

Course Descriptions

Numerical Code

For the engineering and technology courses, the following numerical codes are used.

- The first digit indicates the level of difficulty.
- The second digit indicates the course groups.

For common courses, the above codes do not apply.

The numbers after each course (e.g., 3(3-0-6)) represent the credits, lecture hours, laboratory/practice hours, and self study hours, respectively.

Prerequisite / Corequisite Requirements

It is the responsibility of the student to meet all prerequisite and corequisite requirements. Students may not be allowed to take a course if its prerequisites have not been satisfactorily passed. A corequisite course must be taken concurrently or must have been previously passed.

CES201 Engineering Materials 3(3-0-6)

Prerequisite: None

Metals, plastics, asphalt, wood, cementitious materials, and concrete as engineering materials. Phase equilibrium diagrams and their interpretation. Testing and meaning of properties. Study of macro and microstructures in relationship with properties of engineering materials. Production processes for products using engineering materials. Deterioration and corrosion of engineering materials.

CES202 Introduction to Building Facilities 3(3-0-6)

Prerequisite: None

Introduction to thermofluid science for buildings, building system, components and environment in buildings. Energy conversion and management. Piping system, HVAC system, and lighting system for buildings. Concepts of electrical system. Electrical devices and their specifications. Symbols and circuit diagrams. Standard electrical codes and practices. Load characteristics and calculations. Power distribution and wiring. Electrical systems for buildings.

CES215 Applied Mathematics in Civil Engineering 3(3-0-6)

Prerequisite: Have earned credits of MAS 117 or consent of Head of School

Ordinary differential equations of the first order. Linear ordinary differential equations of higher order. General ordinary differential equations. Boundary-value problems.

Introduction to weak formulations. Initial-value problems. Eigen-value problems and their applications. Introduction to probability and statistics.

CES302 Engineering Hydrology 3(3-0-6)

Prerequisite: None

Hydrologic cycle. Atmospheric water. Subsurface water. Groundwater. Surface water. Unit hydrograph. Flood routing. Hydrologic statistics. Frequency analysis.

CES303 Civil Engineering Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Students are provided with on-the-job training at selected governmental organizations, state enterprises or private companies. The purposes of the course are to provide the students opportunities to experience civil engineering works other than what learned in the class. The training period must not be less than 240 hours. Student must submit a report at the end of the training period. Satisfactory (S) or unsatisfactory (U) grade will be given based on student's performance, quality of the report, and supervisor's comments.

CES305 Urban Hydrology 3(3-0-6)

Prerequisite: None

Hydrologic cycle. Atmospheric water. Surface water. Unit hydrograph. Hydrologic statistics. Frequency analysis. Design storms. Design flows. Drainage design.

CES311 Theory of Structures 3(3-0-6)

Prerequisite: Have earned credits of CES371 or consent of Head of School

Introduction to structural analysis. Reactions, shears and moments in statically determinate structures. Influence lines. Analysis of stresses in trusses. Graphic statics. Structures subjected to moving loads. Deflections of beams and frames by methods of virtual work and strain energy. Williot-Mohr diagrams. Analysis of statically indeterminate structures by the method of consistent deformation.

CES312 Structural Analysis 3(3-0-6)

Prerequisite: Have earned credits of CES311 or consent of Head of School

Analysis of indeterminate structures. Elastic load methods. Strain energy method. Slope-deflection and moment distribution methods. Influence line for continuous beams and frames. Introduction to plastic analysis. Approximate analysis of building frames. Introduction to the matrix method of structural analysis.

CES315 Computational Methods in Civil Engineering 3(3-0-6)

Prerequisite: Have earned credits of MAS 215 or CES215 or consent of Head of School

Use of computers. Programming concepts and techniques. Modern programming languages and tools for engineering problems. Numerical methods as applied to civil engineering problems. Introduction to finite element methods.

