

UNIVERSITY OF THE DISTRICT OF COLUMBIA
UNIVERSITY SENATE
ACADEMIC PROGRAMS
TRANSMITTAL FORM

TYPE OF REVIEW REQUESTED _____ NEW PROGRAM _____

Department Chair Date

College/School Curriculum Committee Chair Date

College/School Dean/Director Date

University Senate ASPPC Chair Date

University Senate President Date

Provost Date

University President (if required) Date

Board of Trustees Chair (if required) Date

**Proposal for a New Graduate Program at UDC
Graduate Program in Civil Engineering
Master of Science Civil Engineering (MSCE)**



Proposer: Pradeep K Behera, PhD, PE, DWRE
Associate Professor & Civil Engineering Program Director

Department of Civil and Mechanical Engineering
School of Engineering and Applied Sciences
University of the District of Columbia
Washington DC

November 2012

Table of Content

A. Review Type Requested – New Program3

B. Program Description3

 B1. Admission Standards5

 B2. Degree Requirements6

 B3. MSCE General Requirements6

 B4. Curriculum.....7

C. Program Feasibility9

 C.1 Demonstration of need (including internal and external supporting data)9

 C.2 Congruence with academic unit objectives and university mission 11

 C.3 Avoidance of duplication or overlap with existing courses or programs 12

 C.4 Relationships with Other UDC Programs 12

 C.5 Standards of relevant accrediting agencies and/or professional societies 12

 C.6 Students immediately affected if relevant and/or projected enrollment 12

 C.7 Effect on Student Development and Employment 13

 C.8 Adequacy and appropriate qualification of current faculty and support staff . 13

 C.9 Adequacy of current facilities (offices, classrooms, labs, etc.) 14

 C.10 Adequacy of supplies and equipment; Identify additional needs, if any 14

 C.11 Estimated costs, available funds and probable funding sources..... 14

 C.12 Adequacy of supportive library and technical resources..... 14

APPENDIX –A..... 15

A. Review Type Requested – New Program

The Department of Civil and Mechanical Engineering (CME) of the School of Engineering and Applied Sciences (SEAS) at the University of the District of Columbia proposes the establishment of a new graduate degree program in the Civil Engineering. This degree program will be named as **Master of Science in Civil Engineering (MSCE)**.

B. Program Description

The proposed graduate program, Master of Science in Civil Engineering (MSCE), is designed to meet the needs of aspiring civil engineering graduates, working professionals in the greater Washington DC Metropolitan area, and other national and international students. The proposed graduate program will (i) *provide UDC graduates a continuous path for obtaining advanced education in various sub-disciplines of civil engineering and (ii) prepare the civil engineering program in advance to meet the academic requirements of a master's degree for professional licensure, and (iii) enhance the existing 4-year BS Civil Engineering undergraduate program.*

Civil engineering, considered one of the oldest engineering disciplines, encompasses many specialties that include construction, environmental, water resources, transportation, structural, and geotechnical engineering. Civil Engineering is a professional engineering discipline that deals with planning, design, construction, operation and maintenance of the physical and naturally built environment for the benefit of humankind and it provides modern society with vital infrastructure and lifeline systems such as cities, roads, buildings, bridges, railroads, water supply systems, wastewater systems and stormwater management etc. The department has been offering ABET accredited bachelor's degree in civil engineering since 1988. The proposed MSCE program will offer a high-level graduate program with strong foundations in theory and applications to: a) equip students with interdisciplinary skills required to grasp and develop new technologies and trends in the civil and environmental engineering field; and b) prepare civil engineers with the knowledge and tools needed to advance into leadership roles and to shape the future of this dynamic field.

The program has been designed as a generic graduate program in civil engineering which can offer several tracks each specializing in various sub-disciplines of civil engineering such as water and environmental engineering, transportation engineering and construction and engineering management, structural engineering and geo-technical engineering. The implementation of these tracks will be accomplished in a gradual manner depending upon the availability of resources and market demand. The current proposal includes curriculum for the following tracks:

- Water and Environmental Engineering
- Transportation Engineering and Management

Future tracks will be added as the graduate program matures.

The MSCE requires a minimum of 30 credit hours of graduate-level work. The program offers both thesis and non-thesis options.

The ultimate goal of the graduate program is to reinforce, broaden, and integrate civil engineering education into university degree offerings and make UDC responsive to educational demands of a growing and advancing field in supply of essential civil engineering professional services, environmental protection, infrastructure rehabilitation and redevelopment, green engineering and urban sustainability and better management of the civil infrastructure (system). To reach this goal, the main educational objectives of MSCE degree program are as follows:

- a. To provide graduate students with up-to-date **advanced training** in selected **marketable** specialties of civil engineering and other civil engineering related **inter-disciplinary fields**;
- b. To provide graduate students with research opportunities to **solve real-world problems** in civil engineering in a sustainable manner and prepare students for entry into research-based doctoral studies in the discipline;
- c. To prepare graduate students for **leadership positions** in their professional field in both public and private sectors;
- d. To prepare civil engineering students academically to meet the requirements of the **engineering profession and their societies** (American Society of Civil Engineers, National Society of Professional Engineers and National Council of Examiners for Engineering and Surveying);
- e. To prepare students in **inter-disciplinary research** for developing innovative technologies.

