (3 credits), MATH 331 or IEGR 251 (3 credits), MATH 340 (3 credits), PHYS 205/205L (5 credits), PHYS 206/206L (5 credits)
  - b. One and a half years of engineering topics – 54 credits as shown above under Transportation Engineering Requirements
  - c. A general education component – 42 credits as outlined above,



6. Show that the number of faculty are sufficient in order to ensure adequate levels of faculty-student interaction,
7. Maintain the facilities in the Center for the Built Environment and Infrastructure Studies (CBEIS) as well as other classrooms and offices on campus to maintain an environment conducive to learning and
8. Show that the program has institutional support.

Given timely acceptance of this program, we hope to have our first program graduate before the next visit by ABET, Inc. occurring in 2019, thereby allowing the program to be fully accredited as promptly as possible.

### ***EIT and PE Preparation***

The ABET, Inc. accreditation will position graduates for hiring and career advancement in transportation engineering by requiring students to acquire the skills necessary to obtain their Professional Engineering (P.E.) license through a curriculum that offers a broad background in engineering coupled with specialized training in transportation. The Fundamental of Engineering (FE) exam is generally the first step in the process to becoming a P.E. *Only students who obtained an undergraduate degree from an EAC/ABET accredited program are eligible to take the FE exam without restrictions.*

The proposed TSE curriculum will prepare students to take the Transportation PE exam. In the state of Maryland, individuals who have passed the FE Exam from an EAC/ABET, Inc. accredited program may take the P.E. exam with four years of experience whereas eight years of experience are required in addition to passing the FE exam without EAC/ABET, Inc. accreditation.

### **5. Contracting with Other Universities**

This program does not require any collaboration with outside institutions.

## **H. Adequacy of Articulation**

There is currently no articulation agreement with programs at other institutions. However, as the only known undergraduate degree program in transportation engineering nationwide, myriad opportunities exist to partner with other institutions (particularly community colleges) in the form of 2+2 articulation agreements that will allow junior transfers to spend two years obtaining the B.S. degree in Transportation Systems Engineering at Morgan State University, after spending the first two years completing the required general education, mathematics, science, and general engineering courses.

## **I. Adequacy of faculty resources (as outlined in COMAR 13B.02.03.11)**

At the conclusion of the program the student will have completed a B.S. degree in Transportation Systems Engineering. The seasoned faculty in the Department of Transportation and Urban Infrastructure Studies have demonstrated their expertise and effectiveness to teach the courses listed, covering the major areas of transportation planning, engineering, logistics and management.

A list of key faculty in the Department of Transportation and the courses they teach are provided below. All non-departmental courses are currently being offered and an adequate amount of seats is available.

**Anthony A. Saka, Ph.D., P.E., PTOE, PTP, FITE, F.ASCE**, Chair and Professor  
*Education:* Ph.D., Civil Engineering (Transportation Systems), University of Virginia  
*Courses:* TRSS 105, TRSS 319, TRSS 399, TRSS 412, TRSS 497, TRSS 499

**Andrew Farkas, Ph.D.**, Director National Transportation Center, Professor  
*Education:* Ph.D. Geography, University of Georgia  
*Courses:* TRSS 399, 499

**Celeste Chavis, Ph.D., P.E.**, Assistant Professor  
*Education:* Ph.D. in Civil Engineering (Transportation), University of California, Berkeley  
*Courses:* TRSS 301, TRSS 414, TRSS 415, TRSS 416, TRSS 420, TRSS 499

**Mansoureh Jeihani, Ph.D., PTP**, Associate Professor  
*Education:* Ph.D. Civil Engineering, Virginia Polytechnic Institute  
*Courses:* TRSS 402, TRSS 410, TRSS 418, TRSS 499

**Young-Jae Lee, Ph.D.**, Associate Professor  
*Education:* Ph.D. Systems Engineering (Transportation), University of Pennsylvania  
*Courses:* TRSS 307, TRSS 406, TRSS 408, TRSS 417, TRSS 499

**Safieh Laaly, D.Eng.**, Adjunct Professor  
*Education:* D.Eng. Transportation, Morgan State University  
*Courses:* TRSS 305, TRSS 318

## **J. Adequacy of library resources (as outlined in COMAR 13B.02.03.12)**

The Earl S. Richardson Library is the main academic information resource center on the campus of Morgan State University. The new building, which covers approximately 222,517 square feet, opened in 2008. It houses approximately 400,000 volumes and access to 1,900 periodical titles. The Library subscribes to over 100 online databases through the use of the University Research Port. The state-of-the-art building includes a multi-story lobby, lounges, private group study rooms, meeting rooms, a technology-enhanced instruction room, computer laboratory, and other computers in many locations, all of which provide wired and wireless access to databases for research and teaching needs of the proposed program. The Transportation Teaching Laboratory has an extensive collection of books, journals and magazines, and government documents on transportation and related subjects to sustain the needs of the proposed program. The President of Morgan State University assures that the institutional library resources meet the proposed program needs.