CES321 Timber and Steel Design 4(3-3-6)

Corequisite: Taking CES311 in the same semester or consent of Head of School

Design of timber and steel structures. Tension and compression members. Beams. Beam-columns. Built-up members. Plate girders. Connection. Design practice. Tutorial design workshops. Allowable Strength Design (ASD) and Load and Resistance Factor Design (LRFD) methods, design practice. Practice in timber and steel design and detailing.

CES322 Reinforced Concrete Design 4(3-3-6)

Prerequisite: Have earned credits of CES351 and taking CES311 in the same semester or consent of Head of School

Material properties of concrete and reinforcing bars. Fundamental behavior in thrust, flexure, shear, torsion, bond and interaction among these forces. Design of reinforced concrete structural components, i.e., beams, columns, slabs, stairs, footings, and retaining walls by working stress and strength design concepts. Reinforcement detailing. Tutorial design workshops. Practice in reinforced concrete design and detailing.

CES331 Soil Mechanics 3(3-0-6)

Prerequisite: Have earned credits of CES371 or consent of Head of School

Classification of soils. Soils and soil formation. Soil constituents and their properties. Physical properties of soils. Basic engineering properties of soils. Effective stress

and pore pressure. Permeability of soils. Stresses and strains in a continuous body. Consolidation: one-dimensional consolidation. Shear strength and failure of soils. Stability analysis: plastic equilibrium, upper and lower bound solutions. Retaining wall.

CES332 Foundation Engineering 3(3-0-6)

Prerequisite: Have earned credit of CES331 or consent of Head of School

Subsurface exploration. Soil/ground improvement: compaction, vibroflotation, precompression, sand drains, mechanical and chemical stabilization. Stability of slopes: infinite slopes, mass procedure and method of slices. Ultimate bearing capacity and Terzaghi's bearing capacity theory. Shallow foundation. Mat foundation. Pile foundation: types of piles, pile capacity, pile driving formula, and group piles. Elastic settlement of both shallow and deep foundations. Sheet piles: cantilever sheet piles and anchored sheet piles.

CES333 Soil Mechanics Laboratory 1(0-3-0)

Corequisite: Taking CES331 in the same semester or consent of Head of School

Soil exploration. Index properties of soils. Permeability. Compaction: CBR. Stress-strain behavior of soils. Shear strength and one dimensional consolidation.

CES341 Transportation Engineering and Planning 3(3-0-6)

Prerequisite: None

Characteristics and equilibrium of transportation demand and supply. Planning, design and evaluation of transportation systems, transportation models; water transportation; pipeline transportation; road transportation; railway transportation; air transportation. Economic and financial assessment of transport projects.

CES343 Highway Engineering 3(3-0-6)

Prerequisite: Have earned credits of CES361 or consent of Head of School

Historical development of highways. Highway administration. Principles of highway planning. Traffic analysis. Geometric design and operations. Highway finance and economics. Highway materials. Flexible and rigid pavement design. Highway construction and maintenance. Problem-based studies.

CES344 Logistics System Engineering 3(3-0-6)

Prerequisite: None

Roles of infrastructure systems and logistics. Basic concepts and case studies in international, regional, and urban logistics. Theory of commodity flows. Inventory management. Transportation costs. Intermodal logistics. Logistics distribution centers. Geographic Information System (GIS) for logistics routing and scheduling. Logistics optimization, decision making, and strategic planning. Information technologies in logistics.

CES351 Concrete Technology 3(2-3-4)

Prerequisite: None

Background of concrete. Cement: production, raw materials, types of cement, chemical and physical properties of cement, and hydration of cement. Aggregates: absorption, moisture content, specific gravity, solid volume and void ratio, gradation, and mechanical properties. Admixtures: mineral and chemical admixtures, and special admixtures. Properties of concrete in fresh state: workability, deformability, and segregation. Properties of concrete in plastic state. Properties of concrete in early age state. Properties of concrete in hardened state: mechanical properties and durability. Concrete practices and testing.

CES352 Material Testing 1(0-3-0)

Prerequisite: Have earned credits of CES351 and taking CES351 in the same semester or consent of Head of School

Tests on properties of cement, properties of aggregates, properties of fresh cement paste, properties of fresh mortar, and properties of fresh concrete. Compression test, tensile test, torsion test, flexural and shear tests on civil engineering materials.

