Texas A&M International University
College of Arts and Sciences
Department of Engineering, Mathematics, and Physics

Student Learning Outcomes
(Updated on 1/24/2014)

Courses included in this document:

- **Computer Science**
  COSC 1136 Fundamentals of Programming Laboratory
  COSC 1336 Fundamentals of Programming
- **Engineering**
  ENGR 1201 Foundations of Engineering I
  ENGR 1202 Foundations of Engineering II
  ENGR 1204 Engineering Graphics
  ENGR 2103 Engineering Mechanics-Statics and Dynamics Laboratory
  ENGR 2303 Engineering Mechanics-Statics and Dynamics
  ENGR 2105 Principles of Electrical Engineering Laboratory
  ENGR 2305 Principles of Electrical Engineering
  ENGR 2372 Introduction to Design of Experiment
  ENGR 2376 Conservation Principles in Thermal Engineering
  SENG 3300 Engineering Economics
  SENG 3301 Engineering Project Management and Proposals
  SENG 3310 Introduction to Control Systems
  SENG 3320 Engineering Modeling and Design
  SENG 3330 Operations Research I
  SENG 3337 Software Development
  SENG 3340 Robotics and Automation
  SENG 3350 Production Planning and Control
  SENG 3380 Measurements and Devices
  SENG 4152-4352 Internship in Systems Engineering
  SENG 4195-4295-4395 Undergraduate Research
  SENG 4301 Project management and Proposals-WIN
  SENG 4315 Embedded Systems
  SENG 4350 Facilities Design & Logistics
  SENG 4360 Systems Simulation
  SENG 4390 Systems Engineering Senior Project
- **Mathematics**
  MATH 1316 Plane Trigonometry
  MATH 1324 Business Mathematics I
  MATH 1325 Business Mathematics II
  MATH 1333 Mathematics for Liberal Arts
  MATH 1342 Introductory Statistics
  MATH 1350 Fundamentals of Mathematics I
  MATH 1351 Fundamentals of Mathematics II
  MATH 2330 Elementary Geometry
  MATH 2371 Communication in Mathematics
  MATH 2412 Pre-Calculus
  MATH 2413 Calculus I
  MATH 2414 Calculus II

MATH 2415 Calculus III
MATH 3195 Seminar
MATH 3310 Introduction to Linear Algebra
MATH 3325 Geometry
MATH 3330 Ordinary Differential Equations
MATH 3360 Statistical Analysis
MATH 3365 Discrete Mathematics
MATH 3390 Principles of Math for Elem Ed
MATH 4152-4452 Internship in Mathematics
MATH 4305 Number Theory
MATH 4310 Abstract Algebra I
MATH 4315 Abstract Algebra II
MATH 4330 Numerical Linear Algebra
MATH 4335 Advanced Calculus
MATH 4340 Numerical Analysis I
MATH 4345 Complex Variables
MATH 4360 General Topology
MATH 4365 Geometry of Curves and Surfaces
MATH 4385 History of Mathematics
MATH 4390 Mathematics in the Middle and High Schools
MATH 5191 Mathematics Seminar
MATH 5290 Research Methods in Mathematics
MATH 5303 Number Theory I
MATH 5305 Real Analysis I
MATH 5306 Linear Algebra
MATH 5316 Graph Theory
MATH 5320 Complex Variables I
MATH 5330 Abstract Algebra I
MATH 5350 Ordinary Differential Equations I
MATH 5360 Partial Differential Equations
MATH 5365 Topology
MATH 5367 Numerical Methods for PDE I
MATH 5370 Mathematical Modeling
MATH 5375 Probability
MATH 5398 Thesis I
MATH 5399 Thesis II

- **Physics**
  ASTR 1111 Planetary Astronomy Laboratory
  ASTR 1311 Planetary Astronomy
  ASTR 1112 Stellar Astronomy Laboratory
  ASTR 1312 Stellar Astronomy
  PHYS 1101 General Physics I Laboratory
  PHYS 1301 General Physics I
  PHYS 1102 General Physics II Laboratory
  PHYS 1302 General Physics II
  PHYS 1170 Survey of Physical Science Laboratory
  PHYS 1370 Survey of Physical Science
  PHYS 2125 University Physics I Laboratory
  PHYS 2325 University Physics I
  PHYS 2126 University Physics II Laboratory
  PHYS 2326 University Physics II

This document is possible by the joint work of all faculty of the Department of Engineering, Mathematics, and Physics, and

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Department of Engineering, Mathematics, and Physics

COSC 1136
Fundamentals of Programming Laboratory

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Laboratory course to accompany COSC 1336. Laboratory exercises reinforce the particular paradigms that are stressed in COSC 1336. Students will develop and run functional programs that solve elementary algorithmic problems. Students will also gain experience with compiling, finding, correcting syntax errors, and executing programs. This course places importance on scientific communication and collaboration methods. Co-requisite: COSC 1336. Lab fee: $30.00.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- demonstrate the skills of editing, running and debugging programs;
- apply the syntax rules of the programming language to recognize and correct various programming errors;
- distinguish programming approaches and constructs best suited to practical problems;
- design and create easily readable and understandable programs that are syntactically and logically correct;
- use computers and software tools to examine syntax and concepts of the programming language, which can be a foundation for more advanced computer science or computer science-related studies.

Department of Engineering, Mathematics, and Physics

COSC 1336
Fundamentals of Programming

Adoption date: April 24, 2009.

COURSE DESCRIPTION

This course introduces fundamentals of a high-level programming language. Students, applying rules of syntax and semantics, develop the skills in program design, implementation and debugging to solve computational problems in the programming language. No programming or computer science experience is required. High school BCIS as well as basic Algebra abilities are helpful. Co-requisite: COSC 1136.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- utilize the basic elements of programming character-based I/O, assignment, loops, conditionals, vectors, functions and parameter-passing in programming practice such as reading, writing and debugging a program;
- apply techniques for expression evaluation, and role of operator precedence and associativity in expression evaluation in programming practice;
- demonstrate the understanding of the importance of structured programming concepts as well as good programming practice;
- demonstrate the understanding of the role of primary data structures and algorithms and perform operations involving various data structures, and implement some simple examples of them;
- apply syntax of the programming language to design, implement, test and debug a non-trivial program that solves a practical problem.

Department of Engineering, Mathematics, and Physics

ENGR 1201
Foundations of Engineering I

Adoption date: April 24, 2009.
Updated and approved: November 19, 2010.

COURSE DESCRIPTION
Introduction to the engineering profession and disciplines; development of skills in problem solving including numbers, units, graphs and error calculation; drawing and design using CAD tools; students work in teams on an engineering design project, including construction, testing and reporting. Co-requisite: MATH 2413.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- identify and describe various engineering disciplines;
- apply the "Problem-Solving Approach" when solving engineering problems;
- state and describe the major steps in designing and implementing engineering projects;
- use basic tools such as tables, graphs, data approximation and estimation to solve engineering problems;
- use CAD software to support the design of engineering products or systems; and
- work in teams on engineering projects.

Department of Engineering, Mathematics, and Physics

ENGR 1202
Foundations of Engineering II

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Introduction to engineering ethics and professional responsibilities, development of skills in problem solving, analysis, estimation, design, and teamwork; introduction to systems engineering; computational analysis, computer programming applications; students work in teams on an engineering design project, including construction, testing, and reporting. Prerequisite: ENGR 1201 and MATH 2413.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- discuss engineering ethics and professional responsibilities;
- apply the engineering design process;
- describe the basic principles of Systems Engineering;
- identify engineering projects and propose possible solutions;
- apply teamwork skills to resolve engineering issues in the real world;
- use software packages (such as LabVIEW and MATLAB) to solve basic engineering problems; and
- prepare and deliver professional presentations.

Department of Engineering, Mathematics, and Physics

ENGR 1204
Engineering Graphics

Adoption date: April 24, 2009.
Updated and approved: November 19, 2010

COURSE DESCRIPTION
Orthographical and isometric drawings; Tolerance, working drawings, three dimensional pictorials, primary and successive auxiliary view and vector graphics; Computer aided design software is used for drawing and development of systems in mechanical, electrical and welding applications. Prerequisite: ENGR 1201.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- communicate design solutions through sketching and computer graphics software using standard graphical representation methods;
- solve auxiliary view problems using graphical geometry, projection theory, visualization methods, and pictorial sketching;
- demonstrate proficiency in geometric modeling and computer aided drafting and design (CADD);
- apply the standard dimensioning and tolerance practice for mechanical drawings; and
- demonstrate proper documentation and data reporting practices.

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ENGR 2103
Engineering Mechanics-Statics and Dynamics Laboratory

Adoption date: April 24, 2009; revised January 24, 2014.

COURSE DESCRIPTION

Laboratory course to accompany ENGR 2303. Laboratory exercises reinforce ENGR 2303 lecture material and place importance on scientific communication and collaboration. Corequisite: ENGR 2303.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- perform a variety of laboratory experiments, including forces in equilibrium, friction forces in an incline plane, single and two-stage gear systems, inertia in rotational motion, and relative and constant velocity;
- conduct laboratory experiments and properly interpret the results;
- state the relationships between theory and experiments;
- use laboratory equipment such as force table, spur gears, friction meters, sear force beam, weights, and remote controlled cars to carry out experiments; and
- work in groups with other students.

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ENGR 2303
Engineering Mechanics-Statics and Dynamics

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Application of the fundamental principles of Newtonian mechanics to the statics and dynamics of particles and the equilibrium of trusses, frames, beams and other rigid bodies. Prerequisites: PHYS 2325/2125 and MATH 2414. Corequisite: ENGR 2103. (Formerly ENGR 2321)

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- conduct free-body diagrams and apply the basic principles of static equilibrium of rigid bodies. Investigate forces and reactions for frames and beams. Determine the resultant force, equivalent force/couple systems, and distributed loads;
- calculate centroids and moments of inertia;
- apply Newton's laws of motion to particles and rigid bodies;
- use the energy and momentum methods for particles, systems of particles and rigid bodies; and
- use methodical approaches to solve statics and dynamics problems.

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ENGR 2105
Principles of Electrical Engineering Laboratory

Adoption date: November 19, 2010.

COURSE DESCRIPTION
Laboratory course to accompany ENGR 2305. Laboratory exercises reinforce ENGR 2305 lecture material and place importance on scientific collaboration. Corequisite: ENGR 2305.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- conduct laboratory experiments and properly interpret the results;
- state the relationships between theory and experiments;
- use laboratory equipment such as oscilloscopes, power supplies, multimeters, and function generators, to carry out electrical experiments;
- work in groups with other students; and
- use software packages to simulate electrical engineering circuits.