**K. Adequacy of physical facilities, infrastructure and instructional equipment  
(as outlined in COMAR 13B.02.03.13)**

The Department of Transportation and Urban Infrastructure Studies is housed in a new state-of-the-art building, Center for Built Environment and Infrastructure Studies (CBEIS). CBEIS opened in fall 2012, and houses programs in transportation, architecture, landscape architecture, city and regional planning, and civil engineering. Students in the B.S. in TSE program will benefit immensely from the vast laboratory resources available in the Department of Transportation and Urban Infrastructure Studies, which currently include a brand-new travel-behavior simulation laboratory equipped with two driving simulator platforms, several workstations, traffic controllers, and a variety of software (SPSS, MATLAB, AUTOCAD, SYNCHRO, TRANSCAD, ARCGIS, LOGWARE, HCS, TSIS, AUTOSCOPE, etc.). Based on the current inventory of resources, there is no anticipated critical shortage of teaching and research resources at the initial stages of the development of the program. Currently, research grants support the maintenance of the laboratories. The President assures that institutional equipment and facilities meet new program needs.

**L. Adequacy of financial resources with documentation (as outlined in  
COMAR 13B.02.03.14)**

**1. Resources & Expenditure**

*Resources Narrative*

*Exhibit 5: Resources*

<b>Resource Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Reallocated Funds	88,350	176,700	176,700	176,700	265,050
2. Tuition/Fee Revenue (c + g below)	152,000	312,000	360,000	424,000	472,000
a. Number of F/T Students	19	39	45	53	59
b. Annual Tuition/Fee Rate	8,000	8,000	8,000	8,000	8,000
c. Total F/T Revenue (a x b)	152,000	312,000	360,000	424,000	472,000
d. Number of P/T Students	0	0	0	0	0
e. Credit Hour Rate	642	642	642	642	642
f. Annual Credit Hour Rate	0	0	0	0	0
g. Total P/T Revenue (d x e x f)	0	0	0	0	0
3. Grants, Contracts & Other External Sources	0	0	0	0	0
4. Other Sources	247,000	507,000	585,000	689,000	767,000
<b>TOTAL (Add 1 – 4)</b>	<b>487,350</b>	<b>995,700</b>	<b>1,121,700</b>	<b>1,128,700</b>	<b>1,504,050</b>

*1. Reallocated Funds*

As shown later in the expenditure table (*Exhibit 6*), the university will reallocate the required resources for one faculty member in the first year, two faculty members in years 2-4, and three

faculty members in year 5. This assumed one additional faculty member per 18 new students enrolled in the program. The existing B.S. in Transportation Systems has 65 students enrolled in the 2016-2017 academic year, five years after its first set of graduates. Upon surveying current students in transportation and other engineering programs, 26 students expressed an interest in enrolling in the proposed TSE program. Thus, we expect the new program to complement the existing B.S. in Transportation Systems program in fulfilling the desire of our students to pursue an undergraduate transportation systems engineering degree without the burden of having to enroll in proxy programs such as civil engineering and industrial/systems engineering.

2. *Tuition and Fee Revenue*

Given that all students in the program will be full-time, an annual tuition and fee rate of \$8,000 is assumed each year.

3. *Grants, Contracts, & Other External Sources*

None assumed for this program.

4. *Other Sources*

A state subsidy of \$13,000 per student enrolled.

***Expenditures Narrative***

*Exhibit 6: Expenditures*

<b>Expenditure Categories</b>	<b>Year 1</b>	<b>Year 2</b>	<b>Year 3</b>	<b>Year 4</b>	<b>Year 5</b>
1. Faculty (b + c below)	88,350	176,700	176,700	176,700	265,050
a. # FTE	1	2	2	2	3
b. Total Salary	66,000	132,000	132,000	132,000	198,000
c. Total Benefits	22,350	44,700	44,700	44,700	67,050
2. Admin. Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
3. Support Staff (b + c below)	0	0	0	0	0
a. # FTE	0	0	0	0	0
b. Total Salary	0	0	0	0	0
c. Total Benefits	0	0	0	0	0
4. Equipment	0	0	0	0	0
5. Library	0	0	0	0	0
6. New or Renovated Space	0	0	0	0	0
7. Other Expenses	1,900	3,900	4,500	5,300	5,900
<b>TOTAL (Add 1 – 7)</b>	<b>90,250</b>	<b>180,600</b>	<b>181,200</b>	<b>182,000</b>	<b>270,950</b>

1. *Faculty*

a. Additional faculty are included using an 18:1 student/faculty ratio. The number of full-time employees (FTE) is calculated using a 70:30 regular/adjunct split.