CES353 Construction Engineering and Management 3(3-0-6)

Prerequisite: None

Project delivery systems. Project organization. Site layout. Project planning. Critical path method. Resource management. Progress measurement. Construction safety. Quality systems. Contracts and tendering. Construction laws and regulations. Construction methods and equipment. Cost estimation.

CES361 Surveying 3(2-3-4)

Prerequisite: None

Introduction to surveying work. Basic field works: leveling. Principles and applications of theodolite. Angle measurement. Distance measurement. Errors in surveying: acceptable error, data correction, and triangulation. Precise determination of azimuth. Precise traverse plane coordinate system. Precise leveling. Route survey. Topographic survey. Map plotting. Introduction to photogrammetry and remote sensing.

CES362 Field Surveying Camp 1(0-80-0)

Prerequisite: Have earned credits of CES361 or consent of Head of School

Practice of surveying planning, reconnaissance survey, topographic survey, topographic mapping, long range leveling, surveying reports and documentation. Total field surveying practice period is 80 hours.

CES370 Mechanics of Materials 3(3-0-6)
(For non-civil engineering students)

Prerequisite: Have earned credits of SCS 138 or consent of Head of School

Forces, stresses, and equilibrium. Strains. Stress-strain relationships. Elastic and plastic behavior of materials. Linear elasticity. Plane stress and plane strain problems. Uniaxial problems. Bending of beams. Torsional problems.

CES371 Mechanics of Solids I 3(3-0-6)

Prerequisite: Have earned credits of MES 350 or consent of Head of School

Forces and stresses. Stress and strain relationships. Stresses in beams. Shear and bending moment diagrams. Deflection of beams. Torsion. Buckling of columns. Mohr's circle and combined stresses. Failure criterion.

CES372 Mechanics of Solids II 3(3-0-6)

Prerequisite: Have earned credits of CES371 or consent of Head of School

Torsion. Shear stress and shear center. Composite beams and reinforced concrete beams. Buckling of columns. Unsymmetrical bending. Impact and repetitive loading. Failure criteria.

CES381 Hydraulics 3(3-0-6)

Prerequisite: Have earned credits of SCS 138 or consent of Head of School

Properties of fluids, viscosity. Fluid statics. Conservation of mass, momentum, and energy. Viscous flow in pipes. Open channel flow. Fluid flow measurements. Dimensional analysis and similarity.

CES382 Hydraulics Laboratory 1(0-3-0)

Corequisite: Taking CES381 in the same semester or consent of Head of School

Experimental measurement of viscosity. Fluid pressure. Principles of fluid flow through orifices and weirs. Measurement of flow in pipes, flow in open channels, and unsteady flow.

CES391 Special Topics in Civil Engineering I 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other civil engineering courses. Topics may vary from semester to semester, but are different from CES392.

CES392 Special Topics in Civil Engineering II 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other civil engineering courses. Topics may vary from semester to semester, but are different from CES391.

CES403 Seminar 1(0-3-0)Prerequisite: Senior standing or consent of Head of School
A group seminar on one or more topics of interest in the field of civil engineering as approved by the seminar advisor.**CES405 Special Study in Civil Engineering I 3(3-0-6)**

Prerequisite: Consent of Advisor and Head of School

An in-depth study of a topic in the field of civil engineering that is different from CES406.

CES406 Special Study in Civil Engineering II 3(3-0-6)

Prerequisite: Consent of Advisor and Head of School

An in-depth study of a topic in the field of civil engineering that is different from CES405.

CES407 Senior Project 6(0-18-0)

Prerequisite: Have earned credits of CES403

An in-depth study on a topic of interest in the field of civil engineering as approved by the project advisor.

CES408 Extended Civil Engineering Training 6(0-40-0)

Prerequisite: Senior standing

Extensive on-the-job training of at least 16 weeks at a selected organization that provides civil engineering services—an individual comprehensive research or practical project related to the training must be intensively conducted under close supervision of faculty members and supervisors assigned by the training organization. At the end of the training, the student must submit a report of the project and also gives a presentation.