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ENGR 2305
Principles of Electrical Engineering

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Fundamentals of electrical circuit analysis, digital logic and semiconductor devices; intended as a terminal course in these areas for most engineering disciplines. Prerequisites: ENGR 1202 and MATH 2414. Corequisite: ENGR 2105. (Formerly ENGR 2315)

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- use Kirchhoff's Laws for circuit analysis;
- use loop and node analysis techniques to analyze series-parallel networks;
- apply network theorems such as superposition, Thevenin's and Norton's to electrical circuits;
- perform transient analysis in RC and RL circuits;
- design simple transformer circuits;
- use common semiconductor components/devices such as transistors, diodes, voltage regulators, waveform generators, op-amps, etc. to design electronic circuits;
- analyze and design signal conditioning circuits using op-amps; and
- design digital logic using AND, OR, NOT, NAND, NOR gates.

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ENGR 2372
Introduction to Design of Experiments

Adoption date: November 11, 2011.

COURSE DESCRIPTION

Introduction to basic probability theories and hypothesis testing. Single factor ANOVA. Randomized blocks and Latin squares, two-factorials and 2k factorial designs, robust parameter design and uncertainty analysis. Software packages are used for data mining and interpretation, with application to engineering and/or other systems. Prerequisite: MATH 2414.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- use probability concepts to determine measures such as mean, mode, median, standard deviation, and variance;
- state the null and alternate hypotheses about the parameters of a probability distribution or the parameters of a statistical model;
- test a stated hypothesis using the z-test (normal distribution), student-t test, chi-square test and F-distribution test and their corresponding P-value.
- set up and run basic factorial and screening experiments and analyze experimental outcomes;
- identify significant effects on process performance and consistency and factors for further study or implementation;
- apply probability theories to model and solve simple engineering problems;
- conduct single factorial ANOVA, multi-variable ANOVA, using software packages such as SPSS, Minitab and JMP for data analysis and interpretation; and
- work together in a group of 2-3 students to design and conduct experiments and to write reports based on their findings.

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ENGR 2376
Conservation Principles in Thermal Engineering

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Theory and applications of energy methods in engineering; conservation principles to investigate "traditional" thermodynamics and internal flow fluids; material properties. Prerequisites: ENGR 2303, MATH 2415 or registration therein. (Formerly ENGR 2312)

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- demonstrate the basic concepts of thermodynamics in solving thermal engineering problems;
- identify and describe the first and second law of thermodynamics and apply them in mathematical modeling of engineering problems;
- describe the properties of pure substances, energy transfer, entropy, power and refrigeration cycles, and gas mixtures and psychometrics;
- use thermal-fluid theories to solve practical engineering problems; and,
- apply basic fluid mechanic, thermodynamic, and heat transfer principles and techniques, including the use of empirical data and property tables to solve thermal engineering problems.

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SENG 3300
Engineering Economics

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Principles of engineering economics including economic 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 2414, ENGR 2372.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- identify what is needed to successfully perform an engineering economy study;
- solve engineering economics problems that involve interest rates, rate of return, cash flows, and time value of money;
- evaluate alternatives using present worth analysis, capitalized cost analysis, annual worth analysis, and future worth analysis;
- use the benefit/cost ratio to evaluate projects;
- perform breakeven computations and analysis;
- apply cost estimation and depreciation methods to solve engineering economy problems;
- use a spreadsheet, such as Microsoft Excel, to solve engineering economy problems.

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SENG 3301
Engineering Project Management and Proposals

Adoption date: November 11, 2011.

COURSE DESCRIPTION
Principles of project management; planning, scheduling, and control. Engineering proposals; t echincal reports. Students prepare proposals, including specifications, timelines, schedule, and budget, for projects to be implemented in SENG 4390. This course should be taken the semester preceding SENG 4390. Prerequisite: ENGL 2311 and senior standing.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- explain the project life cycle and state the general characteristics of a project;
- apply checklists, scoring, and financial methods to screen and select projects;
- construct scheduling network diagrams and determine the critical path of a project;
- develop GANTT charts and apply resource leveling;
- prepare and submit a formal senior project proposal, including a project plan and cost analysis; and
- deliver oral presentations with appropriate audio-visual materials.

Department of Engineering, Mathematics, and Physics

SENG 3310
Introduction to Control Systems

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Analysis and synthesis of controlled, dynamic, linear mechanical, electrical, fluid and/or thermal systems; introduction to concepts of stability, controllability, observability, and to discrete time, sampled data control systems, optimal control systems and nonlinear control theory. Prerequisites: ENGR 2305, MATH 3310.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- define a feedback control system and describe the function of its major components;
- mathematically model a feedback control system using the transfer function;
- derive the Laplace transform of a time-domain function and use the inverse Laplace transform to determine the time-domain of a transfer function;
- use the state variable method to model and analyze control systems;
- analyze second-order systems and determine pole locations, percent overshoot, settling time, rise time and time to peak;
- employ the Routh-Hurwitz stability criterion to determine stability of a system;
- plot Root locus and use it in control system design and sensitivity analysis; and
- use Bode plots to analyze control systems and examine system stability.

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SENG 3320
Engineering Modeling and Design

Adoption date: November 11, 2011; revised January 24, 2014.

COURSE DESCRIPTION

Fundamentals of modeling and specifications engineering design, reverse engineering, rapid prototyping, and manufacturing. Application of the design process and problem solving through individual and/or team projects. Prerequisite: ENGR 1204, ENGR 2305, COSC 1336.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- Describe the fundamentals of systems science, engineering, and design;
- Explain critical design steps such as conceptual system design, preliminary system design, and detail design and development;
- Analyze relevant systems' design requirements in terms of human factors and ergonomics, maintainability, and reliability;
- Analyze an existing or new system in terms of need identification, data collection and analysis, assumptions, validation, selection of modeling tools, and performance improvement;
- Evaluate design and project proposals through the application of profitability-based and multi-criteria decision-making tools;
- Apply basic project management techniques in the organization and management of design and project proposals; and
- Write and present a team research paper covering a real-world systems engineering problem.

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SENG 3330
Operations Research I

Adoption date: November 11, 2011; revised January 24, 2014.

COURSE DESCRIPTION

Introduction to the fundamental deterministic analytical methods and their applications to industrial and systems engineering. Modeling and decision making. Methods include linear programming, integer programming, dynamic programming, and nonlinear programming. Prerequisite: MATH 3310, SENG 3320.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- Describe the origins of operations research and how it came into being;
- Explain the concept of optimization as it relates to modern industrial and systems engineering applications;
- Develop the ability to formulate models for different operations research techniques, interpret their results, and analyze their long term implications;
- Identify the most appropriate operations research technique to use depending on the nature of the problem under study;
- Apply operations research techniques in a variety of interest areas such as manufacturing, logistics and supply chain management, transportation, healthcare, inventory management, and finance;
- Apply sensitivity analyses to evaluate “what-if” scenarios encountered in real-world situations;
- Implement operations research techniques on computer software packages; and
- Work in groups to read two peer-reviewed research articles and summarize how they applied a certain operations research technique, conceptualize ways to improve their results, suggest other alternative techniques that might have been appropriate, and present their work to class.

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SENG 3337
Software Development

Adoption date: January 24, 2014.

COURSE DESCRIPTION

This course will cover advanced software development techniques including object-oriented programming, inheritance, polymorphism, formatted file access, recursion, functional and operator overloading, parsing using a FSM, stacks and queues using linked list, O(log n) searching algorithms using binary search trees, and shortest path algorithms. Prerequisites: ENGR 3330, COSC 1336, COSC 1136.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- explain the basic concepts of object-oriented programming;
- implement source code to include advanced programming techniques such as file access, recursion, and functional overloading;
- design data structures based on linked lists;
- design basic graph theory algorithms; and
- implement parsing algorithms using finite-state machines.

Department of Engineering, Mathematics, and Physics

SENG 3340
Robotics and Automation

Adoption date: November 11, 2011.

COURSE DESCRIPTION
Study of the use, design, and deployment of industrial automation and robotics technologies in high-precision, multi-product manufacturing environments. Robot manipulators, kinematics and dynamics, robot automation and control, integrated robotic systems for manufacturing, automation in manufacturing, programmable logic controllers, applications to industrial systems.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- perform homogeneous transformations and produce forward and inverse kinematic equations of a robot using the standard Devanit-Hartenberg representation;
- perform differential motions and velocity analysis;
- perform dynamic force control analysis;
- explain the functionality of actuators and sensors related to autonomous robotic systems;
- explain the functionality of Programmable Logic Controllers and its use in automation;
- perform fundamental computer vision and image processing operations to support automation; and
- design the hardware and software to produce a simple autonomous system including robotic arms and its appropriate path planning.

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SENG 3350
Production Planning and Control

Adoption date: November 11, 2011.

COURSE DESCRIPTION
Coordination of activities of manufacturing and service systems. System design, inputs and outputs, planning and scheduling. Inventory controls and supply chain management with employment of linear programming. Job scheduling on flexible manufacturing lines. Prerequisite: MATH 3310, SENG 3300.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- explain the need to learn about the various functions in production planning and control to better manage manufacturing and/or service systems;
- apply qualitative and quantitative forecasting techniques to determine short, medium, and long range product forecasting;
- develop material requirement plans (MRP-I) and manufacturing resource plans (MRP-II) as part of resource requirement planning systems;
- use appropriate heuristic decision rules to make lot-sizing decisions;
- develop quantitative models to manage independent demand inventory systems;
- solve sequencing and scheduling problems using various order sequencing rules; and
- develop and analyze the supply chain models using linear programming techniques.

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SENG 3380
Measurements and Devices

Adoption date: January 24, 2014.

COURSE DESCRIPTION

Basic concepts and principles of measurement methods; operational amplifiers; transducers and sensors; oscillators; wave shaping circuits; active filters; rectifiers; voltage regulators; power supplies; measurements of temperature, pressure, velocity, flow, and strain; signal conditioning; data acquisition and processing; Prerequisites: ENGR 2305.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- explain the principles of engineering measurement and modern instruments;
- describe the function and operation of analog and digital devices, electrical devices, signal conditioning, sampling, and data acquisition systems;
- identify and state the operational principles of sensors and instrumentation, and their use within measurements of physical properties (e.g. temperature, pressure, velocity, flow, and strain);
- work in teams to design and conduct measurement experiments and interpret the results; and
- install and configure data acquisition and signal conditioning running with computer software (LabVIEW)..

Department of Engineering, Mathematics, and Physics

SENG 4152-4352
Internship in Systems Engineering

Adoption date: September 28, 2012

COURSE DESCRIPTION

A directed internship in an organization appropriate to the student's career objectives. May be repeated. Evaluation of performance is on a CR/NC basis. Prerequisite: Permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- apply professional judgment in the work environment;
- explain the legal, professional, and ethical issues in engineering;
- identify, analyze and solve technical problems;
- prepare and submit progress reports;
- prepare and submit a final project report; and
- deliver oral presentations with appropriate audio-visual materials.