Program Administration

The Chair of the department of civil and mechanical engineering will be responsible for the implementation and administration of the new MSCE degree program in civil engineering. All requirements in the program will be in compliance with the graduate studies requirements of the academic policies of the university.

The MSCE Degree Program Committee, referred to as the Graduate Committee, will be composed of faculty members in the department of civil and mechanical engineering with a Ph.D. degree and/or faculty from SEAS with a Ph.D. degree. The members of the graduate committee will be responsible for curriculum development and periodic review of the MSCE degree program in civil engineering.

The Graduate Committee will formulate academic policy, guidelines, and requirements consistent with the graduate council and university policies. The course development and day-to-day operations of the MSCE degree program will be the responsibility of the Graduate Committee. The Graduate Committee members will elect the Chair of the committee annually at the beginning of the fall semester.

The course work for each area of emphasis consists of a set of required core courses and a set of elective courses in the areas of civil engineering, mathematics, and other related fields. To integrate the technological advancement in the civil engineering

discipline into the curriculum, members of the graduate committee may propose new courses or changes in course content of any existing course. Proposals for adding new courses or curriculum changes to reflect the changing industry trends will be reviewed and recommended by the graduate committee. Recommendations for the addition of a new course or change of course content will then be presented to the entire CME department faculty for formal review and approval. Formal university procedure for approving the addition of new courses or changing the contents of existing courses will be followed. After formal university review and approval, the course additions/changes will be entered into the appropriate academic catalog and the University's course inventory.

Advising

Each student admitted into the program can select an advisor in his/her area of interest. An interim advisor will be assigned to each student until he/she chooses an advisor. Each student is responsible for discussing any special needs they may have with his/her advisor. Each student must also select an advisory committee that is composed of at least 3 members of the graduate faculty, the majority of whom must be members of the department of civil and mechanical engineering. The advisor serves as the chairman of the student's advisory committee. The advisory committee for each student must be formally approved by the Dean of the graduate school. The selection of advisor and the advisory committee for each student must be completed before the end of the second semester of his/her graduate studies. The dean of the graduate school may also elect to add an external member to the advisory committee. The advisory committee of each student is responsible for approving the course planning guide for that student, monitoring his work progress, and approving the successful completion of his/her studies.

B1. Admission Standards

To be considered for admission into the program, a student must satisfy the university-wide requirements for admission to graduate programs as established by the Office of Graduate Studies (Graduate School) at the university. However, the Civil and Mechanical engineering graduate committee may require higher and/or appropriate academic standards for admitting students to the department's graduate program. In general, the applicant must have completed a Bachelor's degree in civil engineering, or engineering science, or a closely-related field. The applicant must submit all documents required by the Graduate School to the Office of Admission. In addition, each applicant should also submit:

- Graduate Record Examination (GRE) basic test scores;
- A letter of intent describing his/her graduate studies goals and objectives;
- Three letters of reference from faculty, engineers or supervisors that can certify his/her ability to pursue studies at the Master's level.

International students from non-English speaking countries must satisfy the University requirements for English language proficiency. Complete applications satisfying the university's general graduate admission criteria will be sent to the department for consideration for admission to the graduate program. It is the policy of the graduate committee in the department to carefully consider every applicant's previous academic

and professional qualifications, test scores and achievements before an admission decision is made.

The Graduate School will inform applicants accepted for graduate study in writing whether they need to enroll in undergraduate courses and/or prerequisites requiring completion before commencing their graduate studies.

B2. Degree Requirements

There are two options for students enrolled in the MSCE program. They are:

- 1) Thesis option, and
- 2) Non-thesis option

A thesis option is offered for students who want the opportunity to obtain expertise in research and who may be interested in pursuing a doctoral degree in civil engineering or closely related field. A non-thesis option is offered for students who want practical industrial applications-oriented degree based exclusively on course work and a master's project, without a research component. Thesis and project reports must be approved by the faculty advisor and the thesis committee. It is noted that students who are supported as graduate research assistants are required to pursue the thesis option.