CES414 Finite Element Methods in Engineering 3(3-0-6)

Prerequisite: None

Fundamentals of finite element methods. Boundary-value problems. Variational principles. Approximate methods. Development of standard elements. Finite element procedures. Solution techniques and computer implementation. Problem-based studies.

CES423 Building Design 3(3-0-6)

Prerequisite: Have earned credits of CES322 or consent of Head of School

Analysis and design of T-beams, continuous beams, deep beams, long columns, combined footings, mat footings, pile caps. Shear friction design. Strut-and-tie design method. Design of reinforced concrete buildings.

CES424 Bridge Engineering 3(3-0-6)

Prerequisite: Have earned credits of CES322 or consent of Head of School

Planning of bridge projects. Design, analysis and construction of various types of bridges including reinforced and prestressed concrete bridges, steel bridges, composite bridges, and cable-supported bridges.

CES426 Durability of Concrete Structures 3(3-0-6)

Prerequisite: Have earned credits of CES351 or consent of Head of School

Introduction on durability problems in concrete structures. Bleeding. Plastic shrinkage and plastic settlement. Autogenous shrinkage. Thermal properties and thermal cracking. Effect of extreme temperature. Carbonation. Drying shrinkage. Alkali-aggregate reactions. Acid and sulfate attacks. Freezing and thawing. Chloride-induced steel corrosion. Abrasion and erosion. Biological degradation. Concept of durability and service life design for concrete structures. Case studies on durability problems in real structures.

CES444 Hydraulic Engineering 3(3-0-6)

Prerequisite: Have earned credits of CES381 or consent of Head of School

Engineering economy in water resources planning. Reservoirs. Design of gravity dams, arch dams, buttress dams and earth dams. Spillways. Open channel flow and design. Piping systems, water hammer. Pumps and turbines. Design of drainage system.

CES446 Port and Airport Engineering 3(3-0-6)

Prerequisite: Have earned credits of CES341 or CES450 or consent of Head of School

Planning and design of seaports and harbor. Planning of container terminal and cargo handling systems. Airport master planning. Air traffic control. Design of airport facilities.

CES450 Urban Engineering 3(3-0-6)

Prerequisite: None

Urban land use patterns and modeling. Urban land use planning. Population dynamics and cohort analysis. Urban transportation planning. Characteristics and planning of Mass transit systems. Geographic Information System for urban planning. Multi-criteria decision making in urban planning. Optimization and network analysis in urban planning.

CES494 Coastal Engineering 3(3-0-6)

Prerequisite: Have earned credits of CES381 or consent of Head of School

Review of mathematics and hydrodynamics. Linear wave theory. Wave properties. Transformation of regular waves. Analysis of irregular waves. Transformation of irregular waves. Design of breakwaters, seawalls, groins and beach nourishment.

CHS211 Organic Chemistry 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or consent of Head of School

A study of all aspects of fundamental organic chemistry, including nomenclature, chemical and physical properties, reactions and syntheses of the major classes of organic compounds.

CHS212 Physical Chemistry 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or SCS139 or consent of Head of School

Basic kinetics and chemical reactions. Classical thermodynamics including the first, second, and third laws, spontaneity, chemical potential. Electrochemistry: relationship to thermodynamics and chemical equilibrium. Introduction to quantum mechanics: postulates of quantum theory, orbital and spin angular momentum. Simple quantum systems such as particle in a box, harmonic oscillator, hydrogen atom. Molecular Symmetry. Statistical mechanics: partition function and ensembles.

CHS213 Applied Mathematics in Chemical Engineering 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

Treatment and interpretation of engineering data. Ordinary differential equations of the first order and higher order. Laplace transformation. Fourier analysis - Fourier series. Integrals and transforms. Partial differential equations. Nonlinear equations, approximation and interpolation, numerical differentiations and integration. Numerical solution of differential equations. Emphasis on solving chemical engineering problems.