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SENG 4195-4295-4395
Undergraduate Research

Adoption date: September 28, 2012; revised January 24, 2014.

COURSE DESCRIPTION
Permits work on a research engineering project. May be repeated for credit. Prerequisite: Permission of instructor.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- identify current trends in systems engineering and use judgment to select a research topic;
- perform research in systems engineering or related areas;
- prepare and submit progress reports summarizing research results;
- prepare and submit a final project report; and
- deliver oral presentations with appropriate audio-visual materials.

Department of Engineering, Mathematics, and Physics

SENG 4301
Project management and Proposals-WIN

Adoption date: January 24, 2014.

COURSE DESCRIPTION

Principles of project management; planning, scheduling, and control. Engineering proposals; Technical reports. Students prepare proposals, including specifications, timelines, schedule, and budget, for projects to be implemented in SENG4390. This course should be taken the semester preceding SENG 4390.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- Explain the project life cycle and state the general characteristics of a project;
- Apply checklists, scoring, and financial methods to screen and select projects;
- Construct scheduling network diagrams and determine the critical path of a project;
- Develop GANTT charts and apply resource leveling;
- Interpret project management diagrams and charts;
- Write and submit a formal senior project proposal, including a project plan and cost analysis; and
- Deliver oral presentations with appropriate audio-visual materials.

Department of Engineering, Mathematics, and Physics

SENG 4315
Embedded Systems

Adoption date: January 24, 2014.

COURSE DESCRIPTION

Characteristics of embedded systems, microprocessors and microcontrollers, system design, modular programming, interface devices, memory management, interrupts, input/output applications, multitasking, and simulation. Prerequisites: ENGR 2305 and COSC 1336.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- Identify all the components of a typical embedded system;
- Design the necessary hardware and interface for embedded systems;
- Design the necessary software elements for embedded systems;
- Integrate and test the hardware and software;
- Use a development environment to implement embedded systems; and
- Design and implement simple hardware on Field Programmable Gate Array (FPGA).

Department of Engineering, Mathematics, and Physics

SENG 4350
Facilities Design & Logistics

Adoption date: January 24, 2014.

COURSE DESCRIPTION

Design and analysis of models and algorithms for facility location, vehicle routing, and facility layout problems. Emphasis will be placed on both the use of computers and the theoretical analysis of models and algorithms in the design of production/service facilities, sequencing, and scheduling. Fundamental concepts applied through a sequence of design projects. Prerequisite: SENG 3330, SENG 3350.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- explain the various facility design and planning problems encountered in manufacturing and/or service systems;
- analyze the process and material flow involved in various facilities design;
- develop mathematical models and algorithms for the analysis and control of manufacturing and logistics systems;
- apply the techniques to vehicle routing, inventory, scheduling, and integrated distribution models and algorithms;
- apply solution techniques to single-facility and multi-facility location, facility layout, and material handling, warehouse design and operational problems;
- develop and analyze the supply chain and integrated logistics using discrete optimization techniques; and
- work in groups of 2-3 students to design and conduct experiments and write reports based on their findings..

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SENG 4360
Systems Simulation

Adoption date: November 11, 2011.

COURSE DESCRIPTION

Study the structure, logic, methodologies, and computer techniques for simulating systems. Topics include fundamental of discrete simulation, design-modeling and subsequent analysis, model verification and validation, and understanding and predicting the behavior of systems Prerequisite: SENG 3320, SENG 3380.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- manually replicate the execution of a Discrete-Event Simulation Engine;
- summarize the various tasks outlined in a Simulation Project Methodology;
- describe issues associated with establishing a discrete-event simulation capability within any system;
- design a computer-based discrete-event simulation model to represent a complex industrial/business/service system;
- analyze the output of a simulation model in order to verify the appropriateness of the model's performance;
- evaluate various system configurations to determine the most appropriate system design and/or justify proposed changes to a given system; and
- work in teams of 2-3 students to develop the simulation models of an actual system using ARENA, analyze the simulated results, and recommend the possible modification that is required to improve the system.

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SENG 4390
Systems Engineering Senior Project

Adoption date: November 11, 2011.

COURSE DESCRIPTION

This capstone course provides students the experience of implementing (including building, testing, and documenting) the approved project in SENG 3301, with budget and on schedule. Requires integration of knowledge from required systems engineering courses. Course requirements include a written report and oral presentation. To be taken during the semester of graduation.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- apply knowledge of mathematics, science, and engineering;
- design and conduct experiments, as well as analyze and interpret data;
- design a system, component, or process to meet desired needs within realistic constrains such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability;
- function on multidisciplinary teams;
- identify, formulate, and solve engineering problems;
- communicate effectively (both orally and in writing); and
- use the techniques, skills, and modern engineering tools necessary for engineering practice.

Department of Engineering, Mathematics, and Physics

MATH 1316
Plane Trigonometry

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Trigonometry, analytic trigonometry, applications of trigonometry, complex numbers, polar coordinates and parametric equations. Prerequisite: One or more of an ACT Mathematics score of 27 or above, an SAT Mathematics score of 630 or above, a COMPASS score of College Algebra 51 or above, or MATH 1314.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- recall the definition of the six basic trigonometric functions: sine, cosine, tangent, cotangent, secant and cosecant, as well as their basic periodicity properties, graphs and symmetries;
- identify the inverse trigonometric functions, together with their domains and graphs, and use them to solve trigonometric equations;
- verify trigonometric identities and their relative relationships, such as use the value of the trigonometric function of an angle to compute the value of a trigonometric function of the same angle, or double that angle, or half that angle;
- use the sine and cosine law to solve a triangle;
- perform complex number operations using polar form and use D'Moivre's formula to compute the n-th root of a complex number;
- use trigonometry to solve problems related to parametric equations;
- use trigonometry to solve problems related to polar coordinates;
- use vectors and related trigonometry concepts to solve problems in geometry and physics.

Department of Engineering, Mathematics, and Physics

MATH 1324
Business Mathematics I

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Systems of linear equations and matrices; linear programming; mathematics of finance; limits, continuity, derivatives. Prerequisite: One or more of an ACT Mathematics score of 25 or above, an SAT Mathematics score of 600 or above, a COMPASS score of College Algebra 35 or Algebra 81 or above, or MATH 1314.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- set up and solve problems involving simple and compound interest, as well as future and present value of an annuity;
- solve systems of linear equations using the Gauss-Jordan elimination method;
- set up and solve problems in linear programming; that is, use graphical methods, as well as the simplex method (including the dual method) to maximize linear objective functions. Students will also be able to solve linear optimization problems with mixed constrains;
- apply basic concepts from Calculus, such as limit, continuity and the physical and geometrical interpretation of Derivatives to solve problems in Business and Economics;
- set up and solve problems that use derivative techniques such as the product, quotient and chain rule.

Department of Engineering, Mathematics, and Physics

MATH 1325
Business Mathematics II

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Applications of the derivative, anti-derivatives, and techniques of integration; functions and calculus of several variables. Prerequisite: MATH 1324.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- use derivative techniques, such as the product, quotient or chain rule to solve problems in Business and Economics;
- use derivative tests, like the first and second derivative, to graph functions, and apply these techniques to problems in optimization;
- interpret the definite integral of a function geometrically as the area of a region, and apply the Fundamental Theorem of Calculus to compute antiderivatives and definite integrals of continuous functions;
- use methods of integration, such as substitution or integration by parts to compute antiderivatives and definite integrals. Students will apply these techniques to solve problems in the computation of areas between curves, or apply them to problems in Business and Economics;
- apply techniques of calculus of several variables, such as analyzing the second partial derivatives or Lagrange Multipliers, to find the maximum and minimum of a function of several variables;
- use double integrals to compute volumes of solids in three dimensional space.

Department of Engineering, Mathematics, and Physics

MATH 1333
Mathematics for Liberal Arts

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This course is designed to enhance mathematical literacy and to stimulate interest in and appreciation for mathematics and quantitative reasoning as valuable tools for addressing issues in a constantly changing society. Topics may include, at an introductory level: 1) logical reasoning and problem solving through mathematical games and puzzles; 2) counting and number concepts (number theory and infinity); 3) geometry (Euclidean/non-Euclidean/fractal geometrics, and topology); and 4) probability and statistics. Prerequisite: MATH 1314.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- recognize the definitions of basic mathematical terms, such as Pigeonhole Principle and Fibonacci, Prime, Rational, and Irrational numbers and use them in problem solving;
- recognize and describe several types of problems that can be solved by induction;
- recognize, describe, and use specific properties of numbers in problem solving, e.g, identity element properties for addition and multiplication;
- analyze written arguments on mathematical content and problems, e.g. sample solutions/proofs to problems using the Pigeonhole Principle or Mathematical Induction; and
- compose written arguments on mathematical content and problem, e.g. sample solutions/proofs to problems using the Pigeonhole Principle, Mathematical Induction, or Cantor's diagonalization argument.

Department of Engineering, Mathematics, and Physics

MATH 1342
Introductory Statistics

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Topics include organization of data; probability; random variables; the normal distribution; inferences; chi-square; regression and correlation; analysis of variance; and non-parametric statistics. Prerequisite: MATH 1314.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- learn to organize and summarize data as a way to study descriptive statistics;
- find the probability of a compound event and the conditional probability of an event;
- construct a probability distribution and perform relevant calculations, such as mean and standard deviation;
- use the Central Limit Theorem to solve problems;
- determine confidence intervals;
- solve hypothesis testing problems;
- perform calculations for the correlation coefficient and the regression line for a set of ordered pairs.

Department of Engineering, Mathematics, and Physics

MATH 1350
Fundamentals of Mathematics I

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Sets, relations, functions, number system, and elementary number theory. This course cannot be used to fulfill Core Curriculum requirements. Prerequisite: MATH 1314.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- illustrate, explain and exemplify various models of whole and signed numbers and of arithmetic operations with them;
- illustrate and explain the place value systems and the paper-and-pencil algorithms (both standard and alternative) for performing arithmetic operations, in base ten as well as bases other than ten;
- illustrate, explain and exemplify various models of fractions, and models of and strategies for arithmetic operations with them;
- illustrate, explain and exemplify the concepts of ratio, percentages and proportions, and solve related problems by flexibly applying proportional reasoning;
- develop, analyze, compare and evaluate strategies for performing arithmetic operations, including and in particular mental computation and estimation;
- use factor, multiple, prime factorization and relatively prime numbers to solve problems about integers; and,
- use algebraic symbols to illustrate mathematical situations, structures and relationships as algebraic expressions, identities and equations.

Department of Engineering, Mathematics, and Physics

MATH 1351
Fundamentals of Mathematics II

Adoption date: November 19, 2010.

