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Dr. Hoe-Gil Lee Mechanical Engineering Program Coordinator/Graduate Program Coordinator Department of Mechanical, Environmental, and Civil Engineering Box T-0390 Stephenville, Texas United States 76401 254-968-9520 hlee@tarleton.edu

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The department of Mechanical, Environmental, and Civil Engineering (MECE) offers bachelor's degrees in Civil Engineering, Environmental Engineering, Mechanical Engineering, and a master's degree in Mechanical Engineering. MECE majors engage in hands-on applications of discipline-related concepts and tools, taught in an engaging, student-centered, academic success-focused environment. Our department houses state-of-the-art instructional and research equipment including industry-standard software, 3D printing, automation and robotics, hydraulic flume, 145 mph wind tunnel, jet engine, centrifugal pumps, and a 100 kN universal testing machine. Students gain practical experience with these tools throughout the curriculum and also have the opportunity to conduct undergraduate research with our faculty. A degree from the MECE department opens doors to challenging and rewarding, high-salaried, high-tech engineering careers.

Departmental Course Prerequisite Policy

It is important for students to stay academically prepared as they progress through their curriculum. Prerequisite (taken previously) and corequisite (taken previously or concurrently) courses are in place to establish the foundational knowledge and skills needed to be successful in any given course. For all programs in the MECE department, students must earn a grade of "C" or better in all required Engineering, Mathematics and Science coursework to graduate, as well as to proceed to follow-up courses. The following summarizes the policy for allowing/disallowing forward progress when prerequisite (prereq) and/or corequisite (coreq) conditions are not fully met:

- If a student earns an F in a prereq course or has not taken that prereq, the student may NOT enroll in the follow-up course.
- If a student earns a D in a prereq for a course, the student IS allowed a prereq waiver to enroll in the follow-up course only if ALL THREE of the following conditions are met:
 - The student has an overall GPA of 2.2 or higher, AND
 - If by not enrolling in the follow-up course, the student's graduation date is adversely impacted (advisor must check the cascading effect of not enrolling in a course), AND
 - The student has not exceeded the max of FOUR prereq waivers.

If a student qualifies for a prereq waiver, the student must re-enroll in the prereq course concurrently; if the prereq course is not offered concurrently, the student must re-enroll on its immediate next offering. A student may utilize a maximum of FOUR prerequisite waivers over the duration of their pursuit of a degree within the MECE Department. Changing majors within the department does not reset the waiver count.

The department also allows a maximum of TWO engineering courses in a curriculum that can be taken as a transient (temporary) student at another university. Consult the department website, office or an advisor for additional information on these policies.

Bachelor of Science in Civil Engineering

The Civil Engineering (CVEN) program at Tarleton State University was launched in Fall 2014. The program is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org (https://nam11.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.abet.org %2F&data=04%7C01%7CAGAPIE%40tarleton.edu%7C8440dc5d24a14b88d3fc08d8df135a6c%7C2c5ee638a96349c0ac26828dd9b78d5e %7C0%7C0%7C637504621495074894%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAiLCJQIjoiV2IuMzliLCJBTil6lk1haWwiLCJXVCI6Mn0%3D %7C1000&sdata=miktx%2FeS9ehBn5whOh4z7yZLggSW0HQKkznVvAYFDg%3D&reserved=0). The mission of the CVEN program is to prepare the students to work competently as a professional engineer in Civil Engineering related industries and consulting firms, for engineering licensure and for graduate studies through a rigorous curriculum utilizing modern analytical tools, hands-on laboratory experiences and field applications. The program includes the following broad fields of specialization: structural engineering, transportation engineering, construction engineering, hydrology and water resources engineering, geotechnical engineering, materials, and mechanics. Throughout the program, students develop their ability to communicate effectively in a team-oriented and project-driven environment. Additional studies in ethics and sustainability design develop students' ability to understand the responsibilities to public safety and to protect the environment as civil engineers.

The mission of the CVEN program aligns with the mission of the Mayfield College of Engineering (https://www.tarleton.edu/engineering/), as well as the mission of Tarleton State University (http://catalog.tarleton.edu/tarletonstateuniversityanoverview/).

Students must earn a grade of "C" or better in all required Engineering, Mathematics and Science coursework to graduate. Students must also take, or be registered to take, the Fundamentals of Engineering (FE) licensure exam to graduate.

General Education Requirements (http://catalog.tarleton.edu/academicaffairs/)		42
ENGR 1211	Engineering Fundamentals I	2
ENVE 2251	Fundamentals of GIS for Engineers	2
ENGR 2321	Engineering Mechanics: Statics	3
ENGR 2324	Engineering Mechanics: Dynamics	3
ENGR 3311	Engineering Mathematical Methods	3
ENGR 4258	Engineering Professionalism	2
ENGR 4380	Engineering Capstone	3
CVEN 2200	Surveying	2

Total Hours		128
MATH 3306	Differential Equations	3
MATH 3433	Calculus III	4
MATH 2414	Calculus II	4
MATH 2413 [shared]	Calculus I	
Placement is required for Calculus ?	1.	
or PHYS 2426	University Physics II	
ENGR 4084	Professional Practice ¹	3
PHYS 2425 [shared]	University Physics I	
CHEM 1409	College Chemistry for Engineers	4
or BIOL 1406	Biology for Science Majors	
GEOL 1403 [shared]	Physical Geology	
Additional Basic Science Elective [sha	red]:	
ENVE 4310	Water Resources Engineering	3
ENVE 3310	Engineering Hydrology	3
ENVE 3300	Fluid Mechanics	3
ENVE 2311	Soil Mechanics	3
CVEN 4360	Highway Planning and Design	3
CVEN 4450	Transportation Engineering	4
CVEN 4325	Foundation Engineering	3
CVEN 4306	Steel Design	3
CVEN 4305	Reinforced Concrete Design	1
CVEN 3123	Strength of Materials	1
CV/EN 3323	Strength of Materials	ు న
CVEN 3245	Civil Engineering Lab I	2
CVEN 3320	Construction Planning and Management	3
CVEN 3301	Structural Analysis	3
CVEN 2235	Civil Engineering Graphics	2
CVEN 2312		3
01/51/0010		0