B3. MSCE General Requirements

- 1) Educational requirements for admission to program: Baccalaureate Degrees in Civil Engineering, Engineering Science, Environmental Engineering or closely related field.
- 2) Maximum of two graduate-level course units may be transferred from another institution to apply toward the MSCE degree. Transferred courses must logically fit into the student's graduate program. The student's graduate advisor decides which courses are acceptable. Approval of transfer credit is required. These two courses should not have been used in fulfillment of any other degree(s).
- 3) At least half of the coursework credits, excluding thesis or technical report credits, must be taken with other than a single professor.
- 4) Any coursework more than six years old at the time of the final examination will not be used to fulfill any of the MSCE degree requirements.
- 5) All graduate credits must have letter grades of A, B, or C, or pass/fail grades of S (Satisfactory). No more than two graduate courses with letter grade C will be accepted.
- 6) A minimum grade point average (GPA) of 3.0 is required to remain in good standing and to graduate.

Degree Requirements for the Thesis Option

- 1) Plan of Study - the student must meet with his/her advisor to formulate a plan of study. The plan of study must be submitted to the student's advisory committee after completing at least 9 but no more than 15 semester credits.
- 2) Satisfactory completion of 30 credit hours of approved graduate credits including 6 hours of thesis.

- 3) At least 18 credits of course work, excluding thesis, must be at or above the 500 level. Courses below the 500 level must be approved by the student's advisory committee.
- 4) Admission to Candidacy - the admission to candidacy form must be completed prior to the thesis defense. The student should consult the university academic calendar for deadlines on submitting this form for graduation.
- 5) Thesis Defense - a copy of the thesis should be distributed to each member of the advisory committee and to the Graduate School at least two weeks prior to the defense. The advisor and the Graduate School should make a public announcement of the defense within the department to allow attendance by interested faculty, students, and the University Community.
- 6) Upon application for the thesis defense, students are required to submit a technical paper or abstract, based on some aspect of the thesis research, in a form suitable for submission to a regional technical conference.

Degree Requirements for the Non-Thesis Options

- 1) Plan of Study - the student must meet with his/her advisor to formulate a plan of study. The plan of study must be submitted after completing at least 9, but no more than 15 semester credits.
- 2) Satisfactory completion of 30 credit hours of approved graduate credits.
- 3) At least 21 credits of course work must be at or above the 500 level. Courses below the 500 level must be approved by the student's advisory committee.
- 4) Completion of a 3-credit project report based on a current practical industry-type problem or contemporary field application study.

B4. Curriculum

The university catalog contains statements of regulations that apply to all graduate students. Of particular interest are the sections on admissions and degree programs and requirements. Statements referring to foreign language requirements do not apply to students in the MSCE program. The MSCE program has several tracks and all MSCE students, without exception, complete one track. Each degree option described above has provision for course work beyond the selected track. Thus, considerable breadth in the student's program is possible. All course selections must be part of an approved program of study. The course requirements for both options are summarized below:

MSCE – Thesis Option		MSCE – Non-Thesis Option	
Category	Credit hours	Category	Credit hours
Core Courses	09	Core Courses	09
Technical Elective Courses	12	Technical Elective Courses	15
Free Elective Course (Out of Department)	03	Free Elective Courses (Out of Department)	03
Master's Thesis	06	Master's Project	03
Total	30		30

Following presents MSCE two tracks and their course requirements:

The course requirements for students specializing in **Water and Environmental Engineering track** include:

- i) Three core courses
 - a. ELEC – 507 Probability and Random Processes
 - b. CVEN – 540 Modeling of Water Resources Systems
 - c. CVEN – 541 Water Quality Assessment Monitoring & Treatment
- ii) Select the rest of courses from the suggested courses in Group A of and the free elective course from Group B. Selected courses must be approved by the student's advisory committee.
- iii) Project option students must take CVEN-599, Masters project that counts for 3 credit hours
- iv) Thesis option students must take CVEN-699 Master's Thesis that count for 6 credit hours.

The course requirements for students specializing in **Transportation Engineering and Management track** Include:

- i) Take following three core courses
 - a. ELEC – 507 Probability and Random Processes
 - b. CVEN – 560 Modeling Methods in Transportation Engineering
 - c. BGMT – 506 Management Theory and Practice
- ii) Select the rest of courses from the suggested courses in Group A and the free elective course from Group B. Selected courses must be approved by the student's advisory committee.
- iii) Project option students must take CVEN-599, Masters project that counts for 3 credit hours
- iv) Thesis option students must take CVEN-699 Master's Thesis that count for 6 credit hours.