COURSE DESCRIPTION
Probability, statistics, and geometry. This course cannot be used to fulfill Core Curriculum requirement. Prerequisite: MATH 1350.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- recognize, describe and solve descriptive statistics problems, e.g. graphical descriptive statistics, measures of central tendency, measures of variation;
- recognize, describe and solve elementary probability problems, e.g. counting, conditional probability, expected value;
- recognize, describe, and solve elementary measurement problems, e.g. linear, surface and area measures;
- recognize, describe, and use elementary Euclidean geometry in problem solving, e.g. congruency and similarity of triangles and other planar figures;
- recognize, describe, and use elementary analytic geometry in problem solving, e.g. various measurements of planar geometric shapes in coordinate systems;
- recognize, describe, and use transformational geometry in problem solving, e.g. rigid transformations, size transformation, and symmetry in plane;
- analyze written arguments on course-level mathematical content and problems; and
- compose written arguments on course-level mathematical content and problems.

Department of Engineering, Mathematics, and Physics

MATH 2330
Elementary Geometry

Adoption date: November 11, 2011.

COURSE DESCRIPTION
Introduction to classical Euclidean Geometry. Postulates, congruency, similarity and classical constructions. Introduction to solid geometry and transformations in the plane. (Formerly MATH 3320).

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- recognize undefined geometric objects, like point or line, and define geometric objects like segment, ray, circle, media, altitude, or bisector and state basic properties of these;
- use different criteria of congruency to determine congruent sides or angles in different triangles;
- use the Exterior Angle Theorem to deduce inequalities in triangles;
- construct using a compass and a rules a perpendicular to a line through a given point, a bisector to an angle, and a perpendicular bisector to a line;
- use properties of arcs in circles to deduce the measure of angles inscribed in circles, or construct tangent to circles;
- use Euclid's fifth postulate to deduce the measure of angles between parallel lines;
- recognize when two triangles are similar, and use this to prove theorems like Pythagora's Theorem, or to compute the length of segments in a given triangle;
- use isometries to deduce symmetries of geometrical objects, or construct geometrical objects with given properties.

Department of Engineering, Mathematics, and Physics

MATH 2371
Communication in Mathematics

Adoption date: April 24, 2009.

COURSE DESCRIPTION

This course is designated to enhance students' communication skills in mathematics. Emphasis will be placed in writing proofs. Topics include set theory, logic and properties of numbers at an elementary level. Substantial writing in mathematics using LaTeX is required. Prerequisite: ENGL 1302.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- communicate mathematics in well-structured sentences, as well as in oral form;
- explain ethical responsibilities for the major of their choice;
- write mathematical statements in symbols and interpret mathematical symbols into plain English;
- analyze the structure of proofs such as direct and indirect proof, proof by contradiction, proof by cases, proof of equivalences;
- perform operations on sets and apply them to prove mathematical statements;
- perform operations on logical formulas and apply them to prove mathematical statements;
- analyze properties of integers, perform operations of numbers, and apply number theory to prove mathematical statements.

For your information: the following agreement was reached and stated in the 2008 AIER report

In regards to the outcome on “written paper assignment”, students will be asked to attend the writing center, prior to turning any paper to receive feedback on their writings at a non-technical level; faculty may revise and adapt the rubric to take into account that these papers are being written by sophomores and not graduating seniors, to adjust to a different level of expectation; possibly a different benchmark may be used to account for what is satisfactory writing at this level; and finally, students will be given the opportunity to write several versions of their paper before it is evaluated by the Assessment Committee. The idea in this case is that students will be able to revise their paper and learn from the comments given by the instructor, as they improve their writing skills in this course.

In regards to the outcome on “Ethics Writing Assignment”, students will be provided with a sample paper on ethics that relates to their major and will be asked to research for another one related to their major, and report on these papers. We believe this will work better because students in that course that reported on ethics in their major obtained an “A” when a sample paper was provided.

In regards to the outcome on “Oral Presentation”, students will be given an opportunity to practice their presentations in front of their peers and faculty member teaching MATH 2371, who will provide feedback. Students will also receive a guideline for giving presentations, as well as a copy of the rubric to be used to evaluate their presentation.

Department of Engineering, Mathematics, and Physics

MATH 2412
Pre-Calculus

Adoption date: January 24, 2014.

COURSE DESCRIPTION

Topics include: Analytic geometry, complex numbers, and systems of algebraic equations; algebraic, exponential, logarithmic and trigonometric functions and applications; sequences and applications. Students will receive credits for at most two courses from MATH 1314, 1316 and 2412. Prerequisite: A COMPASS score of College Algebra 35 or above, a THEA Mathematics score of 280 or above, an ACT Mathematics score of 25 or above, an SAT Mathematics score of 600 or above, or MATH 1314..

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- set up, solve, and sketch the graphs of polynomial, rational, radical, exponential, and logarithmic equations and inequalities of one variable, and systems of linear and non-linear equations with two or more variables;
- perform operations with complex numbers and matrices to apply them to solve problems. Use the Polar form and D'Moivre's formula to compute the n-th root of a complex number;
- compute the general term of an arithmetic and geometric sequence and the sum of its terms, and perform the expansion of a positive integer power of a binomial;
- identify functions from algebraic, graphical, tabular, and verbal expressions and apply them to solve problems;
- recall the definition of the six basic trigonometric functions: sine, cosine, tangent, cotangent, secant, cosecant, as well as their basic periodicity properties, graphs and symmetries, and identify and use their inverse trigonometric functions, together with their domains and graphs, to solve trigonometric equations;
- verify trigonometric identities and their relative relationships, such as use the value of the trigonometric function of an angle to compute the value of a trigonometric function of the same angle, or double that angle, or half that angle; and
- use vectors and trigonometry concepts to solve problems related to geometry using the sine and cosine laws, or to solve problems related to parametric equations or polar coordinates and physics.

Department of Engineering, Mathematics, and Physics

MATH 2413
Calculus I

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Limits, continuity, differentiation, applications to optimization; integration and the Fundamental Theorem of Calculus. Prerequisite: One or more of an ACT Mathematics score of 29 or above, an SAT Mathematics score of 660 or above, a COMPASS score of College Algebra 60 or above and Trigonometry 51 or above, MATH 1316, or MATH 2412.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- recognize the basic concepts of certain mathematical models and functions and their representation;
- find limits of functions and use limits theorems. Transform indeterminate form limits and apply L'Hopital's rule to evaluate indeterminate limits. Determine continuity of functions;
- differentiate and sketch graphs of various functions such as: polynomial and rational functions, trigonometric functions, exponential functions and logarithmic functions;
- apply derivation rules and theorems such as the chain rule to find derivatives of sums, products,
- quotients, and compositions of functions, and use the derivative to solving extrema problems;
- interpret integration geometrically and apply techniques of integration.

Department of Engineering, Mathematics, and Physics

MATH 2414
Calculus II

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Techniques and applications of integration: area between curves, volumes of solids of revolution, work, areas of surfaces of revolution, arc-length, introduction to differential equations, parametric equations and polar coordinates, sequences and series. Prerequisite: MATH 2413.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- interpret the definite integral of a function geometrically as the area of a region, and use the Fundamental Theorem of Calculus to compute antiderivatives and definite integrals;
- apply different methods of integration, such as substitution, integration by parts, trigonometric integrals and partial fraction decomposition to compute antiderivatives as well as definite integrals;
- set up and compute integrals to solve problems in the computation of areas, volumes, work, arc-length, surface area of a surface of revolution, as well as be able to solve first order differential equations of linear and separable type, and be able to determine if a given improper integral converges;
- use a method of numerical integration to approximate a definite integral using several methods of approximation, including the left point, right point, trapezoid and Simpson's rule. Students will also be able to estimate the error in the computation of such approximations;
- identify curves given in terms of parametric equations, as well as write a curve in terms of a parameter. Students will also be able to apply integration to compute areas enclosed by a parametric curve, as well as to find its arc-length or area of revolution around an axis;
- approximate a given real analytic function using Taylor or Maclaurin series, be able to estimate the error, including determining if such series converges to the function, and use these techniques to compute limits of functions, estimate definite integrals or approximate the value of a function at a point.

Department of Engineering, Mathematics, and Physics

MATH 2415
Calculus III

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Vector operations in R2, R3, lines, planes; vector-functions, space curves, curvature; multivariable calculus, optimization, Lagrange multipliers; multiple integrals; vector fields, theorems of Green, Gauss and Stokes. Prerequisite: MATH 2414.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- use the concepts of continuity, differentiation, and integration of vector-valued functions to determine unit tangent and unit normal vectors in the process of modeling objects in three dimensions;
- compute the curvature and torsion of a curve in space;
- calculate and sketch level curves and level surfaces for functions of several variables and sketch the graphs of functions of two variables;
- compute limits, determine continuity, and compute partial derivatives of multivariable functions;
- use tangent planes, directional derivatives, gradients, the second partials test, and Lagrange multipliers to approximate functions and solve optimization problems;
- demonstrate techniques of computation of multiple integral and compute iterated integrals over planar regions involving change of coordinate systems;
- apply multiple integrals to solve problems involving area, volume, surface area, center of mass, and moments of inertia;
- compute line integrals and surface integrals by applying The Fundamental Theorem for line integrals, Green's theorem, Stoke's Theorem and the Divergence Theorem, and applying these techniques to solve application problems such as work problems.

Department of Engineering, Mathematics, and Physics

MATH 3195
Seminar

Adoption date: January 24, 2014.

COURSE DESCRIPTION

One-three semester hours. Seminar on various topics in mathematics. May be repeated for credit with departmental approval.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- analyze and synthesize issues, topics, and information in a mathematics research field;
- effectively express herself/himself both orally and in writing using well-constructed mathematical arguments;
- integrate knowledge and ideas in a coherent and meaningful manner;
- locate and use information for conducting mathematical investigation and/or research; and
- work independently to conduct mathematical research or inquiry.

Department of Engineering, Mathematics, and Physics

MATH 3310
Introduction to Linear Algebra

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Introduction to linear transformations and matrices; vector spaces, vector operations. Prerequisite: MATH 2415.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- sketch the sum, difference, and linear combinations of two or more given vectors, sketch a (two- or three dimensional) vector with given components, and compute the components of a vector given as an arrow in an affine space;
- write the parametric form and normal form of the equation of a line or of a plane and use them for problem solving;
- using the Gauss-Jordan Elimination method, solve a system of linear equations (namely find a parametric representation of the solution space) or find the dimension and bases of the subspace spanned by a set of vectors. In particular, compute the rank and nullity of a matrix and describe the kernel and range of a linear transformation;
- determine whether the product of two given matrices or the powers of a matrix are defined, or whether the inverse of a matrix exists, and when it is defined / exist, compute it and interpret it;
- describe the linear transformation defined by a given matrix with respect to given bases. Conversely, given a description of a linear transformation, compute its matrix with respect to given bases. In particular, given the matrix of a linear transformation with respect to a certain pair of bases, compute the matrix of that linear transformation with respect to another pair of bases ("change of basis");
- compute the eigenvalues and eigenvectors of a matrix, and determine whether the matrix is diagonalizable; and
- perform the Gram-Schmidt process to orthogonalize a basis of a vector space, and use it to compute the orthogonal complement of a subspace or the orthogonal projection of a vector onto a subspace.