Bachelor of Science in Environmental Engineering

The Environmental Engineering program at Tarleton State University is accredited by the Engineering Accreditation Commission of ABET, www.abet.org. The mission of the Environmental Engineering program is to prepare graduates for employment as engineer in Environmental Engineering related industries and consulting firms, for engineering licensure, and for graduate studies in Environmental Engineering, Civil Engineering or related disciplines. This is accomplished through a curriculum supported by hands-on laboratory and field experiences in which students develop their ability to synthesize concepts into solutions, use modern analytical tools and techniques, communicate professionally and work in a team environment. The program includes a breadth of topics including water and wastewater treatment, environmental risk assessment, solid and hazardous waste management, remediation engineering, and project management. Additional studies in ethics and policy assure that the graduate understands the special responsibilities of an engineer related to public safety and environmental issues. This results in engineering raduates who strive to advance the engineering profession through technical competence, innovative problems solving and design, professional conduct, and lifelong learning. Additional details can be found on the department website: https://www.tarleton.edu/mece/.

Students must earn a grade of "C" or better in all Engineering, Mathematics, and Science coursework in order to graduate. <u>Students must also take, or be</u> registered to take, the Fundamentals of Engineering (FE) licensure exam in order to graduate.

General Education Requirements (http://catalog.tarleton.edu/academicaffairs/)		
ENGR 1211	Engineering Fundamentals I	2
ENGR 2322	Engineering Thermodynamics I	3
ENGR 3311	Engineering Mathematical Methods	3
ENGR 4258	Engineering Professionalism	2
ENGR 4380	Engineering Capstone	3
CVEN 2235	Civil Engineering Graphics	2
ENVE 2251	Fundamentals of GIS for Engineers	2
ENVE 2310	Introduction to Environmental Engineering	3
ENGR 2321	Engineering Mechanics: Statics	3
ENVE 3300	Fluid Mechanics	3
ENVE 3301	Environmental Systems Modeling	3
ENVE 3310	Engineering Hydrology	3
ENVE 3333	Groundwater Contamination and Remediation	3
ENVE 3340	Environmental Risk Assessment	3
ENVE 3350	Environmental Biotechnology	3
ENVE 4302	Atmospheric Systems and Air Pollution Control	3
ENVE 4310	Water Resources Engineering	3
ENVE 4320	Chemical and Biological Processes in Water and Wastewater Treatment	3
ENVE 4319	Physical Operations in Water and Wastewater Treatment	3
ENVE 4350	Solid and Hazardous Waste Management	3
ENVE 4220	Environmental Lab	2
ENVE 4225	Environmental Monitoring and Measurements	2
Placement is required for MATH 24	413	
MATH 2413 [shared]	Calculus I	
MATH 2414	Calculus II	4

3

Total Hours		128
or PHYS 2426	University Physics II	
ENGR 4084	Professional Practice ¹	3
PHYS 2425 [shared]	University Physics I	
or BIOL 4401	Ecology	
BIOL 4441	Freshwater Biology	
Biological Science Elective		2
GEOL 1403 [shared]	Physical Geology	
CHEM 2123	Organic Chemistry I Laboratory	1
CHEM 2323	Organic Chemistry I	3
CHEM 1409	College Chemistry for Engineers	2
MATH 3306	Differential Equations	3
MATH 3433	Calculus III	2

Bachelor of Science in Mechanical Engineering

The Mechanical Engineering program at Tarleton State University was approved in January 2017 and is accredited by the Engineering

Accreditation Commission of ABET, <u>www.abet.org</u> (https://nam11.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.abet.org %2F&data=04%7C01%7CAGAPIE%40tarieton.edu%7C289384552c6a4c6752b508d8ddd75623%7C2c5ee638a96349c0ac26828dd9b78d5e %7C0%7C0%7C637503264299483035%7CUnknown%7C1WFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMZIiLCJBTil6lk1haWwiLCJXVCI6Mn0%3D %7C1000&sdata=KFAsFpXWRiIFQN9DLSy4cS8yE62821ipn739UWIXV1s%3D&reserved=0). The mission of the Mechanical Engineering program is to prepare graduates for employment as an engineer in a breadth of Mechanical Engineering-related industries, for engineering licensure, and for graduate studies in Mechanical Engineering or related discipline. This is accomplished through a curriculum supported by hands-on laboratory and prototyping experiences in which activations and the politity to untherpine engenetic the aplittice use medited industries. which students develop their ability to synthesize concepts into solutions, use modern analytical tools and techniques, communicate professionally and work in a team environment. The program includes topics such as thermal-fluid system design, mechanical system design, <u>mechatronics</u>, and alternative <u>energy</u> systems. Additional studies in ethics develop students' ability to understand the engineer's responsibilities to society. This results in engineering graduates who strive to advance the engineering profession through technical competence, innovative problems solving and design, professional conduct, and lifelong learning. Additional details can be found on the department website: https://www.tarleton.edu/mece/.

Students must earn a grade of "C" or better in all Engineering, Mathematics, and Science coursework in order to graduate. Students must also take, or be registered to take, the Fundamentals of Engineering (FE) licensure exam in order to graduate.