CHS241 Material and Energy Balance 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or consent of Head of School

Introduction to chemical engineering calculation: Stoichiometry and material balance calculation, recycling, bypassing and purging, use of chemical and phase equilibrium data, energy balance. Introduction of chemical engineering units.

CHS242 Thermodynamics I 3(3-0-6)

Prerequisite: None

Definitions and basic concepts. SI units. Properties of pure substances and ideal gases. Heat and work. First and second laws of thermodynamics and their applications. Concept of Entropy. Power and refrigeration cycles, equipment including gas turbines and internal combustion engines.

CHS251 Fluid Dynamics 3(3-0-6)

Prerequisite: Have earned credits of CHS241 or consent of Head of School

Physical properties of fluids, fluids static and application, characteristics of fluid flow and momentum transfer including applications, design of unit operations for solid-fluid separations.

CHS301 Chemical Engineering Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Students are provided with on-the-job training at selected modern industrial or service facilities. The purpose of the course are to allow the students opportunities to observe how chemical engineers function, to learn how to collaborate with co-workers, and to develop self-responsibility. The training period must not be less than 240 hours. Students must submit a report at the end of the training period. A Satisfactory (S) or unsatisfactory (U) grade will be given based on student's performance, quality of the report, and supervisor's comments.

CHS315 Environmental Chemical Engineering 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or consent of Head of School

Impacts of environmental pollution, environmental quality standards, sources and characteristics of industrial wastes and treatment methods, hazardous wastes and disposal methods.

CHS316 Statistics for Chemical Engineering 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

Course covers application of statistics to chemical engineering. Topics include probability, descriptive statistics, estimation, hypothesis testing, regression, and experimental design.

CHS317 Safety in Chemical Operations 3(3-0-6)

Prerequisite: Have earned credits of CHS241 or consent of Head of School

Principles of safety and loss prevention control, hazard identification and handling including risk assessment, principles of safety management, legislation and safety laws.

CHS327 Bio-Chemical Technology 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or consent of Head of School

Molecular biology of cells and biotechnology including microbiology, microbial biotechnology, enzyme catalysis, technology and bio-chemical processes and applications.

CHS328 Pharmaceutical Industry and Technology 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or consent of Head of School

Survey of basic principles of biochemistry and molecular biology with emphasis on broad understanding of chemical events in pharmaceutical products in the industry in terms of metabolism and structure-function relationships of biological molecules. Introduction to pharmaceutical production systems, including separation and purification processes.

CHS331 Chemical Reaction Kinetics and Reactor Design 3(3-0-6)

Prerequisite: Have earned credits of CHS241 or consent of Head of School

Application of thermodynamic and kinetic fundamentals to the analysis and design of chemical reactors, type of reactors: single reactor and multiple reactor systems, isothermal and non-isothermal operation: homogeneous reactors and introduction to heterogeneous reactors.

CHS343 Thermodynamics II 3(3-0-6)

Prerequisite: Have earned credits of CHS242 or consent of Head of School

Thermodynamics of multi-component systems and applications for phase equilibrium and chemical reaction equilibrium.

CHS352 Heat Transfer 3(3-0-6)

Prerequisite: Have earned credits of CHS251 or consent of Head of School

Basic principles and mechanisms for heat transfer, conceptual design for heat transfer equipment.

CHS353 Mass Transfer 3(3-0-6)

Prerequisite: Have earned credits CHS352 or consent of Head of School

Basic principles and mechanisms for mass transfer, conceptual design of mass transfer and simultaneous heat-mass transfer equipment.

CHS355 Chemical Engineering Process Design 3(3-0-6)

Prerequisite: Have earned credits of CHS241 or consent of Head of School

Problem-based course: Applications of chemical engineering fundamentals to the design of a multi-unit process. Emphasis on use of process simulators.

CHS362 Chemical Engineering Laboratory I 1(0-3-0)

Corequisite: Taking CHS352 in the same semester or consent of Head of School

Laboratory practice and experimental studies on topics covered in momentum and heat transfer.