Department of Engineering, Mathematics, and Physics

MATH 3325
Geometry

Adoption date: November 19, 2010.

COURSE DESCRIPTION
Selected topics from the foundations of Euclidean and non-Euclidean geometries. Includes the study of spherical and hyperbolic geometries, as well as transformational geometry, with techniques from linear algebra. Intended primarily for students seeking secondary certification.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- distinguish between defined and undefined terms, and define geometric objects such as segment, ray, triangle, angle;
- recognize, distinguish, and describe the relationships between the theorems of neutral, Euclidean, and hyperbolic geometries;
- reason inductively and deductively with the models of Euclidean, Hyperbolic and Elliptic geometries;
- describe the classification of Euclidean transformations;
- perform and prove basic neutral and Euclidean constructions; and
- use basic theorems such as The Crossbar Theorem, and the Saccheri-Legendre Theorem to solve problems in Geometry.

Department of Engineering, Mathematics, and Physics

MATH 3330
Ordinary Differential Equations

Adoption date: November 19, 2010.

COURSE DESCRIPTION
Solution of first order differential equations. Study of second and higher order equations with constant coefficients. Power series solutions. Laplace Transform and Linear Systems. A brief introduction to numerical methods. Prerequisite: MATH 2415 and MATH 3310.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- solve first order differential equations of separable, exact and linear type;
- use methods such as variation of parameters to solve linear differential equations of second or higher order with constant coefficients;
- use the Laplace transform to solve initial value problems;
- use power series to solve linear differential equations with analytic coefficients;
- use the eigenvalues and eigenvectors of a matrix to solve systems of differential equations with constant coefficients;
- approximate the solution of a differential equation using a numerical technique such as Euler's method; and
- apply differential equations to solve problems in Physics, Engineering, or Geometry.

Department of Engineering, Mathematics, and Physics

MATH 3360
Statistical Analysis

Adoption date: November 19, 2010.

COURSE DESCRIPTION
Fundamentals of probability, distribution theory, random variables, law of large numbers, central limit theorems, statistical inequalities. Prerequisite: MATH 2414.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- compute and interpret measures of location and dispersion, and to calculate probabilities of events;
- describe methods of sampling and construct a sampling distribution;
- construct and interpret confidence and prediction intervals for a dependent variable;
- describe and carryout the five-step hypothesis-testing procedure; and
- describe the relationship between several independent variables and a dependent variable using regression analysis.

Department of Engineering, Mathematics, and Physics

MATH 3365
Discrete Mathematics

Adoption date: November 19, 2010.
Updated and approved: February 3, 2011.

COURSE DESCRIPTION
This course is a study of elements of discrete mathematics. Topics covered: logic; counting techniques; mathematical induction; the binomial theorem; number theory; set, relations and functions.
Prerequisite: MATH 2413.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- discern the validity of logical statements; examine the logic of predicate and quantified statements; recognize whether an argument is valid or not; explain the logic and various methods of mathematical proofs and recognize when a proof is complete;
- generate numerous proofs using appropriate techniques including direct, indirect, counter example and the method of mathematical induction;
- work with and use sequences to solve discrete mathematics problems, e.g., identify arithmetic and geometric sequences and find a formula for the nth term of a sequence;
- solve problems in elementary set theory and formulate properties of sets through proof and counterexample;
- explain and solve problems involving counting using appropriate methods and techniques;
- analyze relations and determine if a given relation has certain properties, e.g. whether it is reflexive, transitive, symmetric, or anti-symmetric; and
- analyze functions and composite functions, and determine if a given function has certain properties, e.g. whether it is injective, surjective, or bijective.

Department of Engineering, Mathematics, and Physics

MATH 3390
Principles of Math for Elem Ed

Adoption date: January 24, 2014.

COURSE DESCRIPTION

An in-depth study of the mathematical principles and concepts underlying the traditionally computational techniques for the teaching of mathematics at early childhood and elementary school levels. The course content includes problem solving; arithmetic, algebra, geometry, probability, logic, counting, numeration and number systems (including natural, integer, rational, and real number systems), and their historical development; content based teaching; integrating various areas of mathematics; and examining connections of college-level mathematics course contents with the mathematics content of and its effective teaching at the early childhood and elementary school levels. Students must earn a “C” or better to successfully complete the course. The course may not be counted toward a major or minor in Mathematics or for certification in secondary mathematics. Open only to early childhood/elementary education majors. Prerequisite: Completion of Block I and a grade of at least “C” in MATH 1351. It is strongly recommended to take this course concurrently with Block II.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- analyze, design and appraise mathematics lesson plans for early childhood and elementary school mathematics;
- recognize, interpret, relate, propose and assess the appropriateness of application of various pedagogical knowledge and the mathematical content of early childhood and elementary school mathematics;
- recognize and appraise the connection between early childhood and elementary school mathematics content with the mathematics content of college level courses, e.g., through in-class lessons involving both elementary and post-secondary content;
- analyze and appraise mathematics from the historical perspectives, e.g., number and numeration systems through the ages;
- recognize, interpret and appraise mathematics contributions from various regions, cultures and societies from ancient recorded history to present;
- recognize, analyze and appraise connections between historical development of mathematical content/concepts and the learning of mathematics by an individual;
- analyze written arguments on mathematical content and pedagogy issues, problems and theorems; and
- compose written arguments on mathematical content and pedagogy issues, problems and theorems.

Department of Engineering, Mathematics, and Physics

MATH 4152-4452
Internship in Mathematics

Adoption date: September 28, 2012

COURSE DESCRIPTION

A directed internship in a public/private organization that is appropriate to the student's career objective or desire in a mathematical science setting. Students will apply mathematical knowledge in a real world setting and receive on-the-job training experience. Seminar and training will be held to discuss field experience from theoretical and applied perspectives. Prerequisite: Permission of the instructor and advisor.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- apply professional judgment in the work environment;
- explain the legal, professional, and ethical issues in mathematics;
- identify, analyze and solve mathematical problems;
- prepare and submit progress reports;
- prepare and submit a final project report; and
- deliver oral presentations with appropriate audio-visual materials.

Department of Engineering, Mathematics, and Physics

MATH 4305
Number Theory

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Divisibility, congruence, power residues, quadratic reciprocity, Diophantine equations, Euler's function, Fermat's theorem, primitive roots, Legendre and Jacobi symbols. Prerequisites: MATH 3365 and MATH 3310.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- determine the solvability of linear, quadratic, and simultaneous congruences;
- determine the solvability of and solve basic Diophantine equations;
- calculate Legendre and Jacobi symbols efficiently;
- test primality probabilistically with the Fermat test; and
- conduct proofs using induction, divisibility, and other techniques.

Department of Engineering, Mathematics, and Physics

MATH 4310
Abstract Algebra I

Adoption date: September 28, 2012

COURSE DESCRIPTION

Introduction to abstract algebra. Topics include Introduction to Ring theory: arithmetic in integers, modular arithmetic, fields, arithmetic in the Ring of polynomials. Unique factorization in integers and polynomials. Introduction to Group theory: definition and examples, subgroups, quotient groups, symmetry groups and permutation groups. Prerequisite: MATH 3365.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- explain and provide examples of the following terms: groups, rings, and fields;
- apply congruence relations in integer arithmetic;
- apply the extended Euclidean Algorithm to represent the greatest common divisor of two integers as a linear combination of them;
- determine if a binary operation on a set is a group operation and justify why or why not;
- compute the decomposition of a permutation and apply this information to solve other problems involving permutation groups;
- determine if a ring is an integral domain or even a field;
- compute the ideals of a ring and the corresponding quotient rings; and
- do arithmetic in a polynomial ring.

Department of Engineering, Mathematics, and Physics

MATH 4315
Abstract Algebra II

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Continuation of MATH 4310. Topics in group theory: group actions, Sylow theorems, fundamental theorem of Abelian groups, and finite simple groups. Topics in Ring theory: ideals and quotient rings, Euclidean domain, principal ideal domain and unique factorization domain. Topics in Field theory: vector spaces, field extensions, finite field, and Galois theory. Prerequisite: MATH 4310.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- recognize and describe various examples of groups, including groups of numbers, permutations, matrices, and transformations. Students will also be able to recognize and describe examples of subgroups and quotient groups of such groups, and examples of homomorphisms and isomorphisms between them;
- derive basic properties of groups, subgroups, quotient groups, homomorphisms, and isomorphisms from their definitions;
- recognize and describe various examples of rings, and as special cases of rings, of integral domains and fields. Students will also be able to recognize and describe examples of subrings, ideals, and quotient rings of such rings, and examples of homomorphisms and isomorphisms between them;
- derive basic properties of rings, integral domains and fields from their definitions.
- discuss and prove the unique factorization property of the ring of polynomials over a field, and perform related operations on polynomials such as Euclidean algorithm, irreducibility tests and factorization;
- recognize and describe the process of construction of field extensions. In particular, students will be able to construct (i) the field extension obtained by adjoining elements to the base field, and (ii) the splitting field of a polynomial over the base field; and
- describe the intermediate fields of a given field extension, and in the case of Galois extension, be able to describe the Galois group and Galois correspondence.

Department of Engineering, Mathematics, and Physics

MATH 4330
Numerical Linear Algebra

Adoption date: November 19, 2010.

COURSE DESCRIPTION
Numerical methods for problems of linear algebra, including the solution of large systems, eigenvalues and eigenvectors. Prerequisite: MATH 3310.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- use the computer to solve large systems of linear equations by using iterative and elimination methods;
- solve least square and eigenvalue problems;
- compute singular value decomposition of matrices, QR factorization, Gram-Schmidt orthogonalization process, and Householder triangularization of matrices;
- apply theories about conditioning, stability, and accuracy to analyze simple numerical algorithms; and
- determine conditioning and stability of some classical algorithms, such as, the least square, Gaussian Elimination and the QR algorithms.

Department of Engineering, Mathematics, and Physics

MATH 4335
Advanced Calculus

Adoption date: April 24, 2009.