Total Hours		127
MATH 3306	Differential Equations	3
MATH 3433	Calculus III	4
MATH 2414	Calculus II	4
MATH 2413 [shared]	Calculus I	
Placement is required for Calculus	s1.	
PHYS 2426 [shared]	University Physics II	
PHYS 2425 [shared]	University Physics I	
CHEM 1409	College Chemistry for Engineers	4
MEEN 4443	Linear Control Systems	4
MEEN 4325	Mechatronics	3
MEEN 4330	Thermal-Fluid System Design	3
MEEN 4340	Heating Ventilation, A/C (HVAC) Systems Design	3
MEEN 4320	Mechanical Engineering Design II	3
MEEN 4310	Mechanical Engineering Design I	3
MEEN 4205	Mechanical Engineering Experimental Lab	2
MEEN 4300	Renewable Energy Systems and Applications	3
MEEN 3345	Heat Transfer	3
MEEN 3335	Mechanical Vibration	3
MEEN 3325	Engineering Thermodynamics II	3
MEEN 2210	Engineering Computer Aided Design	2
CVEN 3123	Strength of Materials lab	1
CVEN 3323	Strength of Materials	3
MEEN 3305	Fluid Mechanics	3
MEEN 3310	Materials and Manufacturing Processes in Design	3
ELEN 2425	Electrical Circuit Theory	4
ENGR 4360	Engineering Capstone II	3
ENGR 4259	Engineering Capstone I	2
ENGR 3311	Engineering Mathematical Methods	3
ENGR 2324	Engineering Mechanics: Dynamics	3
ENGR 2322	Engineering Thermodynamics I	3
MEEN 2212	Programming for Engineers	2
ENGR 2321	Engineering Mechanics: Statics	3
ENGR 1211	Engineering Fundamentals I	2
General Education Requirements (ht	tp://catalog.tarleton.edu/academicaffairs/)	42

Professor

Dr Kartik Venkataraman

Associate professors

- Dr. Jun Xu
- Dr. Lynal Albert
- Dr. Rajesh Vuddandam
- Dr. Hoe-Gil Lee
- Dr. Abolghassem Zabihollah
- Dr. Anne Nichols

Assistant professors

- Dr. Hongbo Du
- Dr. Alexandru Herescu
- Dr. Shihao Huang

Lecturer

Ms. Hyedi Viehmann

Instructor

Mr. Brett Rice

Adjunct Instructors

- Dr. Carlos Silva-Hernandez
- Dr. Michael Weeks

Aerospace Engineering Courses

AERO 4320. Aerospace Propulsion. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course is designed to teach the principles and practice of aircraft propulsion. Overall performance characteristics of propellers, ramjets, turbojets, turbofans, rockets. The aerospace propulsion course is focused on each type of propulsion system commonly used in aerospace vehicles: rockets, piston aero engines, gas turbine engines, ramjets and scramjets. Prerequisite: MEEN 3325.

AERO 4330. Design of Aerospace Systems. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course describes the fundamental concepts of airplanes and space vehicles as aerospace systems. Elements of aerodynamics, airfoils and wings. Airplane performance, stability and control. Aircraft and rocket propulsion. Fundamentals of orbital motion. Aspects of vehicle conceptual design. Prerequisite: CVEN 3323.

AERO 4340. Mechanics of Composite Materials. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course is designed to teach the principles and practice of aircraft composite materials and applications, including micro- and macro-mechanics, thermomechanical analysis, and failure theories for composite materials. It also covers the design and analysis of composite structural elements. The major goal of this course is to provide students with an introduction to the theory, design and applications of advanced fiber-reinforced composite materials understanding bending, buckling and vibration of laminated plates. Prerequisite: CVEN 3323, MEEN 3310.

Automotive Engineering Courses

AUTO 3340. Automotive Electronics Integration. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course introduces automotive engineering from a systems perspective, covering major automotive systems and their subsystems with relevant engineering models. The course includes fundamental electrical principles, semiconductor and integrated circuits, digital fundamentals, microcomputer systems, and electrical test equipment. These topics are explored in the context of their application to automotive technology. The course also reviews automotive electronic systems, automotive sensors, automotive actuators, automotive batteries and buses, automotive controllers, automotive sensing signal processing technologies, and automotive control technologies. Special attention is given to engine sensors, along with the methodologies for their analysis. Prerequisite: ELEN 2425, ENGR 2324.

AUTO 4320. Automotive Power Transmission Systems. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course provides the fundamentals on the structure, functions, analysis, and design of vehicle powertrain systems and various components of vehicle layouts. The course is designed to teach the transmission system of an automotive vehicle, which is the key to the dynamic performance, drivability and comfort, and fuel economy. For electric vehicles, the course provides an introductory subject in the field of electric power systems and electrical to mechanical energy conversion. Prerequisite: MEEN 3335, CVEN 3323.

AUTO 4330. Automotive Engineering Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This is an introductory course in vehicle design with concentrating on power generation and vehicle dynamics. It examines the effects of the main components of a vehicle; engine, suspension system, steering, chassis, brakes, and tires. Existing commercial software and automotive standards will be examined to provide students with a practical sense of design in automotive engineering. Prerequisite: CVEN 3323.

Civil Engineering Courses

CVEN 2200. Surveying. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

Introduction to the principles of measurements of distances, angles, and elevations; use of modern surveying equipment, area calculations, effects of observation errors; topographic mapping, traverse and area computations, and triangulation. Lab fee: \$2.

CVEN 2235. Civil Engineering Graphics. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

Introduction to technical drawing applied to civil engineering; design and drawing of various reinforced concrete structure members and connections; use of computer graphic tools, such as AUTOCAD for drawing geometric construction, isometric projection, sectional view, dimensioning, multi-view projections and plans. Lab fee: \$2.

CVEN 2312. Intro to Civil Engineering. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Introduction to the disciplines of civil engineering practice through understanding of various sub-specializations within civil engineering discipline such as geotechnical, structural, transportation, water resources and environmental engineering; sustainable design approaches to civil engineering projects through critical thinking and environmental stewardship; and professional and ethical obligations of civil engineering profession. Prerequisite: ENGR 1211.

CVEN 3123. Strength of Materials lab. 1 Credit Hour (Lecture: 0 Hours, Lab: 3 Hours).