Following presents MSCE two tracks and their course requirements:

Group A Course List

CVEN 543	3	Engineering Hydrology
CVEN 544	3	Advanced Urban Stormwater Management
CVEN 545	3	Open Channel Hydraulics
CVEN 546	3	Water and Wastewater Engineering
CVEN 547	3	Environmental Law & Environ. Policy Development
CVEN 548	3	Principles of Environmental Engineering
CVEN 549	3	Advanced Environmental Engineering
CVEN 550	3	Water and Wastewater Treatment Systems
CVEN 551	3	Advanced Topics in Water and Environmental Engineering
CVEN 552	3	Evaluation of Environmental Engineering Systems
CVEN 555	3	Field Databases
CVEN 561	3	Transportation Systems Analysis
CVEN 562	3	Highway Traffic Flow Theory
CVEN 563	3	Urban Transit Planning and Rail Transportation Eng.

CVEN 564	3	Advanced Traffic Engineering
CVEN 565	3	Intelligent Transportation Systems
CVEN 566	3	Advanced Topics in Transportation Engineering
CVEN 579	3	Special Studies in Civil Engineering
CVEN 589	3	Independent Studies
CVEN 641	3	Water Resources System Analysis
CVEN 642	3	Sustainable System & Green Engineering
CVEN 588	3	Independent Study
CVEN 599	3	Master's Project (3 credit hours)
CVEN 699	3	Master's Thesis (6 credit hours)
WTRM 501	3	Surface & Ground Water Hydrology
WTRM 505	3	GIS for Water Resource Management
WTRM 601	3	Water Quality Modeling
BSEF 505	3	Managerial Economics
ACCT 504	3	Accounting for Management Functions
BGMT 506	3	Management Theory and Practice
BGMT 509	3	System Approach and Project Management
BGMT 526	3	Quantitative Business Methods
BGMT 518	3	Management of Human Resources
MATH 599	3	Research Method, Statistics and Data Mining

Group B Course List

MMED 520	3	Public Communication for STEM Professionals
----------	---	---

The course requirements for students majoring in any of the above tracks in the civil engineering area are:

- i) Take three core courses in applicable track.
- ii) Select four/five technical courses from the depth courses defined for each of the track. Selected courses must be approved by the student's advisory committee.
- iii) Select one course on public communication for STEM professionals
- iv) Select following courses from for thesis and non-thesis options.
 - (1) Project option students must take CVEN-599 Master's Project that counts for 3 credit hours.
 - (2) Thesis option students must take CVEN-699 Master's Thesis that counts for 6 credit hours.

C. Program Feasibility

C.1 Demonstration of need (including internal and external supporting data)

The department of civil and mechanical engineering has a critical need to establish a Master of Science in Civil Engineering (MSCE) degree program for the following reasons:

- According to the U.S. Bureau of Labor Statistics 2010-20 (http://www.bls.gov/emp/ep_table_102.htm), overall engineering employment in US is expected to grow by 10% over the 2010–20 decade, however, **civil engineers and environmental engineers are expected to have employment growth of 19.4% and 21.9% respectively over the projection decade**, which is much faster than the average for all occupations. The civil engineering employment growth is attributed to population growth and related need to improve the Nation’s infrastructure replacement and/or rehabilitation of aging infrastructure. The growing demand for civil engineers in both public and private sectors remain not only with bachelor’s degree but also specialized master’s degree.
- Employment projections continue to show an increase in science, technology, engineering and Mathematics fields (STEM); especially in Washington, D.C. region. Employment projections in STEM fields appear promising. The U.S. Department of Labor has predicted a 29 percent increase in STEM jobs, adding about 2.1 million new jobs between 2010 and 2020. Washington, D.C. region has more than two times the concentration of STEM jobs than the national average.
- American Society of Civil Engineer’s (ASCE) Board of Direction adopted the “Policy Statement 465: First Professional Degree, which supported the concept that the master’s degree or an equivalent would be required for a graduate engineer to practice civil engineering at the professional level” (Nowatzki, 2003). Consequently, the Civil Engineering Body of Knowledge (BOK) for 21st Century (2nd Edition) published by ASCE defined the policy as “the necessary depth and breadth of knowledge, skills and attitudes required of an individual entering the practice of civil engineering at the professional level in the 21st century”. The implementation of Policy Statement 465 is presented in following Figure:

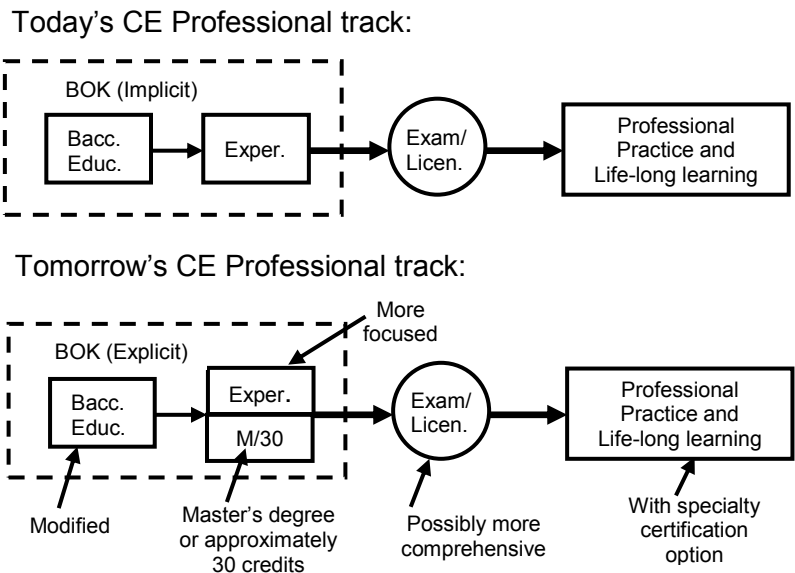


Figure: Implementation of ASCE’s Policy Statement 465

- National Council of Examiners for Engineering and Surveying (NCEES) published the Model law (http://www.ncees.org/About_NCEES/Publications_Publications/Model_Law.php), which states that the minimum academic requirement- for Professional Engineer licensure would be a masters degree effective January 2020.
- The proposed graduate program will address both the implementation of ASCE's policy for future civil engineering students and creation of opportunities for current and future civil engineering students and professionals within the Washington DC metropolitan area as well as national and international students. There are a number of engineers, mainly civil engineers, who have a desire to further their education in environmental engineering to add more specialization to their general undergraduate studies. Most of the local universities (GWU, HU, CUA, UMD, and GMU) offer traditional graduate programs in various sub-disciplines of civil engineering. The comparative cost of graduate programs has been a hindrance for underrepresented minorities to pursue advanced degree which would be attractive for our MSCE program.
- In the Metropolitan Washington, DC region of over 4 million people, the role of the profession of civil engineer and the architectural-construction industry is ranked close to the professions of law, finance, information technology and service oriented business as driving engines of the region's economy. As the nation's first, and only, urban land grant university, a graduate program in civil engineering along with existing nationally accredited B.S. Civil Engineering program would immeasurably improve UDC's capacity to fully exercise its responsibilities as a major institutional partner in the promotion of culture, in increasing economic development, and on the influence of physical planning policies for Washington, DC and the national capital region.
- The availability of graduate programs in the CME department will enhance existing undergraduate B.S. program and increase the visibility of the department and improve its academic ranking in the nation. This will help attract highly qualified faculty, and more and better qualified undergraduate students to the department and School of Engineering and Applied Sciences.

C.2 Congruence with academic unit objectives and university mission

The University of District of Columbia Strategic Plan is structured around goals that lie in the intersecting arenas of learning, scholarship and community service. The proposed graduate program will support goals in each of these arenas and intersections. In the arena of learning it will promote advanced civil engineering education and its integration into the curricula, and it will help students develop critical thinking and advanced professional skills that will make them more competitive in career placement. In the arena of scholarship it will help students develop skills to support faculty in meeting the goals of using advanced science, engineering and technology innovation in various dimensions of scholarship. In the arena of service it will, by supporting outreach activities and serving minority civil engineering students, address the needs of DC residents. It will rise to meet the obligations of only urban land-grant university of the nation.

The proposed graduate program will also meet the SEAS's goals of providing graduate program in all of the engineering programs and creating opportunities for research activities in civil engineering. It will provide synergistic effect on the other programs within the school as well as other programs of the university.

In addition to meeting University and SEAS goals related to interdisciplinary collaboration, and scholarship, the graduate program will also meet more specific department goals. To this end, it will support the goal of integrating instructional, research and outreach efforts. Since engineering entails analysis and solution of real-world problems, the program will promote the departmental goal of focusing its scholarship "on the real-world, problem-solving needs of the built environment."

C.3 Avoidance of duplication or overlap with existing courses or programs

The master of civil engineering program will not duplicate any other program or courses currently offered at UDC. Closely related to the proposed MSCE in (i.e., Water and Environmental Engineering) is Water Resources Management program offered as a Professional Science Masters (PSM) degree program offered by the College of Agriculture, Urban Sustainability and Environmental Sciences (CAUSES). The degree offered by CAUSES is suited exclusive for science majors and not suited for civil and environmental engineering majors.

C.4 Relationships with Other UDC Programs

The proposed MSCE program will complement and help strengthen other graduate programs not only within the SEAS but also other programs in the university, through collaboration in multidisciplinary research activities. The Master of Civil Engineering program will have the same synergistic relationships with other UDC programs as have always existed between the undergraduate civil engineering programs and UDC programs in engineering, urban studies, and environmental sciences. The interdisciplinary nature of the civil engineering will enhance the collaborative research activities with other disciplines.