COURSE DESCRIPTION

A course in real analysis. It will include topology, continuity, differentiation, integration, sequences, series and power series. Prerequisite: MATH 2415.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- describe the usual topology, including completeness, of the set of real numbers, including compact sets using the Heine-Borel Theorem;
- use the Bolzano-Wierstrass Theorem to determine the convergence of a sequence;
- determine the convergence or divergence of a numerical sequence or series, and determine if a series converges absolutely or conditionally;
- determine the convergence (and uniform convergence) of a sequence or series of functions, including a Taylor series, the interval of convergence of a power series and the possible outcome of integrating or differentiating a series of functions term by term;
- determine the continuity of a function at a point, the continuity of a function in an interval and if a continuous function is uniformly continuous in an interval;
- use Theorems such us Rolle's Theorem, the Mean Value Theorem, the Intermediate Value Theorem, and the Inverse Function Theorem for functions of one variable to solve problems in Analysis;
- use the definition of the Riemann Integral to determine if a bounded function defined in a closed and bounded interval is integrable, and use the Fundamental Theorem of Calculus for integrable functions to compute derivatives or to compute a definite integral;
- use definitions and theorems to provide proofs related to topics in this course.

Department of Engineering, Mathematics, and Physics

MATH 4340
Numerical Analysis I

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Error analysis, solutions of non-linear functions, systems of linear equations, eigenvalue problems, interpolation theory, numerical differentiation and integration, numerical methods for ordinary differential equations. Prerequisites: MATH 3330 and MATH 3310.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- demonstrate factual knowledge in the theoretical and practical aspects of the use of numerical methods;
- apply course material along with techniques and procedures covered in this course to solve problems, including nonlinear equations, systems of linear equations, eigenvalue problems, interpolation theory, numerical differentiation and integration, and numerical methods for ODEs;
- implement numerical methods for a variety of problems by using software packages such as Matlab;
- establish the limitations, advantages, and disadvantages of numerical methods; and
- determine numerical methods for a variety of applications.

Department of Engineering, Mathematics, and Physics

MATH 4345
Complex Variables

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This is a course in complex variables which will include analytic functions, power series, the theory of residues and conformal mappings. Prerequisite: MATH 4335 or permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- use the algebra, geometry and topology of complex numbers in problem solving;
- analyze and geometrically describe basic complex mappings including linear, reciprocal, Mobius transformations, power, root, exponential and logarithmic mappings;
- use the Cauchy-Riemann equations to prove that a function is analytic;
- use theorems like the Maximum Principle and Liouville's Theorem in problem solving;
- analyze and describe the local properties of complex analytic or meromorphic mappings at regular points (con formality), at branch points, and at singularities (poles);
- use properties of and operations on power (Taylor) series and Laurent series to analyze the properties of analytic or meromorphic functions; and
- use Cauchy's Theorem, Cauchy's Integral Formula, and the Residue Theorem to evaluate complex and real definite integrals.

Department of Engineering, Mathematics, and Physics

MATH 4360
General Topology

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Basic concepts of point-set topology including connectedness, compactness, etc. and metric spaces. Prerequisite: MATH 4335 or permission of the instructor.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- recall and recognize similarities and differences between Metric Spaces and Topological Spaces;
- construct a Topology in a space using different tools and operations, e.g. closure, basis and sub-basis;
- classify Topological Spaces according to properties such as being compact, connected, normal, Haussdorff, etc.;
- construct new Topological Spaces from old ones such as constructing quotient spaces, product spaces or subspaces;
- recognize and construct continuous mappings from one Topological Space to another;
- determine if two different Topological Spaces are homeomorphic.

The following agreement was reached about outcomes for this course

- the course will be renamed to "Introduction to Topology";
- the sentence "or permission of the instructor" will be removed from the prerequisites;
- the course description will be changed to
  Basic concepts of point-set topology including connectedness, compactness, etc. and metric spaces. *Additional topics such as the fundamental group may be included*. Prerequisite: MATH 4335;
- it is proposed to add MATH 3365 as a prerequisite to MATH 4335.

Instructors can add optional outcomes to this course, in case that they decide to include additional topics, as explained in the course description. Additional outcomes can only refer to the optional topic. In this case, instructors must submit their outcomes for the approval of the Department prior to inclusion in the syllabus, unless they have already been approved. Examples of outcomes approved by the Department are:

- recall and recognize homotopy, path homotopy, and the fundamental group of a Topological Space;
- construct an homomorphism between fundamental groups corresponding to a given homeomorphism between topological spaces.

Department of Engineering, Mathematics, and Physics

MATH 4365
Geometry of Curves and Surfaces

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This course will present geometry of curves and surfaces in three dimensional Euclidean space. Topics include 1) From Curve Theory: Parametrized Curves, Arc Length, Frenet-Serret Frame, Singularities, Theory of Contact, Curvature, Torsion, Intrinsic Equation of Curves, Global Properties of Curves; 2) From Surface Theory: Parametrized Surfaces, Tangent Plane and Normal Line, First and Second Fundamental Forms, Curvature of Surfaces. Prerequisite: MATH 2415, 3310.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- compute, describe, and interpret the curvature, torsion, Frenet-Serret frame, osculating circle, and osculating plane of a regular curve;
- analyze and classify regular plane and space curves;
- compute and interpret the total curvature of a regular curve;
- analyze and describe simple irregular points (cusps) of a curve;
- compute the first fundamental form of a surface and use it to analyze curves on the surface, such as the geodesics, and to compute the surface area;
- compute the second fundamental form of a surface, as well as principal, Gaussian, and mean curvatures, and use them to analyze the surface;
- analyze and describe examples of special classes of surfaces, such as ruled surfaces, minimal surfaces, and surfaces of constant curvature; and
- analyze and describe examples of isometries between surfaces.

Department of Engineering, Mathematics, and Physics

MATH 4385
History of Mathematics

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Topics from arithmetic and computation, algebra, geometry, trigonometry, calculus, number theory, linear algebra, etc. from ancient recorded history to modern times intertwined with historical perspectives, biographies of several mathematicians from different cultures and times, their contributions, and that of their cultures, to mathematics and society. Prerequisite: Nine semester hours of advanced mathematics.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- analyze and appraise mathematics from the historical perspectives, e.g. number and numeration systems through the ages;
- recognize, interpret, and appraise mathematics contributions from various regions, cultures, and societies from ancient recorded history to present;
- recognize, analyze and appraise connections between historical development of mathematical content/concepts and the learning of mathematics by an individual;
- analyze written proof to introductory to intermediate-level problems and theorems both in a historical and contemporary settings; and
- compose written proof to introductory to intermediate-level problems and theorems both in a historical and contemporary setting.

Department of Engineering, Mathematics, and Physics

MATH 4390
Mathematics in the Middle and High Schools

Adoption date: April 24, 2009.

COURSE DESCRIPTION
Selected topics from secondary school mathematics. Content, materials, and contemporary issues specific to teaching of mathematics at the secondary school level. Prerequisite: EDCI 4993.

STUDENT LEARNING OUTCOMES
Upon successful completion of this course, the student will be able to:

- analyze, design and appraise mathematics lesson plans;
- recognize, interpret, relate, propose and assess the appropriateness of application of various pedagogical knowledge and the mathematical content of the middle and high school mathematics courses;
- recognize and appraise the connection between middle and high school level mathematics content with the mathematics content of intermediate and advanced college level courses;
- analyze written arguments on mathematical content and pedagogy issues, problems and theorems; and
- compose written arguments on mathematical content and pedagogy issues, problems and theorems.

For your information: the following agreement was reached and stated in the 2008 AIER report

> In regards to the results of the TExES exam, we believe that students should have some familiarity with the exam before they take it for the first time. Because of this, activities will be added to the course “MATH 4390 Mathematics in the Middle and High School” (a capstone course for students in this degree), that will help students prepare for this exam.

Department of Engineering, Mathematics, and Physics

MATH 5191
Mathematics Seminar

Adoption date: November 19, 2010.

COURSE DESCRIPTION

A seminar presents diverse topics from pure and applied mathematics. Students are encouraged to present a series of articles, journals and portions of monograms during the class meetings. May be repeated once when topics vary. Prerequisites: Graduate standing and permission of instructor. (Formerly MATH 5190)

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- effectively express themselves both orally and in writing using well constructed mathematical arguments;
- demonstrate the ability to integrate knowledge and ideas in a coherent and meaningful manner;
- demonstrate the ability to locate and use information for conducting mathematical investigation and/or research;
- demonstrate the ability to work independently towards conducting mathematical research or inquiry; and
- apply the mathematical sciences in other academic disciplines.

Department of Engineering, Mathematics, and Physics

MATH 5290
Research Methods in Mathematics

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This course deals with the basic tools of the mathematics to better understand mathematical research. Analytical concepts, survey research, in some cases, statistical/computational software and their methods will be the basis of this course. Prerequisites: Graduate standing and permission of the instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- recall a variety of mathematical research methods in pure and applied mathematics, and how they have been used to address particular research questions in different settings;
- recognize and evaluate different research designs and methodologies;
- develop research project proposals;
- work independently on research projects; and
- write and extended paper.

Department of Engineering, Mathematics, and Physics

MATH 5303
Number Theory I

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This first course in number theory introduces algebraic number theory as well as the analytic methods. Topics include: Number fields, algebraic integers, ideals and units, ideal class groups, ramification theory, quadratic and cyclotomic fields, zeta-functions and L-series. Prerequisites: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- compute Legendre and Jacobi symbols efficiently using Quadratic Reciprocity Law;
- identify the ring of integers in quadratic, cyclotomic, or other select number fields;
- compute the discriminant of quadratic, cyclotomic, or other select number fields, and apply it to find the set of ramified primes;
- compute the prime decomposition in quadratic, cyclotomic, or select number fields, by Kummer's Theorem;
- compute the ideal class group and number of quadratic number fields using the Minkowski constant;
- compute the rank of the unit group of any number field using the Dirichlet's Unit Theorem, and compute the fundamental units of select real quadratic number fields; and
- identify the Dedekind zeta-function of any number field and compute it in select number fields.

Department of Engineering, Mathematics, and Physics

MATH 5305
Real Analysis I

Adoption date: November 19, 2010.

COURSE DESCRIPTION
This is a course on Lebesgue measure and integration. The classical Lp spaces will be defined and basic results established, such as the Holder and Minkowski inequalities and completeness of the spaces. Prerequisites: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- explain the concepts of measurable sets, measurable function and measure;
- define the concept of Lebesgue Measure and Lebesgue Integral;
- explain the difference between the Lebesgue Integral and the Riemann Integral;
- distinguish between uniform convergence and pointwise convergence, and apply the Lebesgue dominated convergence theorem to prove convergence of integrals and the continuity of basic integral transforms, such as the Fourier Transform;
- explain the definition of L^p spaces, the Riesz representation theorem, and the completeness of the L^p spaces;
- explain the definition of the derivative of a measurable function; and
- explain how to construct measure theory in spaces other than the real line.