- b. Faculty salary is calculated using a rate of \$75,000 for full-time (FT) faculty and \$45,000 for adjunct faculty. Benefits are 40% and 10% for full time adjunct faculty members, respectively. No inflation factor is applied to the salary and benefits over the 5 year period.
2. *Administrative Staff*  
None required.
3. *Support Staff*  
None required.
4. *Equipment*  
None required.
5. *Library*  
None required.
6. *New or Renovated Space*  
None required.
7. *Other Expenses*  
It is estimated that the department will need \$100 to support each additional student in the program.

**M. Adequacy of provisions for evaluation of program (as outlined in COMAR 13B.02.03.15).**

Courses in the proposed transportation systems engineering will be routinely evaluated for timeliness and professional relevance by consulting as needed with the program's Advisory Board, comprising seasoned transportation and logistics professionals. Faculty effectiveness/performance will be evaluated against those of their peers, using the existing online system that requires students to answer a set of questions, including course management, course content, course delivery method, instructor-student interaction, instructor's communication skill and familiarity with course materials, and adequacy of assessment tool. Students in the proposed transportation engineering program will be evaluated based on ABET, Inc. EAC (Engineering Accreditation Commission) student learning outcomes. Consistent with the evaluation procedures used for the existing applied science program in transportation systems, the Department will develop performance indicators for each of the EAC student learning outcomes. Each course will be mapped to one or more student learning outcomes and their associated performance indicators, and appropriate inferential tests will be used to track continuous course/program improvement in the context of student performance. In addition, data will be collected to determine the success rate of program graduates in finding and retaining employment, and passing the FE/PE licensure exams.

**N. Consistency with the State’s minority student achievement goals (as outlined in COMAR 13B.02.03.05 and in the State Plan for Postsecondary Education).**

The proposed program is consistent with the Commission’s minority student achievement goals. Specifically, the primary goal of the proposed program is to increase the labor participation of the urban minority population (particularly African-Americans) in the STEM field of transportation as professional engineers, and opportunity to pursue advanced studies in engineering.

**O. Relationship to low productivity programs identified by the Commission:**

This program is not related to any low productivity programs identified by the Commission.

**APPENDIX**  
**COURSE DESCRIPTIONS**

BIOL 101 INTRODUCTORY BIOLOGY I— This course involves the study of the fundamental principles and concepts of biology with emphasis on molecular, cellular biology, and heredity and is designed for non-majors only. *4 credits*

CEGR 106 INTRODUCTION TO CIVIL ENGINEERING - 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, geotechnical and environmental engineering. *1 credit*

CEGR 107 COMPUTER-AIDED ENGINEERING GRAPHICS, ANALYSIS & DESIGN – This course introduces students to computer-aided engineering graphics and engineering analysis in the context of defining, demonstrating and solving interesting but simple visualization and design problems in civil engineering; review of geometry and trigonometry in conjunction with related computer graphics functions; data reduction and analysis, graphing and presentation. Introduction to Computer-Aided Drafting and Design (CADD) and to contemporary CAD/3D modeling and analysis software for civil engineers. Modeling exercises and design projects, with students working in teams and using computer analysis and design spreadsheets and technical word processing and presentation programs. *3 credits*

CEGR 110 GEOSPATIAL TECHNOLOGIES IN CIVIL ENGINEERING - The course provides students with comprehensive knowledge and understanding of geospatial technologies/sciences and their applications in Civil Engineering. It will highlight surveying, geographic information systems (GIS), differential global positioning system (DGPS), remote sensing, and spectroradiometer concepts, principles, and techniques for developing appropriate skills for their integration and applications in civil engineering. Students will actively participate in data acquisition, mapping, surveying, site geometries, and geology. Lectures include geospatial features, attributes, image exploitation, and relational database. Labs include training in ArcGIS/ArcView, ENVI, GeoMedia Suite, TerraSync and Pathfinder Office software. Differential correction of field data, analyses, syntheses and applications will be provided Term project, with oral presentation and written report will form part of this course. *2 credits*

CEGR 202 STATICS - Two hours lecture, two hours practicum; *3 credits*. Review of relevant concepts from geometry, algebra and calculus. Representation and resolution of vectors. Resultants of force and couple systems by graphical and analytical approaches. Particle interaction forces; Coulomb friction, spring behavior. Application of Free Body Diagrams in problem solving. Equilibrium of particles and rigid bodies. Analysis of simple trusses and frames. Center of gravity, center of mass, and centroid of area. Reduction of distributed normal loads, internal reactions, area moments of inertia Practicum: Problem solving in statics; forces and force components, moments and equilibrium, introduction to computer-aided design and simulations of simple structural systems. Project(s) would require oral and visual presentation and written report. Prerequisites: CEGR 107 (CAE Graphics, Analysis & Design) and PHYS 205 (General Physics I). Co-requisite: MATH 242. *3 credits*.