Application of theory of strength of materials by conducting laboratory experiments. Students will conduct series of experiments to measure the properties of materials such as young's modulus and poison's ratio, tensile strength, compressive strength, torsional shear stress, as well as compute stress concentration factors, principal stresses and strains, and deformation using deflection equations. Prerequisite: ENGR 2321; CVEN 3323 or concurrent registration Lab fee: \$2.

CVEN 3245. Civil Engineering Lab I. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

This course covers topics on the design of experiments with a focus on the mechanical and physical properties of construction materials. It includes experiments and demonstrations of basic concepts of fluid mechanics using a fluid circuit system and flume. Topics encompass the measurement of hydraulic pressure, strains using mechanical gauges and electrical resistance strain gauges, sieve analysis of aggregates, and concrete mix design & asphalt mix design. The course further includes experiments on metals, aggregates, Portland cement, concrete, asphalt, asphalt mixtures, and wood. Prerequisite: CVEN 2312 or concurrent registration Lab Fee: \$2.

CVEN 3301. Structural Analysis. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Introduction to the basic principles of structural analysis; various methods of analyses for beams, trusses, rigid frames, as well as statically indeterminate beams and trusses. Prerequisite: ENGR 2321.

CVEN 3320. Construction Planning and Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Importance of construction planning and management from awarding contract to completion; construction equipment and management techniques; scheduling, and control techniques in civil engineering; scheduling, progress monitoring, and recovery schedules, and use of tools for schedule optimization. Prerequisite: CVEN 2312.

CVEN 3323. Strength of Materials. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). Basic concepts of the theory of strength of materials to engineering design and analysis. Topics include stresses and strains in members subjected to tension, compression, torsion, and shear; flexural and shearing stresses in beams, principal stresses and deflection of beams, column analysis. Prerequisite: ENGR 2321.

CVEN 3325. Contracts and Construction Engineering. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Legal aspect of construction industry, ownership, and contractor; contracts and contracting procedure; drawing and specifications used in contract, cost estimation and bidding; contract surety bonds, construction insurance; construction project management and administration; effective project time management; project cost management; prevailing labor market, labor laws, and labor relations; ethics and project safety aspect of construction engineering. Prerequisites: ENGL 1302; CVEN 2310: CVEN 2325.

CVEN 3346. Civil Engineering Lab II. 3 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

This course introduces the cutting-edge realm of civil engineering software. The course topics include modules on using software such as AutoCAD and Autodesk Civil 3D for stormwater plan and corridor design, Autodesk Revit for Building Information Modeling (BIM), Robot Structural Analysis for the analysis and design of reinforced concrete and steel structural elements, Plaxis for foundation design, and pavement design software. Prerequisite: CVEN 2312.

CVEN 3423. Strength of Materials. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Application of the theory of strength of materials to engineering design and analysis. Topics include stresses and strains in members subjected to tension, compression, torsion, and shear; flexural and shearing stresses in beams, principal stresses and deflection of beams, column analysis. Prerequisite:ENGR 2321 Lab fee: \$2

CVEN 3430. Civil Engineering Materials. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Introductions to materials engineering; general properties and behavior of construction materials used in civil engineering particularly their mechanical and nonmechanical properties of cement, aggregate, concrete, metals, steel, aluminum, plastics, wood, and composites; environmental influences and construction material behavior; laboratory evaluation of civil engineering material properties through experiments; standard specifications for material properties, techniques for testing. Prerequisite: CVEN 2312 or concurrent enrollment Lab fee: \$2.

CVEN 4086. Special Problems. 1-4 Credit Hours (Lecture: 1-4 Hours, Lab: 1-4 Hours).

Directed study of selected topics in Civil Engineering. May be repeated with approval of department head.

CVEN 4305. Reinforced Concrete Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Flexural analysis and design of reinforced concrete beams including singly and doubly reinforced rectangular beams and T-beams, shear and diagonal tension, serviceability, bond, anchorage and development length, short and slender columns, slabs, footings, and retaining walls, including computer software and a design project. Prerequisite: CVEN 3323.

CVEN 4306. Steel Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Fundamentals of analysis and design of steel structures; structural elements; simple and eccentric connections; includes a design project. Prerequisite: **CVEN 3323**

CVEN 4325. Foundation Engineering. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Focuses on geotechnical design of shallow foundations, including spread footings, mats, driven piles, and drilled piers; coverage of bearing capacity, settlement, group effects, lateral load capacity of various foundation types; subsurface exploration, construction of deep foundations and analysis of pile behavior using wave equation and dynamic monitoring methods. Prerequisites: CVEN 2312 and ENVE 2311.

CVEN 4360, Highway Planning and Design, 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course aims to help students understand the basic principles and techniques in highway planning and design. It includes highway planning process, design of the alignment of intersections, evaluation of earthwork requirements, and safety consideration. Upon completion students should be able to perform basic highway design. The course also covers the topics in highway design in the FE exam. Prerequisite: ENGR 3311.

CVEN 4450. Transportation Engineering. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours). [WI (http://catalog.tarleton.edu/academicaffairs/)]

Introduction to highway engineering and traffic analysis; geometric design of highways, traffic flow and queuing theory, highway capacity and level of service analysis, traffic control and analysis at intersections, travel demand and traffic forecasting. Prerequisite: CVEN 2312 or concurrent enrollment Lab fee: \$2.

Engineering Courses

ENGR 1211. Engineering Fundamentals I. 2 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Introduction to engineering fundamentals, including problem solving methods and concepts, algorithm development, and analysis tools, including spreadsheets. Introduction to engineering as a profession, including ethics, team-based design, technical communication, and career paths. Prerequisite: Corequisite: MATH 1316 or 2412 or 2413. Lab fee: \$2.

ENGR 1212. Engineering Fundamentals II. 2 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Development of skills in problem solving, design, analysis, estimation, communication and teamwork; introduction to accounting and conservation principles in engineering sciences emphasis on computer applications and programming. Prerequisites: ENGR 1211; MATH 2413 or concurrent registration. PHYS 2425 or concurrent registration. Lab fee: \$2.