CHS363 Chemical Engineering Laboratory II 1(0-3-0)

Corequisite: Taking CHS353 in the same semester or consent of Head of School

Laboratory practice and experimental studies on topics covered in simultaneous heat and mass transfer.

CHS364 Experimental Design and Methods for Chemical Engineering 3(3-0-6)

Prerequisite: Have earned credits of CHS316 or consent of Head of School

Scientific and technological concepts, ethics and good practice in research, searching the literature, regression, applications of statistical analyses, research design principles, factorial design, non regular design, design with complex aliasing, interpretation of analyses.

CHS371 Petroleum and Petrochemical Technology 3(3-0-6)

Prerequisite: Have earned credits of CHS211 or consent of Head of School

Introduction to petroleum and petrochemical products, natural gas and their uses. Study chemical and physical properties of some important petrochemical products. Applications of chemical engineering fundamentals to the design of processes in petrochemical industry including refinery and production plants.

CHS374 Polymer Science and Engineering 3(3-0-6)

Prerequisite: Have earned credits of CHS211 or consent of Head of School

Principles of polymer synthesis, characterization, and structure/property relationship. Polymer processing. Mechanical properties: fluid mechanics, viscoelasticity, creep and stress relaxation, macroscopic and microscopic aspects of deformation and fracture.

CHS375 Analytical and Instrumental Chemistry 3(3-0-6)

Prerequisite: Have earned credits of SCS126 or consent of Head of School

Theory and practice of chemical quantitative analyses. Conventional and modern instrumental chemical and physical analyses include: statistical treatment of data, gravimetric and volumetric analyses, chemical equilibria, acid-base chemistry, electrochemistry, complex formation reaction, chromatographic analyses. Theory and applications of analytical instruments used in chemical engineering and technology.

CHS402 Seminar 1(0-2-1)

Prerequisite: Senior standing

Students are required to present reports on current developments of chemical engineering technology to their classmates and faculty members. The reports may lead to senior projects later on. The reports have to be submitted for grading.

CHS425 General Food Science 3(3-0-6)

Prerequisite: None

A study of the physical, chemical, and microbiological aspects of food, the function of and changes in components during preparation and processing of food.

CHS456 Transport Phenomena 3(3-0-6)

Prerequisite: None

Constitutive equations for momentum, energy and mass transfer. Development of microscopic and macroscopic momentum, energy and mass transfer equations for homogeneous and heterogeneous systems. Analogy and dimensionless analysis. Problems and applications in unit of chemical engineering.

CHS457 Chemical Engineering Plant Design 3(3-0-6)

Prerequisite: Have earned credits of CHS355 or consent of Head of School

Problem-based course: Conceptual design of a chemical plant, general design considerations and selection, process design project of a chemical plant.

CHS461 Process Dynamics and Control 3(3-0-6)

Prerequisite: Have earned credits of CHS241 or consent of Head of School

Mathematical modeling of chemical engineering systems, solution techniques and dynamics of these systems, introduction to automatic control, feedback control concept, stability analysis, frequency response and control system designs, introduction to measurement and control instrument characteristics.

CHS463 Energy Technology and Management 3(3-0-6)

Prerequisite: Have earned credits of CHS241 or consent of Head of School

Electric power generation and distribution, heat exchangers, pinch analysis, fuels and combustion, heat engines and steam boiler, principles of energy management in industry, energy auditing, cleaner technology, and tools and methods to enhance the efficiency of industrial energy systems.

CHS481 Special Topics in Chemical Engineering I 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other chemical engineering courses. Topics may vary from semester to semester. Topic covered is different from CHS482 and CHS483.

CHS482 Special Topics in Chemical Engineering II 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other chemical engineering courses. Topics may vary from semester to semester. Topic covered is different from CHS481 and CHS483.

CHS483 Special Topics in Chemical Engineering III 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other chemical engineering courses. Topics may vary from semester to semester. Topic covered is different from CHS481 and CHS482.