CEGR 212 MECHANICS OF MATERIALS AND LABORATORY - Stress and strain for various types of loads - axial, shear, torsion and bending. Constitutive Laws. Multidimensional Hooke's Law. Stress concentration. Introduction to Indeterminate analysis - Equilibrium vs. Compatibility. Combined stresses in 2D and 3D using Mohr's Circle. Laboratory exercises to include tension,

compression, bending and torsion. Concrete mix design and asphalt mix design. Elastic vs. plastic behavior of metals. Use of basic finite element software to investigate concepts of stress and deformation caused by external loads. (Formerly CEGR 301) Prerequisite: CEGR 202 (Statics). 3 credits

**CEGR 302 DYNAMICS** - Kinematics and kinetics of particles and rigid bodies in one and two-dimensional motion. Frictional behavior, Mass moments of inertia. Motion of particle systems and simple deformable mass systems. Use of impulse and momentum methods. Application of principles of work, energy and power. Simple 3D gyroscopic motion. Introduction to free and forced vibrations of particles and simple rigid bodies. Coursework includes problems involving computer simulations. Prerequisite: CEGR 202. 3 credits

**CEGR 307 COMPUTER METHODS AND PROGRAMMING FOR CIVIL ENGINEERING** - This course will introduce and reinforce computer methods and programming in Civil Engineering Analysis and Design. Overview of basic linear algebra, relevant numerical analysis algorithms, basic algorithm development and programming; types of variables, objects and classes, conversion of mathematical equations to objects and classes, and generation of corresponding software. Application of Spreadsheet and Computational-Math software to routine analysis and design; development of e-books in writing technical reports. Further exposure to general purpose CAD, Modeling and Analysis software. Examples will draw from diverse sub disciplines within Civil Engineering. Prerequisite: CEGR 107 (Computer-Aided Engineering Graphics Analysis and Design), MATH243 (Calculus III) and MATH 340 (Differential Equations). 2 credits

**CEGR 324 STRUCTURAL ANALYSIS I AND LABORATORY** - Structural forms; structural load definitions; statically determinate structures; reactions; axial force, shear, bending moment and qualitative deflected shape diagrams for determinate beams and frames; cable-supported structures; arches; influence lines; Computer programming assignments are incorporated into the coursework. Prerequisites: CEGR 202 (Statics), CEGR 212 (Mechanics of Materials & Lab). 3 credits

**CEGR 325 GEOTECHNICAL ENGINEERING AND LABORATORY** - Basic physical and mechanical structural characteristics of geotechnical engineering applied to soil classification, permeability and seepage, in-situ stresses and compressibility, lateral earth pressures, slope stability, and bearing capacity of shallow foundations. Prerequisites: CEGR 202 (Statics) and CEGR 212 (Mechanics of Materials & Lab). 3 credits

**CEGR 332 HYDRAULIC ENGINEERING** - Includes hydrology; open- channel flow; pipe flow; ground water flow; dams and reservoirs. Computer programming assignments are incorporated into the course work. Prerequisite: CEGR 214. 3 credits

**CEGR 338 ENVIRONMENTAL ENGINEERING I AND LABORATORY** - The lecture applies the knowledge of fluid mechanics to the planning and design of elements of water treatment plants and elements of wastewater treatment plants, and the design of sewers and water distribution system hydraulics. The laboratory applies the knowledge of general chemistry to sanitary chemical analyses, which include the various forms of solids, pH measurements, and salinity. The laboratory will also introduce the students to the use of the atomic absorption spectrophotometer. Prerequisites: CHEM 110 (Gen Chemistry for Eng), BIOL 101 (Intro to Biology I), MATH 242 Calculus II. 3 credits