ENGR 2105. Electrical Circuits I. 1 Credit Hour (Lecture: 0 Hours, Lab: 1 Hour).

ENGR 2106. Introduction to Digital Systems. 1 Credit Hour (Lecture: 0 Hours, Lab: 1 Hour).

ENGR 2251. Fundamentals of GIS for Engineers. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

This course offers an introduction to methods of managing and processing geographic information. Basic principles of geographic information systems and their use in spatial analysis and information management are introduced. Students gain experience with cutting-edge geospatial technologies and an understanding of their capabilities. Application in engineering is emphasized. Prerequisite: MATH 2413 or concurrent registration Lab fee: \$2.

ENGR 2303. Engineering Economy. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Principles of economics equivalence; time value of money, analysis of single and multiple investments; comparison of alternatives; capital recovery and tax implications; certainty; uncertainty; risk analysis; public sector analysis; and break-even concepts. Prerequisites: MATH 1316, MATH 2412, MATH 2413, or MATH 1352.

ENGR 2305. Electrical Circuits I. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

ENGR 2306. Introduction to Digital Systems. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

ENGR 2321. Engineering Mechanics: Statics. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Theory and analysis of bodies in equilibrium, including vector algebra, Newtonian mechanics, forces due to friction; forces acting on members of trusses and frame structures, and determinations of centroids and moments of inertia. Prerequisites: Either ENGR 1211, and concurrent enrollment in PHYS 2425 and MATH 2414; or PHYS 2425, and concurrent enrollment in ENGR 1211 and MATH 2414.

ENGR 2322. Engineering Thermodynamics I. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Theory and application of energy methods in engineering; conservation principles to investigate traditional thermodynamics (e.g., temperature, thermodynamic equilibrium, and heat). Prerequisite: ENGR 1211; MATH 2414 or concurrent registration.

ENGR 2324. Engineering Mechanics: Dynamics. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Application of theory and principles of mechanics to dynamic particles and rigid body systems in rectilinear and curvilinear systems, including forces, acceleration, conservation of energy, and impulse and momentum. Prerequisite: ENGR 2321.

ENGR 2405. Electrical Circuits I. 4 Credit Hours (Lecture: 3 Hours, Lab: 1 Hour).

ENGR 2406. Introduction to Digital Systems. 4 Credit Hours (Lecture: 3 Hours, Lab: 1 Hour).

ENGR 3311. Engineering Mathematical Methods. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course presents mathematical techniques frequently encountered in advanced engineering analyses. The topics include the following areas: linear algebra, including matrix and eigenvalue applications; probability and statistics, including descriptive and inferential statistics, probability densities, statistical simulations and quality control. Prerequisites: MATH 2413 and ENGR 1211.

ENGR 4084. Professional Practice. 1-3 Credit Hours (Lecture: 0 Hours, Lab: 1-3 Hours).

Internships and cooperative education; students work individually in a professional organization (business, technical, or government) under the supervision, monitoring, and mentorship of a licensed professional engineer or EIT (engineering in training), performing tasks and duties directly related to the environmental and civil engineering disciplines; A minimum of 80 hours per credit earned is required. Oral and written reports of internship experience are required. This course may be offered pass/fail. No more than 3 credits may count towards the ENVE-BS and CVEN-BS program. Internship performance evaluation report completed by the supervisor at the end of the internship is required. Prerequisite: CVEN 2312 or ENVE 2310 Lab Fee: \$2.

ENGR 4086. Special Problems. 1-4 Credit Hours (Lecture: 1-4 Hours, Lab: 1-4 Hours).

Directed study of selected topics in Engineering. May be repeated with approval of department head.

ENGR 4258. Engineering Professionalism. 2 Credit Hours (Lecture: 2 Hours, Lab: 0 Hours).

This course covers knowledge, skills and values necessary in engineering professional practice. Includes FE review sessions, engineering ethics, design process including multiple realistic constraints such as social, economic, safety, and sustainability, and the impact of engineering solutions in a global, economic, environmental, and societal context. Prerequisite: Within one year of graduation as per departmental capstone policy.

ENGR 4259. Engineering Capstone I. 2 Credit Hours (Lecture: 2 Hours, Lab: 0 Hours).

This course is the first part of the capstone design experience synthesizing knowledge, skills and values necessary in engineering practice. Includes FE review sessions, engineering ethics, design process including multiple realistic constraints such as social, economic, safety, and sustainability, and the impact of engineering solutions in a global, economic, environmental, and societal context. During this course students develop a proposal for their capstone project. Prerequisites: Within one year of graduation and subject to instructor approval as per departmental capstone policy.

ENGR 4360. Engineering Capstone II. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (http://catalog.tarleton.edu/academicaffairs/)]

This course is part 2 of the culminating design experience in the last year of the curriculum used to integrate the student's education. Includes reference to business concepts, mathematics, science, engineering and humanities. Emphasizes team work, a holistic approach to problem solving, and incorporates appropriate engineering standards and multiple realistic constraints. Prerequisite: ENGR 4259.

ENGR 4380. Engineering Capstone. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (http://catalog.tarleton.edu/academicaffairs/)]

This course covers the culminating design experience in the last year of the curriculum used to integrate the student's education. Includes reference to business concepts, mathematics, science, engineering and humanities. Emphasizes team work, a holistic approach to problem solving, and incorporates appropriate engineering standards and multiple realistic constraints. Prerequisite: Within one year of graduation and subject to instructor approval as per departmental capstone policy.

Environmental Engineering Courses

ENVE 2251. Fundamentals of GIS for Engineers. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

This course offers an introduction to methods of managing and processing geographic information. Basic principles of geographic information systems and their use in spatial analysis and information management are introduced. Students gain experience with cutting-edge geospatial technologies and an understanding of their capabilities. Application in engineering is emphasized. Lab fee: \$2.