CHS484 Chemical Engineering Project 6(0-18-0)

Prerequisite: Senior standing

A student team will be given a problem, for which they must determine appropriate approaches and actions to obtain feasible solutions. This involves establishment of initial contacts, project proposal development, preliminary data collection, data analysis, verification of the results, and practical implementation. A presentation of the project and a submission of a comprehensive report are due at the end of the semester.

CHS485 Special Studies in Chemical Engineering I 3(3-0-6)

Prerequisite: Consent of Advisor and Head of School

An in-depth study of a topic in the field of chemical engineering.

CHS486 Special Studies in Chemical Engineering II 3(3-0-6)

Prerequisite: Consent of Advisor and Head of School

An in-depth study of a topic in the field of chemical engineering. Topic covered is different from CHS485.

CHS487 Extended Chemical Engineering Training 6(0-40-0)

Prerequisite: Senior standing

Students are provided with on-the-job training at selected modern industrial or service facilities for an extended period of at least 16 weeks. The purpose of the course are to allow the students opportunities to observe how chemical engineers function, to learn how to collaborate with co-workers, and to develop self-responsibility. Students must submit a report at the end of the training period.

CSS221 Computer Graphics and Applications 3(2-3-4)

Prerequisite: None

Representation and manipulation of graphic data. Representation and transformations of two-dimensional space, three-dimensional space. Illumination and shading modes. Visualizing and analyzing numerical data associated with scientific, business, and/or entertainment applications. Methods of creating, storing, manipulating, presenting and animating two and three dimensional graphical objects. Elements of image processing. Programming computer graphics with OpenGL or similar library.

CSS224 Computer Architectures 3(3-0-6)

Prerequisite: Have earned credits of ECS371 or

Corequisite: Taking ECS371 in the same semester or consent of Head of School

Computer evolution. Conventional computer architectures. CPU and ALU structures and design. Instruction sets. Hardwired and microprogrammed control. Pipelining. Array and vector processors. Multiprocessor systems. Memory organizations. Cache memory. I/O organizations.

CSS225 Operating System 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Basic concepts of operating systems. Processes. Interprocess communication and synchronization. Input-output. File systems. Memory management.

CSS226 Scientific Computing 3(3-0-6)

Prerequisite: Have earned credits of GTS210 or consent of Head of School

An introduction to elementary numerical analysis and scientific computation. Topics include conditioning, stability, interpolation, quadrature, linear and nonlinear equation solving, least-squares fitting, eigenvalue and eigenvector computation, optimization, and ordinary differential equations.

CSS300 Computer Engineering Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Practical training in private sectors or governmental departments in the field of Computer Engineering not less than 240 hours during summer vacation of the third year. Students must submit a report to his/her supervisor who will decide for the final grade of either satisfactory (S) or unsatisfactory (U).

CSS321 Theory of Computation 3(3-0-6)

Prerequisite: None

Automata, computability, and complexity, emphasizing computability and computational complexity theory. Regular and context-free languages. Decidable and undecidable problems, reducibility, completeness theory, recursive function theory. Finite automata and regular languages. Push-down automata and context-free languages. Turing machines and decidable (recursive) languages.

CSS331 Fundamentals of Data Communications 3(3-0-6)

Prerequisite: None

An overview of techniques used in data communications and switched communication networks. Topics include: protocol architectures; data transmission and transmission media; signal encoding techniques; data link control protocols; multiplexing, multiple access and spread spectrum; switching networks.

CSS332 Microcontrollers and Applications 3(2-3-4)

Prerequisite: Have earned credits of ECS371 or consent of Head of School

Microcontroller and microprocessor architecture. Assembly language programming. Microcontroller interfacing. Descriptions of the microcontroller-based system components: electronics, functions, and interfaces. System bus. Interrupts. DMA and I/O. Laboratory practice and experimental studies on topics related to microcontrollers.

CSS333 Parallel and Distributed Computing 3(3-0-6)

Prerequisite: Have earned credits of CSS225 or consent of Head of School

Architectures, algorithms, and languages for parallel and distributed processing. Pipeline computing; super computing; multi-processing control; dataflow computing. Distributed computer systems; distributed file systems; distributed shared memory.