**CEGR 400 PROJECT MANAGEMENT, FINANCE & ENTREPRENEURSHIP** - The principles and techniques of project management in the planning, design and operation of civil engineering infrastructure and service systems. Specific topics and project management techniques covered include: Project manager and Team building and leadership, Economic analysis in project selection, Project Financing and entrepreneurship, project planning, project organization Project cost estimation, Network analysis and related applications to Project scheduling (i.e. PERT -CPM), Project Monitoring and control using Microsoft project software and project termination process. Prerequisites: ECON 211 (Prin. of Econ I) or ECON 212 (Prin. of Econ II), MATH 331 (Probability & Statistics). *2 credits*

**CEGR 416 TRANSPORTATION ENGINEERING** - 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 211/212. *3 credits*

**CEGR 436 ELEMENTARY STRUCTURAL DESIGN** -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. Prerequisite: CEGR 324. *3 credits*

**CEGR 465 TRAFFIC ENGINEERING** - 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 (Transportation Eng). (Fall) *3 credits*

**CEGR 466 TRANSPORTATION MODELS AND SIMULATION** – 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 MATH 331 or IEGR 251. (Spring) *3 credits*

**CEGR 467 CIVIL ENGINEERING SYSTEMS** - 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) *3 credits*

**CEGR 475 FUNDAMENTALS OF CONSTRUCTION ENGINEERING AND MANAGEMENT** – This course will teach the applications of the fundamentals of construction engineering and management in construction practice and provide a foundation in the important aspects of construction management and the emerging areas that will concern the construction manager in the future. Prerequisite: CEGR 400 (Project Management, Finance & Entrepreneurship) or Permission of Instructor. *3 credits*.

**CEGR 492 SENIOR REVIEW AND PROJECT PROPOSAL** - This course, typically undertaken in student's penultimate semester, has two parts: (1) Lecture (Senior Project Proposal) - during which student develops, in concert with a faculty advisor (for some projects, it is also desirable

that the student select an advisor from industry, in addition to the faculty advisor), the technical proposal for the Senior Design Project, and (2) Practicum - comprehensive review of the Fundamentals of Engineering (FE) civil-discipline-specific examination topics and mock-FE examinations. A brief initial part of the practicum reviews technical report writing and presentation for engineers and development of a design project proposal. Two 4-hour mock-FE exams (simulating the A.M. and P.M. sessions of the FE exam) serve as the program's Comprehensive examination, as well as an assessment of the practicum part of the course. The final grade in the course is a combination of the faculty advisor's evaluation of the student's project proposal effort and written report, and the student's performance in the mock-FE exams and other aspects of the practicum. Civil Engineering students of at least junior standing may be allowed, with department approval, to audit the review class portion without financial obligation. Prerequisite: Senior Standing, and Permission of Faculty Advisor and Department Chair. (Fall) *2 credits*

CEGR 493 SENIOR PROJECT - This is a follow up on the proposal developed and approved in CEGR 492, and will focus on the execution of the proposed analysis and design, under the guidance of the same faculty advisor (and external advisor, if any). Specific guidelines on the successful completion of the project should come from the student's faculty advisor. However, this second semester of the two-semester CEGR 492-493 sequence should be spent on finalizing preliminary design and analysis, as well as completion of detailed design and possible optimization, creation of a design project report of acceptable format, conclusion of student's electronic portfolio, and a formal delivery of a PowerPoint (or similar) presentation of the project to an audience of faculty, students and others. The grade for this course is based upon two components: (1) the advisor's assessment of the student's progress through the entire design project and the quality of the written technical report and (2) department's assessment of the student's up-to-date electronic portfolio; and assessment, by the attending department faculty, of the content and the quality of the presentation made by the student. (Formerly CEGR 491) Prerequisite: CEGR 492. *1 credit*

CEGR 498 TOPICS IN CIVIL ENGINEERING - In-depth study in areas of student/faculty interest. Approval of the faculty advisor and Department Chair required. *3 credits*

CHEM 110/110L GENERAL CHEMISTRY FOR ENGINEERING STUDENTS – Chemistry 110 is designed to give a general overview of the fundamental aspects of chemistry that is relevant to engineering students, with emphasis on critical thinking, stoichiometry, kinetics, thermodynamics, chemical equilibrium, and electrochemistry. Mathematical manipulation relevant to these topics will be emphasized. Pre and/or co-requisites: MATH 113, 114, 141, 241, 242, 243, or 340 with a “C” or better. *4 credits*.