Department of Engineering, Mathematics, and Physics

MATH 5306
Linear Algebra

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Topics include: Canonical structure theorems, diagonalization, the spectral theorem, inner-product spaces, and their applications and extensions. Prerequisite: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- recognize, state, and use the definition of terminology, e.g. vector space, inner product space;
- recognize, distinguish and classify linear algebraic substructures, e.g. vector spaces, inner product spaces;
- analyze written proof to problems and theorems in Linear Algebra, e.g. spectral mapping theorem for linear transformations;
- compose written proof to problems and theorems in Linear Algebra, e.g. whether a linear operator is diagonalizable or not; and,
- demonstrate the ability to do independent learning and problem solving.

Department of Engineering, Mathematics, and Physics

MATH 5316
Graph Theory

Adoption date: November 11, 2011.

Course Description
This is a basic course in graph theory. Fundamental concepts of graph theory will be investigated. Topics include: directed graphs, trees and distance, spanning trees, coloring of graphs, planar graphs, edges and cycles. Prerequisites: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- demonstrate knowledge of graph theoretic concepts such as simple graphs, diagraphs, Eulerian and Hamiltonian graphs, trees (sorting and prefix codes), matchings, paths and cycles, graph colorings, planar graphs, isomorphism, walks, bipartite graph components, cut-edges, vertex degrees, and degree sequences;
- state the basic principles of structural graph theory and of graph minors including algorithmic applications on networks such as shortest path, minimal spanning tree, and mini-flow max-cut;
- apply a Hasse diagram to illustrate the relation among elements in a partially ordered set and a PERT diagram to prioritize tasks in executing a project;
- investigate matrix representation of graphs, including directed graphs, undirected graphs, connected components, and counting walks of a given length; and
- apply graph theory to solve classical problems, including minimum connector, marriage, assignment, network flow, committee scheduling, four color, and traveling salesman.

Department of Engineering, Mathematics, and Physics

MATH 5320
Complex Variables I

Adoption date: November 19, 2010.

COURSE DESCRIPTION
This is the first course on functions of one complex variable. It will begin with the complex number system and will treat topics such as power series, analytic functions, Mobius transformations, complex integrations, residue calculus, singularities, and Schwarz's Lemma. Prerequisite: Graduate standing and consent of instructor.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- determine whether a complex function is differentiable and use the Cauchy-Riemann equations to calculate the derivative;
- determine whether a function is harmonic and find a harmonic conjugate via the Cauchy-Riemann equations;
- determine whether a complex series converges and find the region of convergence of a power series;
- find the Taylor or Laurent series for simple functions;
- use Cauchy's Integral Formula to evaluate contour integrals;
- use a Mobius Transformation to find a conformal mapping between two given regions; and
- identify and classify zeros and singular points of functions and use residues to evaluate various contour integrals.

Department of Engineering, Mathematics, and Physics

MATH 5330
Abstract Algebra I

Adoption date: January 24, 2014.

COURSE DESCRIPTION

This is the first course in Abstract Algebra. The main topics in this course will be groups, rings, fields, subgroups, quotient groups, ideals, homomorphisms and introduction to field extensions. There will be classical examples of permutation groups, polynomial rings and integral domains, questions of factorization, ideals and fundamental homomorphism theorems.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- compute cyclic (sub)groups and their generators;
- classify certain small finite groups using Sylow's theorems;
- apply theoretical tools (e.g. the isomorphism theorems) to handle certain questions on concrete groups, such as dihedral groups, symmetric groups, abelian groups;
- apply the basic concepts of ring theory such as ideals by solving problems about concrete examples; and
- calculate the splitting field of certain polynomials.

Department of Engineering, Mathematics, and Physics

MATH 5350
Ordinary Differential Equations I

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This is the first course in ordinary differential equations. The course will include systems of linear differential equations, two dimensional autonomous systems, existence, uniqueness and continuation of solutions, dependence of solutions on initial conditions and parameters. Prerequisites: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- solve first-order nonlinear differential equation such as logistic population, constant harvesting, and periodic harvesting models (this includes exploration of a two-parameter family);
- apply the ideas of elementary differential equations to solve planar systems of differential equations with constant coefficients;
- plot phase portraits for planar systems;
- classify planar systems of differential equations; and
- solve higher-dimensional linear systems of differential equations; however, emphasis remains on three- and four-dimensional systems, though many of the techniques extend immediately to higher dimensions.

Department of Engineering, Mathematics, and Physics

MATH 5360
Partial Differential Equations

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This is a basic course in partial differential equations. The course will cover the following: first order linear partial differential equations, classification of second order equations and canonical forms, Fourier series and integrals, the wave equation, the Cauchy problem for hyperbolic equations, the heat equation, the weak maximum principle, the strong maximum principle, the Laplace equation, Green's function and Poisson's formula. Prerequisite: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- explain clearly the mathematical formulation of stationary and time-dependent boundary value problems arising in physical problems and to derive equations with source in one and three-spatial dimensions for different physical models;
- solve boundary value problems involving partial differential equations, in particular the heat, wave and potential equations by using the method of separation of variables;
- apply Fourier series and integral transform techniques to obtain solutions of appropriate initial and boundary value problems;
- find D'Alembert's solution of the wave equation and the distributed-source solution of the heat equation; and
- classify the second order PDE by using the discriminant of the principal part as a hyperbolic, parabolic or elliptic equation, to interpret the geometrical and physical meanings of the classification, and how this classification is connected with patterns that the equation predicts.

Department of Engineering, Mathematics, and Physics

MATH 5365
Topology

Adoption date: November 11, 2011.

COURSE DESCRIPTION

This is an introductory course in point-set topology. The course will include topological spaces, continuous functions, connectedness, separation axioms. Tychonoff's theorems, para- compactness, complete metric spaces and function spaces will also be discussed. Prerequisite: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- prove the equivalence between the topological and epsilon-delta definition of limit and continuity in metrizable spaces;
- construct new topological spaces, such as constructing quotient spaces, product spaces or subspaces, from old ones;
- apply concepts such as connectivity, compactness, and dimension theory to topologically distinguish between non-homeomorphic pairs of spaces that naturally arise from geometry;
- determine, for both the uniform and pointwise convergence topologies, whether the space of continuous functions between two naturally arising metric spaces is metrizable and whether it is completely metrizable; and
- apply the axiom of choice or its equivalents to solve problems that arise in its application to other areas of mathematics.

Department of Engineering, Mathematics, and Physics

MATH 5367
Numerical Methods for PDE I

Adoption date: January 24, 2014.

COURSE DESCRIPTION

A study of algorithms for the numerical solution of hyperbolic and parabolic partial differential equations using the finite difference method; stability and convergence of methods and error bounds. Applications from physics and engineering will be emphasized.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- identify appropriate numerical solution procedures for a given PDE;
- derive and implement finite difference schemes for hyperbolic and parabolic PDEs;
- apply the finite element method to elliptic PDEs;
- analyze stability and convergence properties of numerical schemes; and
- identify the potential sources of error in numerical methods for PDEs.

Department of Engineering, Mathematics, and Physics

MATH 5370
Mathematical Modeling

Adoption date: November 19, 2010.

COURSE DESCRIPTION

This is the first course in mathematical modeling. Topics include: linear equations and models, non-linear equations and models, modeling with linear systems, modeling with non-linear systems, mathematical modeling and dynamical systems, non-homogeneous systems, empirical models and linear regression, bifurcation and chaos. Working knowledge of a computer programming language is preferred. Prerequisites: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- determine a proper class of mathematical models for a problem and classify the variables;
- determine interrelationships among the variables selected in the problem;
- make and test conjectures;
- use real-world data to create a mathematical model; and
- solve the model problem to predict results based on the given data.

Department of Engineering, Mathematics, and Physics

MATH 5375
Probability

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Topics include: distribution functions, random variables, expectation, independence, convergence concepts, law of large numbers, characteristic functions, the central limit theorem, conditional expectation, martingales and Brownian. Prerequisites: Graduate standing and permission of instructor.

STUDENT LEARNING OUTCOMES

Upon successful completion of this course, the student will be able to:

- interpret the main concepts and results in measure theory, define sample spaces, probability measure, and events, and compute probabilities of events;
- distinguish various modes of convergence ;
- explain concept of conditional probability and independent events, determine whether events are independent or not, and compute probabilities (joint and conditional) of two or more random variables;
- interpret and simulate law of large numbers, and apply central limit theorem to compute normal approximations to random variables;
- solve simple problems on martingales, stopping time, and Brownian motion.

Department of Engineering, Mathematics, and Physics

MATH 5398
Thesis I

Adoption date: January 24, 2014.

COURSE DESCRIPTION

To be scheduled by the student in consultation with his/her advisor. Prerequisite: Graduate standing and permission from the student's thesis advisory committee. Approval of the major professor and the department chair. All core courses should be completed prior to beginning thesis work preferably during the last year of the student's program of study. Evaluation of performance in this course is on CR/NC basis. If grade of IP is received, student must enroll again for credit.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- efficiently search the mathematical literature for books and journal articles relevant to his/her thesis topic, including efficient use of the MathSciNet database and interlibrary loan;
- recognize, interpret, and appraise mathematical concepts needed in the study of a particular topic in mathematics;
- analyze written proof of introductory to advanced-level problems and theorems;
- summarize in written form the field's current state of knowledge regarding his/her thesis topic; and
- write a research proposal in a widely used mathematical journal format, such as AMS, SIMA, Springer, etc.

Department of Engineering, Mathematics, and Physics

MATH 5399
Thesis II

Adoption date: November 19, 2010.

COURSE DESCRIPTION

To be scheduled by the student in consultation with his/her advisor. Prerequisite: Graduate standing and permission from the student's thesis advisory committee. Approval of the major professor and the department chair. Evaluation of performance in this course is on CR/NC basis. A good standing in MATH 5398 Thesis I is required. If grade of IP is received, student must enroll again for credit.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- demonstrate a knowledge of formal mathematical writing and presentation;
- demonstrate an ability of self study and research in mathematics;
- recognize, interpret, and appraise mathematical concepts needed in the study of a particular topic in mathematics;
- analyze written proof of introductory to advanced-level problems and theorems; and
- compose written proof to introductory to intermediate-level problems and theorems.

Department of Engineering, Mathematics, and Physics

ASTR 1111
Planetary Astronomy Laboratory

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Laboratory course to accompany ASTR 1311. Practical exercises reinforce ASTR 1311 lecture material. Topics include unaided-eye observation, telescopic observation, telescope manipulation, and experiments/exercises. Must be taken concurrently with ASTR 1311. Carries no credit towards a major or minor in Physics. Lab fee: $30.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- describe the basic function of a telescope;
- use a telescope and other basic astronomical tools, such as a spectroscope;
- collect experimental data to compare with theoretical predictions;
- plot astronomical data to show relationships between variables in graphical form;
- interpret astronomical data from tables and graphs.