C.5 Standards of relevant accrediting agencies and/or professional societies

The undergraduate civil engineering program of the CME department is accredited by ABET, Inc. ABET accredits either the undergraduate or the graduate program of any particular department. In our case, no outside accreditation is required for the graduate program. American Society of Civil Engineers is the professional association of civil engineering profession. It provides general directions to the program.

C.6 Students immediately affected if relevant and/or projected enrollment

Most of the UDC civil engineering students currently enrolled in the 4-year B.S. civil undergraduate programs will be positively affected. Also affected, are the majority of undergraduate program graduates over the past decade those who are employed in various public and private sectors within the Metropolitan DC area. It is expected that the civil engineering alumni will make up a significant portion of the potential MSCE program applicant pool.

An implemented MSCE professional degree program at UDC would hold tremendous market attraction to persons seeking a quality, economical alternative to existing civil

engineering graduate Washington area programs. Most of the Washington area graduate programs including those at Howard University, Catholic University, George Washington University, University of Maryland at College Park, and Morgan State University in Baltimore attract a significant number of students who would find an economical program at UDC to be a serious and good option. Most of those programs are prohibitively expensive in comparison to UDC.

In summary, enrollment in the UDC Master of Civil Engineering program would be drawn from several sources:

- a. Currently enrolled UDC undergraduate civil engineering students,
- b. Recent UDC civil engineering graduates,
- c. UDC civil graduates dating back over the past 20 years,
- d. Graduate Students transferring from other universities,
- e. Other engineering bachelors degree holders seeking a career change, and
- f. International students who are interested to pursue graduate program in civil engineering.

An initial entering class of 5 to 10 qualified and highly motivated students drawn from the above pool of potential applicants can be considered as a highly realistic enrollment target for the first year of the MSCE program. The impact of a SEAS civil engineering master's program will have a dramatic effect on undergraduate recruitment. The eventual enrollment of 50 new undergraduate and 10 graduate civil engineering students each year becomes a highly credible target. We also expect faculty to increase their scholarship and to provide research assistantships to the students.

C.7 Effect on Student Development and Employment

The advanced specialized studies in civil engineering would also have a significant effect on the development and employability of students. The addition of the graduate professional degree and university commitment to research and innovation will represent a strong, positive signal to current and future undergraduate and graduate students. Student morale will increase significantly. Prospective employees will be favorably impressed, thereby raising the bargaining position of graduates in the market place. In addition, a graduate program would improve faculty productivity and the probability of winning competitive research grants.

C.8 Adequacy and appropriate qualification of current faculty and support staff

The program will initially depend upon the appropriately qualified faculty members in the primary area of this program. The faculty of the CME department has the highest qualifications needed for their profession. However, adjunct faculty will be hired both to take advantage of the specialized expertise found in the Washington metropolitan area and to expose our students to professionals working in the field, and expose potential employers to our future graduates.

The program's faculty and visiting faculty consists of other nationally recognized civil engineering educators and practitioners. However, the addition of the MSCE to the department will require at least two additional full-time permanent faculty members. In order to sustain the program in the initial period, graduate students will be encouraged to

take elective courses from the PSM Water Resources Management program and maximum of two courses from the group of consortium universities.

C.9 Adequacy of current facilities (offices, classrooms, labs, etc.)

The current department facilities (academic space) shared by SEAS and other program square footage (dispersed through buildings 32 and 42) will be adequate to support the program in first year. However, space will be needed for lecture room, research laboratory and graduate student offices as the program matures.

C.10 Adequacy of supplies and equipment; Identify additional needs, if any

The expected increase in enrollment will require the acquisition of additional software licenses, laboratory equipment, more office supplies and teaching and research materials.

C.11 Estimated costs, available funds and probable funding sources

This budget presented in this section is preliminary since the actual fiscal impact statement will be prepared by the Budget Office. The rationale for the use of adjunct faculty is described previously in Section C.8. In addition The Department of Civil and Mechanical Engineering expects external funding, from the federal, and District agencies as well as industries, after the successful implementation of the MSCE program. Currently initiatives of the department, primarily in civil engineering, include (i) Capital Transportation Research Center- Improving Safety and Mobility in the Greater, (ii) National Capital Region Flood Risk Assessment Program by UMD, UDC and GMU, and (iii) University Transportation Center are in progress. The civil engineering faculty are involved in these proposals.

As student enrollment increases the requirement of additional full-time faculty is needed for the civil engineering program. Moreover, institutional resources in the amount of \$200,000 on average per year in the first three years may be needed to help jumpstart the program. Part of this funding will be used to hire new faculty members, funding for research activities, and to support research and teaching assistants in the program.

Moreover, in order to make this program sustainable, it is proposed that the MSCE will start with one track in the fall of 2011 and other track will be introduced subject to the availability of resources and/or extramural funding.