ECON 211 PRINCIPLES OF ECONOMICS I – The focus of this course is on macroeconomics. Topics covered include the determinants of national income, employment, inflation, investment, the banking system, and government fiscal and monetary policies. *3 credits*

ECON 212 PRINCIPLES OF ECONOMICS II – The focus of this course is microeconomics. Topics covered include the theory of the firm, consumer theory, alternative market structures, public goods and distribution theory. *3 credits*



EEGR 453 COMMUNICATIONS THEORY – Includes probability theory, analog and digital modulation techniques, noise in modulating systems, digital data transmission, optimum receivers. Pre-requisite: EEGR 322 with a “C” or better. (FALL) *3 credits*

EEGR 480 INTRODUCTION TO CYBER SECURITY – This course will provide a basic introduction to of all aspects of cyber-security including business, policy and procedures, communications security, network security, security management, legal issues, political issues, and technical issues. This serves as the introduction to the cyber security program. Prerequisite: EEGR 317. Students must pass EEGR 317 with a grade of “C” or better. *3 credits*

EEGR 481 INTRODUCTION TO NETWORK SECURITY – This course will provide the basic concepts in the many aspects of security associated with today’s modern computer networks including local area networks and the internet. It includes the fundamentals of network architecture, vulnerabilities, and security mechanisms including firewalls, guards, intrusion detection, access control, malware scanners and biometrics. Prerequisite: EEGR 317. Students must pass EEGR 317 with a grade of “C” or better. *3 credits*

ENGL 101 FRESHMAN COMPOSITION I – This course is designed to develop the student’s command of language as an instrument of learning and expression. It focuses on essay writing. *3 credits*

ENGL 102 FRESHMAN COMPOSITION II – This course is designed to develop the student’s command of language as an instrument of learning and expression, and it focuses on research and writing the documented essay. *3 credits*

ENGL 357 BUSINESS WRITING – This course focuses on four forms of writing in the workplace: letters, memos, reports, and proposals. Students will incorporate graphics and multimedia techniques in their assignments. *3 credits*

GEOG 309 URBAN GEOGRAPHY—This course acquaints students with cities around the world. Topics include global variations in urban form and urban economics; the importance of race, gender, and ethnicity; and the future of cities. (offered as needed). *3 credits*

HEED 103 HEALTH SCIENCE: HUMAN & SOCIAL DETERMINANTS – This course is an in-depth study of health behavior in light of the nature of humans and the environment in which we live and interact. *3 credits*

HIST 101 WORLD HISTORY I —This course is a survey of the development and spread of civilization from ancient times to the present day. It adopts a global perspective of history, while at the same time attempting to do justice to the distinctive character and recent development of individual civilizations and regions in the world. *3 credits*

HIST 105 HISTORY OF THE UNITED STATES I—This course begin with colonial America and offer a survey of the political, economic, social, and cultural factors which have shaped the pattern of life in the United States. *3 credits*

HIST 350 INTRODUCTION TO THE AFRICAN DIASPORA – This course traces the scattering of the peoples of African ancestry across their continental homeland, their subsequent dispersion around the world to Europe, the Middle East, Asia and the Americas, and the return to Africa. It

places emphasis on resistance movements, slavery and emancipation and current diasporic developments. Prerequisite: successful completion of 36 college credits. *3 credits*

HUMA 201 INTRODUCTION TO HUMANITIES I – This course offers an interdisciplinary study of the literature and philosophy of ancient and transitional Western, African, and Asian cultures, reinforced by experiences in music and art. Prerequisites: ENGL 101-102 or ENGL 111-112. *3 credits*

IEGR 251 PROBABILITY & STATISTICS FOR ENGINEERS I – 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. *3 credits*

IEGR 305 THERMODYNAMICS - Three hours lecture and 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. Student must pass PHYS 206 and MATH 242 with a grade of “C” or better. *3 credits*.

IEGR 417 SYSTEMS ENGINEERING PRINCIPLES AND TECHNIQUES – 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. Prerequisites: Math 242 and Junior standing. Student must pass MATH 242 with a grade of “C” or better. (FALL). *3 credits*.

IEGR 432/SEGR 435 INTRODUCTION TO QUALITY ENGINEERING – Engineering and Robust Design. 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 351. Student must pass IEGR 351 with a grade of “C” or better. (Offered as needed) *3 credits*

IEGR 459 INTRODUCTION TO LOGISTICS MANAGEMENT AND SUPPLY CHAIN – 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. Prerequisite: IEGR 367. Student must pass IEGR 367 with a grade of “C” or better. (FALL) *3 credits*.