ENVE 2310. Introduction to Environmental Engineering. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Introduction to environmental and occupational health, atmospheric systems and air pollution control, hazardous waste management, solid waste management, waste water management, and water supply treatment. Prerequisites: CHEM 1409 or CHEM 1312 and 1112.

ENVE 2311. Soil Mechanics. 3 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).

Introduction to the principles of soil and their influence on the hydrological cycle, Darcy's law and fluid flow through porous medium, stress distribution and consolidation of soil, subsurface exploration. Prerequisite: MATH 2413; PHYS 2425 or concurrent enrollment Lab fee: \$2.

ENVE 3300. Fluid Mechanics. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Principles of hydrostatics, dynamics of viscous and inviscid non-viscous fluids, resistance to flow in pipes and open channels, transport processes, energy equation, Bernoulli equation, conservation of mass, conservation of momentum, pump characteristics, similitude, dimensional analysis. Includes an introduction to computational analysis of fluid flow and pressure distributions and laboratory experiences. Prerequisites: PHYS 2425 and MATH 2414.

ENVE 3301. Environmental Systems Modeling. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Apply conceptual and numerical techniques to model environmental systems. Use differential equations to describe processes. Prerequisites: MATH 3306 or concurrent registration, ENVE 2310.

ENVE 3310. Engineering Hydrology. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (http://catalog.tarleton.edu/academicaffairs/)]

Study of the hydrologic cycle, precipitation processes, soil moisture, infiltration, groundwater, rainfall-runoff processes, utilization of water resources, and frequency analysis; introduction to HEC-HMS programs for modeling hydrologic processes, elementary principles of field work. Prerequisite: ENVE 3300.

ENVE 3333. Groundwater Contamination and Remediation. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course is an introduction to the fundamentals of subsurface flow with emphasis on the examination of the fate and transport of inorganic and organic contaminants therein and their management. Topics include groundwater flow and well hydraulics, modeling of contaminant transport processes, site investigations, natural attenuation, remediation and legal issues in groundwater protection. Prerequisite: ENVE 3310; MATH 3306 or concurrent registration.

ENVE 3340. Environmental Risk Assessment. 3 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).

Introduction to the fundamentals of environmental and ecological risk assessment, including toxicity assessment, characterizing fate and transport processes in various environmental media, evaluating exposure pathways, dose-response assessment and modeling uncertainty. Prerequisites: ENVE 2310 and ENGR 3311 Lab fee: \$2.

ENVE 3350. Environmental Biotechnology. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Application of fundamental principles of aquatic chemistry, molecular biology and biochemistry to understand and analyze complex chemical/biological processes in environmental engineering (natural and engineered systems). Prerequisites: CHEM 1409 or CHEM 1312 and 1112; MATH 2414; ENVE 2310.

ENVE 3401. Environmental Systems Modeling. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Apply conceptual and numerical techniques to model environmental systems. Use differential equations to describe processes. Prerequisites: MATH 3306 and ENVE 2310. Lab fee: \$2.

ENVE 3420. Groundwater Hydrology. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Topics include aquifer characteristics, infiltration, fluid dynamics of groundwater flow, potential flows, well analysis, water quality, groundwater pollution, legal issues in groundwater. Credit for both HYDR 320 and ENVE 320 will not be awarded. Prerequisites: ENVE 2411, GEOL 1403 or ENVE 2310, CHEM 1312 and 1112, MATH 2414. Lab fee: \$2.

ENVE 3450. Environmental Biotechnology. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Application of fundamental principles of aquatic chemistry, molecular biology and biochemistry to understand and analyze complex chemical/biological processes in environmental engineering (natural and engineered systems). Prerequisites: CHEM 1409 or CHEM 1312 and 1112, MATH 2414, ENVE 2310 Lab fee: \$2.

ENVE 4086. Special Problems. 1-4 Credit Hours (Lecture: 1-4 Hours, Lab: 0 Hours).

Directed study of selected topics in Environmental Engineering. May be repeated with approval of department head.

ENVE 4220. Environmental Lab. 2 Credit Hours (Lecture: 1 Hour, Lab: 2 Hours).

This course provides an understanding of theoretical concepts in conjunction with practical experimental approaches, skills and techniques pertinent to environmental engineering, water and waste water treatment methods and water quality analysis. Laboratory methods and interpretation of results will be focused. Prerequisite: ENVE 3301 or concurrent registration; ENVE 2310 Lab Fee: \$2.

ENVE 4225. Environmental Monitoring and Measurements. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

Studying and analyzing environmental methods and systems through appropriate experimental methods. The course will include sampling, protocol development and design of experiments, relevant measurement techniques and experimental methods. Emphasis on quality control, calibration, documentation and interpretation of results facilitating the development of best practice approaches for experimental design and analysis. Prerequisite: ENVE 3350 (coreq); ENVE 4320 (coreq) Lab Fee: \$2.

ENVE 4302. Atmospheric Systems and Air Pollution Control. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Study of atmospheric impact on air pollution. Study of sources of air pollution and their control to include gases and particulate matter. Study of air pollution regulations and air pollution modeling. Design of systems to control and abate air pollution. Study and design of sampling systems to monitor air pollution. Prerequisite: CHEM 1409, ENGR 2322.

ENVE 4310. Water Resources Engineering. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (http://catalog.tarleton.edu/academicaffairs/)]

Fundamentals of hydraulics applicable to open channel flow, natural streams and waterways; irrigation flow characteristics; hydrologic analysis; fluid measurement methods; introduction to hydraulic models including HEC-RAS; and economic aspects of water resources. Prerequisite: ENVE 3300.

ENVE 4319. Physical Operations in Water and Wastewater Treatment. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Physical operations in water and wastewater treatment are covered in this course. These include the design of lift stations and gravity sewers, screens, sedimentation tanks, clarifiers and holding basins. Prerequisite: ENVE 3300.