C.12 Adequacy of supportive library and technical resources

The supportive library and technical resources are adequate to start the program. However, it may be required the UDC subscription to some of the digital libraries for various discipline specific journals and books. We will work collaboratively with the LRD on these acquisitions.

APPENDIX –A

Detailed Catalog Descriptions for Courses in the Program

Course Name & Number	Course Description
ELEC – 507 Probability and Random Processes (3 crd.)	This course deals with foundations for the engineering analysis of random processes: Review of probability theory, Introduction to stochastic processes, Continuous time and discrete time processes, Mean functions, correlation functions, covariance functions, noise, Strict- and wide-sense stationarity, ergodicity, Gaussian processes, power spectral densities, mean square estimation, Markov processes. Prerequisite: Graduate standing and understanding of probability at the level of 3531-307 or consent of instructor.
CVEN-540 Modeling of Water Resources Systems (3 crd.)	This course deals with water resources systems that are physically complex and the solution of appropriate mathematical models is computationally demanding. Global and national water problems, law and legislation; Hydraulic structures; Urban drainage and runoff control: meteorological data analysis, deterministic and stochastic modeling techniques. This course considers physical processes in water resource systems, their mathematical representation and numerical solutions.
CVEN-640 Water Resources System Analysis (3 crd.)	This course deals with the planning, design and management of multi-component water resources systems. After a review of the use and nature of water resources systems, topics studied in detail are: water resource economics, methodology of design, system analysis, system design and decision making, applied mathematical programming, probabilistic models and water quality subsystems.
CVEN-543 Engineering Hydrology (3 crd.)	This course emphasizes engineering applications of hydrologic science. Topics include Rainfall-runoff analysis, lumped and distributed flow routing, reservoir and river flood routing, kinematic, diffusive and dynamic waves. Precipitation data analysis and optimal interpolation. Hydrologic design: risk analysis, hydro-economic analysis, and analysis of uncertainty. Bayesian decision analysis. Design storms. Design flows. Hydrologic reservoir design. Watershed modeling applied to hydrologic design.
CVEN-544 Advanced Urban Stormwater Management (3 crd.)	This course deals with urban hydrology, evolution of urban drainage problems, land development, point source and non-point source pollution, Stormwater quantity and quality control strategies, erosion and sediment control, modeling of urban stormwater management systems, design of best management practices, green engineering and sustainable water management systems.
CVEN 552 Evaluation of Environmental Engineering	This course investigates the issues and techniques for the evaluation of alternative plans, designs and policies for civil engineering systems with a focus on environmental and transportation problems. Topics include rational decision-making;

Systems (3 crd.)	the measurement of benefits and costs; alternative public investment criteria; risk management; and various evaluation techniques, such as cost benefit analysis, weighting methods, decision analysis and mediation. A number of case studies are discussed in class.
CVEN-545 Open Channel Hydraulics (3 crd.)	This course deals with open channel flow and their properties, energy and momentum principles, uniform flow, gradually varies flow, hydraulic structures, unsteady flow and numerical solutions of unsteady flow equation.
WTRM 501 Surface and Groundwater Hydrology (3 crd.)	This course concentrates on the quantification of surface and groundwater hydrological processes. An understanding of rainfall, evapotranspiration, runoff, groundwater recharge, groundwater storage, groundwater movement and the engineering and/or management of the water environment. The course provides a conceptual and quantitative understanding of hydrology and the basic principles of hydraulics as a basis for later applied studies of water quality, water engineering, and water management.
WTRM 505 GIS for Water Resources (3 crd.)	This course equips the student with a set of spatial data management and analysis tools, which can be applied to different water resources problems. The course focuses on the principle and application of the Geographical Information System to water resource management.
CVEN 546 Water and Wastewater Engineering (3 crd.)	This course provides the fundamental of water and wastewater engineering, that deals with theory, practice and design principles
CVEN 548 Principles of Environmental Engineering	The course covers basic concepts in environmental engineering design including environmental engineering hydrology, hydraulics, and pneumatics; water treatment; and conventional wastewater treatment.
CVEN-549 Advanced Environmental Engineering	Topics of current interest in environmental engineering. Content may vary from offering to offering.
CVEN 547 Environmental Law and Policy Development (3 crd.)	This course will focus on an interdisciplinary approach to water resources research that integrates the human and the technological dimensions of water resource issues. This course also include an introduction to current environmental and natural resource law regulation emphasizing point and non-point source pollution under the federal Clean Water Act. It is comprised of lecture and discussion sessions with guest lectures by visiting seminar speakers.
CVEN 555 Field Databases (3 crd.)	Introduction to databases, the relational model, normalization and relationships and trends including web applications, A modern application software package is used to build a database that include tables, queries, forms and reports.