IEGR 461 OPERATIONS RESEARCH, DETERMINISTIC MODELS – 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. Student must pass IEGR 361 with a grade of “C” or better. (SPRING). *3 credits*

MATH 118 FINITE MATHEMATICS - This course is designed to cover the following topics: statement calculus, set operations, counting principles, probability, statistics, matrices, systems of linear equations and inequalities, and linear programming with applications involving optimization utilizing the simplex method. Prerequisite: MATH 113 with a grade of “C” or better. *3 credits*

MATH 120 AN INTRODUCTION TO PROBABILITY AND DECISION MAKING - This is a first course in probability theory and should be of interest to students with little mathematical background. The course is intended to expose majors in psychology, sociology, biology, chemistry, physics, business administration, political science as well as mathematics to sound decision making in their respective fields. Prerequisite: MATH 113 or MATH 141 with a grade of “C” or better. *3 credits*

MATH 241 CALCULUS I – Topics to be discussed include limits and continuity of real functions of one variable; differentiation and anti- differentiation of algebraic, trigonometric, exponential, and logarithmic functions; the chain rule, the Rolle's Theorem, and the Mean Value Theorem; applications of differentiation to various problems including optimization problems and curve sketching; and an introduction to definite and indefinite integrals. Prerequisite: MATH 114 or MATH 141 with a grade of "C" or better or departmental permission. *4 credits*

MATH 242 CALCULUS II – This course is the continuation of MATH 241 and is designed to cover the following topics: definite integrals and their applications, fundamental theorem of calculus, techniques of integration, approximate integration, and improper integrals. Integrals yielding inverse trigonometric functions, infinite sequences and series, and other topics are also discussed. Prerequisite: MATH 241 with a grade of "C" or better or departmental permission. *4 credits*

MATH 243 CALCULUS III - Topics to be discussed include partial differentiation, directional derivatives, gradients and line integrals, multiple integrals, applications, Green's Theorem and Stokes' Theorem. Prerequisite: MATH 242 with a grade of "C" or better. *4 credits*

MATH 312 LINEAR ALGEBRA I– This course is designed to cover the following topics: a study of linear transformations and matrices, vector spaces, eigenvalues and canonical forms and other topics as time permits. Prerequisite: MATH 241 with a grade of “C” or better. *3 credits*

MATH 331 APPLIED PROBABILITY & STATISTICS – This is a first course in statistics with emphasis on applications in engineering and the sciences, including the role of statistics in quality control, descriptive statistics, basic probability, discrete and continuous probability models, sampling distributions, drawing inferences from population samples via estimation and significance tests, brief exposure to regression and analysis of variance. Students are required to complete computer projects using statistical software systems. Prerequisite: MATH 242 with a grade “C” or better. *3 credits*

MATH 340 INTRODUCTION TO DIFFERENTIAL EQUATIONS – This is a first course dealing with methods of solving ordinary differential equations (ODE) with modeling applications. The following topics are included: first order ordinary differential equations, second and higher order linear ordinary differential equations, (homogeneous and nonhomogeneous), Laplace Transforms,

systems of linear ordinary differential equations. Prerequisite: MATH 242 with a grade of “C” or better. *3 credits*

MATH XXX PRE-CALCULUS OR HIGHER *3 credits*

MGMT XXX APPROVED MANAGEMENT TECHNICAL ELECTIVE *3 credits*

MHTC 103 INTRODUCTION TO GROUP DYNAMICS – Introduction to theory and practice of group functioning and interaction among and between group members are discussed. Small group activities in the class serve as processes to study and understand group development and behavior. Emphasis is placed on the development of effective group skills including verbal and non-verbal communication, conflict resolution, group cohesion, group roles, and group leadership. *3 credits*

OREN 104 FRESHMEN ORIENTATION FOR ENGINEERING MAJORS – 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, the legacy and traditions of Morgan State University, college success strategies, and 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. *1 credit*

PHEC XXX PHYSICAL EDUCATION ELECTIVE (*1 credit*)

PHIL 109 INTRODUCTION TO CRITICAL THINKING – This course is a study of the fundamental principles of logic, including reflective thinking. Emphasis will be given to the study of the traditional or classical forms of deductive and inductive inference and the processes of communicating, symbolizing and defining. Constant practice in detecting fallacious reasoning will be provided. *3 credits*

PHIL 220 ETHICS AND VALUES – This course explores contemporary moral issues stemming from business, science and technology, law, international affairs, the environment, public policy, interpersonal relations, etc., against the background of cultural values as illuminated by various ethical theories. *3 credits*

PHYS 205 UNIVERSITY PHYSICS I + LAB – This is a calculus-based course designed for students in the natural sciences and engineering. Mechanics, sound, and thermodynamics. Co-requisite: MATH 241 *5 credits (1 hour lab)*

PHYS 206 UNIVERSITY PHYSICS II + LAB – This is the second semester of a two-semester sequence. Electricity, magnetism, and optics. Co-requisite: MATH 242. *5 credits (1 hour lab)*