ENVE 4320. Chemical and Biological Processes in Water and Wastewater Treatment. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course covers processes associated with water and wastewater treatment that are mediated chemically or using biological means as well as the design of systems that use such mechanisms. Design of secondary treatment systems, removal of nutrients and design of tertiary treatment systems are covered. Prerequisites: CHEM 2323 (coreq); ENVE 3350 (coreq).

ENVE 4325. Environmental Monitoring and Measurements. 3 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

Studying and analyzing environmental engineering processes and systems through appropriate experimental methods. The course will include sampling, protocol development and design of experiments, relevant measurement techniques and experimental methods. Emphasis on quality control, calibration, documentation and interpretation of results facilitating the development of best practice approaches for experimental design and analysis. Prerequisite: ENVE 3350 (coreq); ENVE 4320 (coreq) Lab fee: \$2.

ENVE 4330. Texas Water Resource Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (http://catalog.tarleton.edu/academicaffairs/)]

The ecological relation of water in this biosphere with special reference to the human role; the role of behavioral sciences (social, legal, economic, political, and psychological) in the development, conservation, regulation, and utilization of water resources; current political structure and laws pertaining to the administration of water resources in the state of Texas. Prerequisites: ENVE 3310 and GOVT 2306.

ENVE 4350. Solid and Hazardous Waste Management. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course is designed to provide students with the necessary background and knowledge pertaining to the engineering design of solid and hazardous waste management and disposal. Topics covered include landfill design, resource conservation recovery and reuse, hazardous waste management. Prerequisites: CHEM 1409 or CHEM 1312 and 1112, and ENVE 2310.

ENVE 4420. Water and Waste Water Treatment. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Treatment and distribution of residential and industrial water supplies, waste water treatment and disposal methods of municipal and industrial systems, environmental toxicology; aspects of groundwater monitoring and water quality maintenance. Laboratory analysis of water and waste water quality. Design of elementary treatment, distribution, and collection systems. Prerequisites: CHEM 2423 or both CHEM 2323 and CHEM 2123, ENVE 2310, and ENVE 3300 Lab fee: \$2.

Mechanical Engineering Courses

MEEN 2115. Engineering Computer Aided Manufacturing. 1 Credit Hour (Lecture: 1 Hour, Lab: 2 Hours).

This is a fundamental course that demonstrates the integration of Computer-Aided-Design (CAD) and Computer-Aided-Manufacturing (CAM), and examines how to program and operate Computer Numerical Control (CNC) mills and lathes. It is a study of modern prototyping and machining methods, with emphasis on teaching the use of CAM software. This program converts 2D and 3D CAD drawing geometry directly into tool path information that is used to drive numerically-controlled turning and milling machines. Prerequisite: MEEN 2210 (prereq); MATH 2413 (coreq).

MEEN 2210. Engineering Computer Aided Design. 2 Credit Hours (Lecture: 2 Hours, Lab: 2 Hours).

Fundamentals of engineering design and solid modeling using computer aided drafting tools; application of solid modeling, analysis and simulation software and 3-D printing to problem solving and design. Prerequisite: ENGR 1211 (coreq); MATH 2412 (coreq) Lab fee: \$2.

MEEN 2212. Programming for Engineers. 2 Credit Hours (Lecture: 1 Hour, Lab: 2 Hours).

Programming principles and techniques for matrix and array operations, equation solving, and numeric simulations applied to engineering problems and visualization of engineering information; platforms include spreadsheets, symbolic algebra packages, engineering analysis software, and laboratory control software. Prerequisite: MATH 2413 Lab fee: \$2.

MEEN 2310. Engineering CAD/CAM. 3 Credit Hours (Lecture: 2 Hours, Lab: 3 Hours).

Application of solid modeling, analysis and simulation software and 3-D printing to problem solving and design. Fundamentals of engineering design and solid modeling using computer-aided drafting tools. Standard terminologies, conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications, merits and demerits of Computer Numerical Controlled (CNC) machines. Prerequisite: ENGR 1212; MATH 2413 or concurrent registration Lab fee: \$2.

MEEN 3305. Fluid Mechanics. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course is an introduction to fluid mechanics, and emphasizes fundamental concepts and problem-solving techniques. Topics to be covered include fluid properties, fluid statics, fluid kinematics, control volume analysis, dimensional analysis, internal flows (pipe flows), and external flows (lift and drag). Brief introductions to computational fluid dynamics (CFD), compressible flow, and fluid power systems such as turbomachinery (pumps and turbines) will also be provided. Prerequisite: PHYS 2425, MATH 2414, ENGR 2322.

MEEN 3310. Materials and Manufacturing Processes in Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course covers the relationship between product design and manufacturing, assembly, testing and service. Includes materials selection, traditional and nontraditional manufacturing process, inspection, reliability, quality engineering and the economic impact of modern process engineering. Also emphasizes mechanical properties of materials, material microstructures and use of design methodology. Prerequisite: MEEN 2210, ENGR 2324, CVEN 3323 or concurrent enrollment.

MEEN 3314. Signals and Systems. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Modeling and analysis of electrical and mechanical systems using Laplace transformation methods; transient and steady-state analysis; Fourier series; Fourier transform; elementary feedback. Prerequisite: ELEN 2425, MATH 3306 or concurrent registration.

MEEN 3325. Engineering Thermodynamics II. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Design of power and refrigeration systems, mixing or separation, multiphase, air conditioning and energy conversion processes; engine design and operating parameters dealing with thermo-chemistry of fuel air mixtures; properties of working fluids; power cycle analysis with thermodynamic properties and working fluids. Prerequisites: ENGR 2322, CHEM 1409, and MATH 3306 (coreq).

MEEN 3335. Mechanical Vibration. 3 Credit Hours (Lecture: 3 Hours, Lab: 2 Hours).

Modeling, analysis and design for mechanical vibrations. Fundamentals of free vibration, harmonically excited vibration and vibration under general forcing conditions for one degree and multidegree of freedom systems; vibration design strategies including isolation and absorbers; analysis of mechanical systems for stability, resonance, damping, and modal coupling. Prerequisite: ENGR 2324, CVEN 3323, MATH 3306 Lab fee: \$2.