<p>MATH-599 Research Method, Statistics and Data Mining (3 crd.)</p>	<p>This course provides the basic methods and techniques of the scientific research, helping students to understand data, interpret them and use data to predict future outcomes of a certain process or phenomenon, including examples from water resource management and other specialties required by the students enrolled. It examines the principles of statistical data mining including the foundation of probability and data analysis, modeling, data mining algorithms, patterns and rules of discovering. Different hands –on applications of data mining techniques will be introduced during the course.</p>
<p>WTRM 601 Water Quality Modeling (3 crd.)</p>	<p>This course is designed to give graduate level students an overview of water quantity and quality aspects of surface water characteristics and the analytical methods used in the development of water quality models and the application of these models to stream and river systems, lakes and reservoir systems and estuaries. Mathematical conceptualization and formulation of physical, chemical, biological, and hydrological water quality constituent transport and fate mechanisms will be discussed in depth. Students will consider the origin, behavior, and fate of nutrients and toxic substances in rivers, lakes and estuaries.</p>
<p>BGMT-506 The System Approach – Project Management (3 crd.)</p>	<p>This course examines management, the systems concept and matrix management; project planning, organization, staffing, direction, and control; project management authority; project budgeting and cost analysis; project implementation and evaluation.</p>
<p>CVEN-561 Transportation Systems Analysis (3 crd.)</p>	<p>This course deals with use of operations research and systems engineering techniques in analyzing and evaluating transportation systems.</p>
<p>CVEN-562 Highway Traffic Flow Theory (3 crd.)</p>	<p>An examination of physical and statistical laws that are used to represent traffic flow phenomena. Deterministic models including heat flow, fluid flow, and energy-momentum analogies, car following models, and acceleration noise. Stochastic approaches using independent and Markov processes, Queuing models, and probability distributions.</p>
<p>CVEN-563 Urban Transit Planning and Rail Transportation Engineering (3 crd.)</p>	<p>Basic engineering components of conventional and high speed railroads and of air cushion and other high speed new technology. The study of urban rail and bus transit. The characteristics of the vehicle, the supporting way, and the terminal requirements will be evaluated with respect to system performance, capacity, cost, and level of service.</p>
<p>CVEN-564 Advanced Traffic Engineering (3 crd.)</p>	<p>Students become proficient in the use of traffic simulation and analysis software used in industry, include design of intersection traffic signals and traffic signal controller settings. Several projects will be assigned throughout the semester.</p>

CVEN-565 Intelligent Transportation Systems (3 crd.)	This course deals with commands, controls and communications in modern multimodal transportation; infrastructure/highway and vehicle automation, advanced traffic management, vehicle control and safety systems; information, data, and sensory requirements; practical applications and projects.
CVEN 599 Master's Project (Non-thesis Option)	A supervised project for non-thesis option equivalent to one regular three-credit course. Topics to be determined by student and supervisor. The project must appear on the Proposed Program Form for approval prior to start.
CVEN 699 Master's Thesis	A supervised research project for thesis option equivalent to two regular three-credit courses. Topics to be determined by student and supervisor.
Special Studies in Civil Engineering	This course offers research-stream graduate students the opportunity to expand their writing and presentation skills in preparation for writing top-notch papers, theses and other publications.
CVEN-588 Independent Study (3 crd.)	This course allows graduate students the opportunity to explore areas of academic and professional interest in which no formal course is available. It provides the graduate student the opportunity to explore an area which may lead to a thesis problem or which will provide further understanding in a particular area.
BGMT 506 Management Theory and Practice	This course provides concepts of management, application of management principles, comparative management practices in different types of organizations, and the impact of modern computer technology.
BGMT 509 System Approach and Project Management	This course examines management and the systems concept, matrix management; project planning, organization, staffing, direction, and control; project management authority; project budgeting and cost analysis; project implementation and evaluation.
BGMT 526 Quantitative Business Methods	This course provides a survey of quantitative techniques used in solving management problems. Potential and limitations of analytical methods and their application to modern problems. Topics included are probabilistic and deterministic models, linear programming, decision theory. PERT and CPM, and Markov analysis.
BGMT 518 Management of Human Resources	This course deals with basic personnel functions to build and work with an effective and satisfied work force. Attention is focused on tasks of procuring, developing, maintaining, and utilizing a work force and on topics such as specifying job and manpower requirements; attracting, screening, interviewing, and testing people, employee training and development; merit evaluation; compensation and employee service programs; and collective bargaining.
ACCT 504 Accounting for Management Functions	Provides an understanding of the reporting, control, and analytical context in which accounting functions; pre-planning and analyzing financial statements; cost/volume/profit relationships; capital budgeting.

MMED 520 Public Communication for STEM Professionals	This course deals with communication skills for STEM professionals – investigative informative speaking, persuasion, group discussion, impromptu, manuscript, and research writing.
--	---