PHYS 301 ANALYTICAL MECHANICS I - This is part one of an intermediate course including particle motion, the statics and dynamics of rigid bodies, motion under central forces, and vibratory motion. This course is recommended for students interested in Physics, Applied Mathematics, and Engineering. Prerequisites: MATH 242 and PHYS 206. *3 credits*

PHYS 302 ANALYTICAL MECHANICS II – This is part two of an intermediate course including particle motion, the statics and dynamics of rigid bodies, motion under central forces, and vibratory

motion. This course is recommended for students interested in Physics, Applied Mathematics, and Engineering. Prerequisites: PHYS 301. *3 credits*

PHYS 308 HEAT AND THERMODYNAMICS - This course is a study of thermometry, specific heats, transfer of heat, change of state, kinetic theory, the laws of thermodynamics, thermodynamic potentials and Maxwell's relations. Prerequisite: MATH 242 (SPRING). *3 credits*

PHYS 312 PROPERTIES OF MATERIALS - This course covers basic principles, nature and properties of materials, as well as correlation of the structure of solids with their physical properties. Prerequisite: PHYS 204 or 206. Co-requisite: one semester of chemistry. (SPRING) *3 credits*

TRSS 105 SEMINAR ON PROFESSIONAL PRACTICE I – 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. (Spring) *1 credit*

TRSS 301 INTRODUCTION TO TRANSPORTATION SYSTEMS – This is the introductory course for transportation systems. It will discuss the basic concepts and strategies in the study of systems, and 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. *3 credits*

TRSS 305 URBAN LAND USE PLANNING – This course deals with the basic concepts, principles, strategies, and tools of urban land use planning. Emphasis will be on the interaction between transportation and land use variables, including modeling requirements, impacts, and data needs within the context of good community planning and economic development. (Fall) *3 credits*

TRSS 307 FREIGHT TRANSPORTATION SYSTEMS & LOGISTICS – 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. (Fall) *3 credits*

TRSS 318 TRANSPORTATION PLANNING & POLICY – 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. (Spring) *3 credits*

TRSS 319 GEOGRAPHIC INFORMATION SYSTEMS – 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. (Fall) *3 credits*

TRSS 399 TRANSPORTATION PRACTICUM – 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. *3 credits*

**TRSS 402 ECONOMICS OF TRANSPORTATION** – 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 or ECON 211 and MATH 114 or equivalent, and Junior status. (Fall) *3 credits*

**TRSS 406 PUBLIC TRANSPORTATION** – 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, MATH 114 or equivalent, and Junior status. (Fall) *3 credits*

**TRSS 408 ADVANCED LOGISTICS & SUPPLY CHAIN MANAGEMENT** – 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 and MATH 118. (Spring) *3 credits*

**TRSS 410 MANAGEMENT OF TRANSPORTATION SYSTEMS** – This course will discuss managerial issues and problems in the transportation industries, including economic, marketing, operational, financial, labor relations, and institutional components. Prerequisite: Junior status. (As needed) *3 credits*

**TRSS 412 TRANSPORTATION INFRASTRUCTURE/ASSET MANAGEMENT** – 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, MATH 118 or higher, and Junior status. (Fall) *3 credits*

**TRSS 414 TRAFFIC ENGINEERING** – 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 and Junior status. (Fall) *3 credits*

**TRSS 415 HIGHWAY ENGINEERING** – 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 and Junior status. (Fall) *3 credits*

**TRSS 416 MICROCOMPUTER APPLICATIONS IN TRANSPORTATION** – 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 414, TRSS 415, and Junior status. (Spring) *3 credits*.

TRSS 417 INTELLIGENT TRANSPORTATION SYSTEMS – 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 and junior status. (Spring) *3 credits*

TRSS 418 ADVANCED TRANSPORTATION PLANNING – 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 and Junior status. (Spring) *3 credits*

TRSS 420 TRANSPORTATION SYSTEMS EVALUATION – 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, MATH 114 or equivalent, and Junior status. (Spring) *3 credits*

TRSS 497 SENIOR TRANSPORTATION SEMINAR – This is a seminar arrangement intended to expose students to the art of developing research proposals, including identifying topics for senior projects; using statistical and other quantitative methods for data collection and analysis; and making oral presentations. (Fall) *1 credit*

TRSS 498 FUNDAMENTALS OF ENGINEERING EXAM SEMINAR – This seminar prepares student for taking the Fundamentals of Engineering Examination. Prerequisite: Senior status. *1 credit*

TRSS 499 SENIOR TRANSPORTATION PROJECT – 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: TRSS 497. *3 credits*

XEGR XXX MULTIDISCIPLINARY ENGINEERING ELECTIVE