MEEN 3345. Heat Transfer. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Heat transfer by conduction, convection, and radiation; steady-state and unsteady heat conduction; free and forced convection heat transfer; radiative heat transfer; heat exchanger analysis. Prerequisite: ENGR 2322, MEEN 3305 (coreq), MATH 3306.

MEEN 3350. Measurement System Design. 3 Credit Hours (Lecture: 2 Hours, Lab: 3 Hours).

Design of measurement systems including hardware and software specifications, design, prototyping and testing. Includes fundamentals of data acquisition, design of experiments, instrumentation and sensor calibration commonly used in industry and research (e.g., sensors, signal conversion and conditioning, and wireless data communications). Prerequisite: ELEN 3314, MEEN 2210, PHYS 2426 Lab fee: \$2.

MEEN 3400. Fluid Mechanics. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Perform analyses involving hydrostatics, fluid dynamics, pipe flow, open-channel flow, pumps, and dimensional analysis. Design and conduct fluid mechanics experiments. Perform computer simulations of fluid processes. Prerequisites: PHYS 2425 and MATH 2414 Lab fee: \$2.

MEEN 3440. Heat Transfer. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Steady and transient conduction in one- and two-dimensions; forced and natural convection; radiation; phase change; basic heat exchangers design; elements of thermal system design. Includes an introduction to computational analysis of heat transfer and temperature distributions and laboratory experiences. Prerequisite: ENGR 2322 Lab fee: \$2.

MEEN 4086. Special Problems. 1-4 Credit Hours (Lecture: 1-4 Hours, Lab: 1-4 Hours).

Directed study of selected topics in Mechanical Engineering. May be repeated with approval of department head.

MEEN 4205. Mechanical Engineering Experimental Lab. 2 Credit Hours (Lecture: 1 Hour, Lab: 3 Hours).

Experimentation and measurements in fluid mechanics and heat transfer; efficiency analysis; design of experiment; data processing and analysis; report writing. Prerequisite: MEEN 3305, MEEN 3345 Lab fee: \$2.

MEEN 4300. Renewable Energy Systems and Applications. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours). [WI (http://catalog.tarleton.edu/ academicaffairs/)]

Study of renewable energy sources, future demands, energy management and conservation techniques with focus on sources such as solar energy, biomass (conversions), wind power, geothermal energy, ocean energy, fuel cells and hydro power; assessing the viability of renewable energy systems; and analysis of renewable energy systems, applications, backup energy needs and economic factors. Prerequisite: MEEN 3325, MEEN 3305, MEEN 3345.

MEEN 4310. Mechanical Engineering Design I. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Application of principles of mechanics and physical properties of materials, stress fundamentals and failure theories to the design, selection and analysis of linear elastic solid materials in machine elements with consideration of economics, safety and design for manufacturing. Prerequisite: MEEN 3310.

MEEN 4320. Mechanical Engineering Design II. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Modeling, analysis and design of machine elements such as springs, bearings, gears, shafts, and mechanisms based on extensive application of physics, mathematics, core engineering principles and industrial practice; design for optimal manufacturability, quality and reliability in the mechanical engineering practice of design. Prerequisite: MEEN 4310, MEEN 3305.

MEEN 4325. Mechatronics. 3 Credit Hours (Lecture: 3 Hours, Lab: 1 Hour). The study and design of electromechanical devices including comprehensive principles from mechanics, electronics, instrumentation and software; includes sensors, control systems and actuators along with how to choose a proper controller for mechanical engineering design problems. Prerequisite: ELEN 2425, MEEN 4310; ELEN or MEEN 4443 Lab Fee: \$2.

MEEN 4330. Thermal-Fluid System Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

Application of thermodynamics, heat transfer and fluid mechanics concepts to the analysis and design of thermal-fluid systems. Emphasis on component and system modeling, energy balances, performance measurements and experimental design. Prerequisite: MEEN 3345.

MEEN 4340. Heating Ventilation, A/C (HVAC) Systems Design. 3 Credit Hours (Lecture: 3 Hours, Lab: 0 Hours).

This course is designed to introduce fundamentals of refrigeration and HAVC systems, properties of refrigerants, non-conventional systems. Students will study: 1) thermal analysis of building envelope including solar heat gain, thermal zoning, 2) HVAC load estimation using ASHRE method as well as commercial software for residential and commercial buildings, 3) HVAC system configuration both all-air and air-water system, and 4) Air-distribution systems including heat pumps, chillers, and boilers. Prerequisite: MEEN 3325, MEEN 3345.

MEEN 4420. Thermal-Fluid System Design. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Application of thermodynamics, heat transfer and fluid mechanics concepts to the analysis and design of thermal-fluid systems. Emphasis on component and system modeling, energy balances, performance measurements and experimental design. Prerequisite: ENGR 2322, MEEN 3305, MEEN 3345 Lab fee: \$2.

MEEN 4425. Mechatronics. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

The study and design of electromechanical devices including comprehensive principles from mechanics, electronics, instrumentation and software; includes sensors, control systems and actuators along with how to choose a proper controller for mechanical engineering design problems. Prerequisite: ELEN 2425, MEEN 4310; ELEN/MEEN 4443 Lab fee: \$2.

MEEN 4443. Linear Control Systems. 4 Credit Hours (Lecture: 3 Hours, Lab: 3 Hours).

Application of state variable and frequency domain techniques to modeling and analysis of single input, single output linear control systems; physical implementation of control systems by integrating sensors, actuators and other control system components; use of software design tools. Prerequisite: ELEN 2425, ELEN 3320 or COSC 3344 or MEEN 2212, MATH 3306. Lab fee: \$2.

School of Engineering Courses

SENG 1000. TCC Dual Admit. 0 Credit Hours (Lecture: 0 Hours, Lab: 0 Hours).