Department of Engineering, Mathematics, and Physics

ASTR 1311
Planetary Astronomy

Adoption date: April 24, 2009.

COURSE DESCRIPTION

An introductory survey of the solar system to include astronomical history and instrumentation, the planets and their moons, comets, asteroids, and meteoroids. Designed to fulfill laboratory science core curriculum requirements. Must be taken concurrently with ASTR 1111. Carries no credit toward a major or minor in Physics.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- describe how scientists combine observation, theory, and testing in their study of the universe;
- describe how and why the Sun, the Moon, and the stars appear to change their positions from night to night and from month to month;
- describe the major contributions of Galileo, Kepler, and Newton to the development of our understanding of the solar system;
- discuss the nature of electromagnetic radiation and tell how that radiation transfers energy and information through interstellar space;
- summarize the basic differences between the terrestrial and the jovian planets.

Department of Engineering, Mathematics, and Physics

ASTR 1112
Stellar Astronomy Laboratory

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Laboratory course to accompany ASTR 1312. Practical exercises reinforce ASTR 1312 lecture material. Topics include unaided-eye observation, telescopic observation, telescope manipulation, and experiments/exercises. Must be taken concurrently with ASTR 1312. Carries no credit towards a major or minor in Physics. Lab fee: $30.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- describe the basic function of a telescope;
- correctly use a telescope and other basic astronomical tools, such as a spectroscope, to observe celestial objects;
- collect experimental data to compare with theoretical predictions;
- plot astronomical data to show relationships between variables in graphical form; and
- interpret astronomical data from tables and graphs.

Department of Engineering, Mathematics, and Physics

ASTR 1312
Stellar Astronomy

Adoption date: November 19, 2010.

COURSE DESCRIPTION

An introductory survey of stellar properties and life cycles, H-R Diagrams, as well as galaxies and Hubble's Law. Instrumentation techniques used to collect astronomical data is discussed in addition to topics from cosmology including General Relativity theory and the Big Bang theory. May be taken independently from ASTR 1311. Designed to fulfill laboratory science core curriculum requirements. Must be taken concurrently with ASTR 1112. Carries no credit towards a major or minor in Physics.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- describe how scientists combine observation, theory, and experimentation in the study of the universe;
- explain why the Sun, the Moon, the planets, and the stars appear to change their positions in the sky from night to night and from month to month;
- describe the major contributions of Galileo, Kepler, and Newton to the development of our understanding of the solar system;
- discuss the nature of electromagnetic radiation and describe how radiation transfers energy and information through interstellar space; and
- summarize the life cycle of stars of different masses.

Department of Engineering, Mathematics, and Physics

PHYS 1101
General Physics I Laboratory

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Laboratory course to accompany PHYS 1301. Laboratory exercises reinforce PHYS 1301 lecture material and place importance on scientific communication and collaboration as well as measurement methods, uncertainty and basic error analysis. Must be taken concurrently with PHYS 1301. Carries no credit towards a major or minor in physics. Lab fee: $30.00.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- define the basic physics principles in each experiment;
- set up and correctly operate the instruments;
- collect and process the experiment data;
- interpret the results, and identify the sources of the error;
- prepare and complete an experimental report.

Department of Engineering, Mathematics, and Physics

PHYS 1301
General Physics I

Adoption date: April 24, 2009.

COURSE DESCRIPTION

A non-calculus-based treatment of the fundamentals of classical mechanics, sound, fluid mechanics and heat. Topics include one and two dimensional motion, forces and Newton's Laws, momentum conservation, energy conservation, rotational dynamics, angular momentum, waves, simple harmonic motion, kinetic theory, calorimetry and thermodynamics. Designed to fulfill laboratory science core curriculum requirements. Prerequisite: MATH 1316 or equivalent. Must be taken concurrently with PHYS 1101. Carries no credit toward a major or minor in physics.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- state Newton's three laws of motion, and apply it to solve physics problems;
- illustrate work-energy theorem and law of energy conservation, and apply them to solve physics problems;
- illustrate momentum conservation, and apply it to solve physics problems;
- interpret rotational motion, and apply it to solve physics problems;
- describe simple harmonic motion, and apply it to solve physics problems.

Department of Engineering, Mathematics, and Physics

PHYS 1102
General Physics II Laboratory

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Laboratory course to accompany PHYS 1302. Laboratory exercises reinforce PHYS 1302 lecture material and place importance on scientific communication & collaboration as well as measurement methods, uncertainty and basic error analysis. Must be taken concurrently with PHYS 1302. Lab fee: $30.00.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- explain the basic physics principles in each experiment;
- set up and operate the instruments correctly;
- collect and process the experimental data;
- interpret the results, and identify the sources of the error; and
- prepare and complete an experimental report.

Department of Engineering, Mathematics, and Physics

PHYS 1302
General Physics II

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Continuation of PHYS 1301. A non-calculus-based treatment of the fundamentals of electricity and magnetism, sound, light and modern physics. Topics include electrostatics, magnetostatics and magnetic materials, electromagnetic waves, geometric optics, physical optics, quantum mechanics, nuclear physics and relativity theory. Designed to fulfill laboratory science core curriculum requirements. Must be taken concurrently with PHYS 1102. Prerequisites: PHYS 1301/PHYS 1101. Carries no credit toward a major or minor in physics.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- describe electric fields, electric potential and electric potential energy, and apply them to solve physics problems;
- illustrate Ohm's law and Kirchhoff's law, and apply them to solve DC circuits;
- describe magnetic forces and magnetic fields, and apply them to solve physics problems;
- illustrate electromagnetic induction, electromagnetic waves, and apply it to the solution of physics problems;
- state what an alternating current circuit is, and apply it to the solution of physics problems;
- describe the reflection and refraction of light, and apply them to the solution of physics problems; and
- explain interference and the wave nature of light, and apply them to solve physics problems.

Department of Engineering, Mathematics, and Physics

PHYS 1170
Survey of Physical Science Laboratory

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Laboratory course to accompany PHYS 1370. Laboratory exercises reinforce PHYS 1370 lecture material and place importance on scientific communication and collaboration as well as measurement methods. Some mention is made of uncertainty and basic error analysis. Must be taken concurrently with PHYS 1370. Carries no credit towards a major or minor in physics. Lab fee: $30.00.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- define the basic physics principles in each experiment;
- set up and correctly operate the instruments;
- collect and process the experiment data;
- interpret the results, and identify the sources of the error;
- prepare and complete an experimental report.

Department of Engineering, Mathematics, and Physics

PHYS 1370
Survey of Physical Science

Adoption date: November 19, 2010.

COURSE DESCRIPTION

An introductory survey of physical science. Topics include physics (motion, forces, waves and thermodynamics), chemistry (periodic table, reactions), earth science (geology, weather, biosphere and environment) and astronomy (astronomical history, planetary astronomy, stellar astronomy and cosmology). Designed to fulfill laboratory science core curriculum requirements. Must be taken concurrently with PHYS 1170. Carries no credit towards a major or minor in physics.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- describe Newton's three laws of motion and apply them to solve physics problems;
- explain mechanical energy and law of energy conservation, and apply them to solve physics problems;
- state the heat equation, the first and second laws of thermodynamics, and apply them to solve physics problems;
- outline wave and wave equations, and apply them to solve physics problems;
- state Ohm's law, describe power and electric energy and apply them to solve physics problems; and
- describe the properties of light, and the dual nature of light from the modern physics point of view.

Department of Engineering, Mathematics, and Physics

PHYS 2125
University Physics I Laboratory

Adoption date: April 24, 2009.

COURSE DESCRIPTION

Laboratory course to accompany PHYS 2325. Laboratory exercises reinforce PHYS 2325 lecture material and place importance on scientific communication and collaboration as well as measurement methods, uncertainty, and basic error analysis. Must be taken concurrently with PHYS 2325. Lab fee: $30.00.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- explain why experiments are an important component of the scientific method;
- explain why uncertainty is present in all measurements;
- collect experimental data to compare with theoretical predictions;
- plot data to show relationships between variables in graphical form;
- interpret data from tables and graphs.

Department of Engineering, Mathematics, and Physics

PHYS 2325
University Physics I

Adoption date: April 24, 2009.

COURSE DESCRIPTION

A calculus-based treatment of the fundamentals of classical mechanics, sound, fluid mechanics, and heat. Topics include one- and two-dimensional motion, forces and Newton's laws, momentum conservation, energy conservation, rotational dynamics, angular momentum, waves, simple harmonic motion, kinetic theory, calorimetry, and thermodynamics. Prerequisite: MATH 2413 or equivalent, or concurrent registration therein. Must be taken concurrently with PHYS 2125.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- differentiate between a vector quantity and a scalar quantity;
- state Newton's three laws of motion and give everyday examples of each law;
- state the work-energy theorem and apply it to physics problems;
- state the law of conservation of energy and apply it to physics problems;
- state the law of conservation of momentum and apply it to physics problems.

Department of Engineering, Mathematics, and Physics

PHYS 2126
University Physics II Laboratory

Adoption date: November 19, 2010.

COURSE DESCRIPTION

Laboratory course to accompany PHYS 2326. Laboratory exercises reinforce PHYS 2326 lecture material and place importance on scientific communication and collaboration as well as measurement methods, uncertainty, and basic error analysis. Lab fee: $30.00.

STUDENT LEARNING OUTCOMES

Upon successful completion of the course, the student will be able to:

- explain why experiments are an important component of the scientific method;
- explain why uncertainty is present in all measurements;
- collect experimental data to compare with theoretical predictions;
- plot data to show relationships between variables in graphical form;
- interpret data from tables and graphs; and
- prepare a physics laboratory report in proper format.

Department of Engineering, Mathematics, and Physics

PHYS 2326
University Physics II

Adoption date: November 19, 2010.

COURSE DESCRIPTION
A calculus-based treatment of the fundamentals of electricity and magnetism, sound, light, and modern physics. Topics include electrostatics, magnetostatics and magnetic materials, electromagnetic waves, geometric optics, physical optics, quantum mechanics, nuclear physics, and relativity theory. Must be taken concurrently with PHYS 2126. Prerequisites: MATH 2414 or equivalent (or concurrent enrollment therein) and PHYS 2325/PHYS 2125.

STUDENT LEARNING OUTCOMES
Upon successful completion of the course, the student will be able to:

- describe qualitatively and quantitatively the concept of the electric field;
- state Gauss' law and apply it to solve physics problems;
- describe qualitatively and quantitatively the concept of the electric potential;
- state Kirchhoff's rules for DC circuits and apply them to solve physics problems;
- state Faraday's law of electromagnetic induction and apply it to solve physics problems; and
- describe qualitatively and quantitatively the concept of electromagnetic waves.