CSS334 Computer Networks and Internetworking 3(3-0-6)

Prerequisite: None

An overview of networking and internetworking technologies. Topics include Open Systems Interconnect (OSI) reference model, Internet Protocol suite, standards, design concepts of protocols, routing algorithms, and applications of networks.

CSS400 Project Development 1(0-3-0)

Prerequisite: Senior standing or consent of Head of School
Practical projects or problems in Computer Engineering for individual students or groups of students under supervision of faculty members. Students are required to submit and present the project proposal to their project committee appointed by the department of School.

CSS403 Computer Engineering Project 6(0-18-0)

Prerequisite: Senior standing or consent of Head of School
Practical projects or problems in Computer Engineering for individual student or group of students under supervision of faculty members. Students are required to submit and present the project report to their project committee appointed by the school.

CSS431 Machine Learning and Pattern Recognition 3(3-0-6)

Prerequisite: None

Introduction to machine learning and statistical decision theory, adaptive classifiers, and supervised and unsupervised learning. Different types of machine learning and pattern recognition systems are introduced, including transducers, feature extraction, and decision units. Techniques for optical character recognition, speech processing, and remote sensing.

CSS432 Information Retrieval 3(3-0-6)

Prerequisite: None

Organization, representation, and access to information. Categorization, indexing, and content analysis. Data structures. Design and maintenance of databases, indexes, classification schemes, and thesauri. Use of codes, formats, and standards. Analysis and evaluation of search and navigation techniques.

CSS433 Computer Vision 3(3-0-6)

Prerequisite: None

Optics and image acquisition. Image sequence processing. Stereo vision. Texture segmentation. Multivariate data analysis. Discriminant functions. Unsupervised learning and clustering. Self-organizing map (SOM). 3-D medical imaging (computed tomography), Range data and surface analysis. 3-D structure analysis.

CSS434 Knowledge Representation and Reasoning 3(3-0-6)

Prerequisite: Have earned credits of ITS201 or consent of Head of School

This course concerns how knowledge can be represented symbolically and how it can be manipulated in an automated way by reasoning algorithms. The topics include logic-based knowledge representation, first-order logic, description logic, inference mechanisms, and their applications in ontologies and the Semantic Web.

CSS441 Security and Cryptography 3(3-0-6)

Prerequisite: None

Principles of number theory and the practice of network security and cryptographic algorithms. Topics include primes, random numbers, modular arithmetic and discrete logarithms, conventional or symmetric encryption, and public key or asymmetric encryption, key management, hash functions, digital signatures, certificates and authentication protocols, electronic mail security, web security and protocols for secure electronic commerce. There are some applications, such as smart cards, electronic voting, and some programming topics, e.g., provable security.

CSS442 Computer Interfacing 3(3-0-6)

Prerequisite: Have earned credits of CSS332 or consent of Head of School

Architectural view of microprocessor-based systems. Components of microprocessor-based systems. Detailed descriptions of the components: electronics, functions, and interfaces. System bus. Interrupts, DMA and I/O. Interfacing techniques

CSS443 Real-time and Embedded Systems 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Design and development of real-time systems, real-time programming and real-time operating systems, multitasking and other concurrent-system concepts, real-time schedulers, process synchronization, memory management, interrupts. Real-time modeling languages, state chart diagrams and sequence diagrams. Real-time systems and embedded system applications.

CSS444 Wireless Networks 3(3-0-6)

Prerequisite: Have earned credits of (ITS327 or CSS334) or

Corequisite: Taking (ITS327 or CSS334) in the same semester or consent of Head of School

Concepts and technologies that allow untethered communications between users and computers, especially in wireless networking. Major topics include: characteristics of wireless communications and mobile devices; wireless personal area networks; wireless local area networks (WLANs); mobile telephone systems and fixed wireless access; mobile Internet technologies and applications; ad-hoc, mesh and sensor networks; design of wireless systems for performance and security.

CSS495 Special Studies in Computer Engineering I 3(3-0-6)

Prerequisite: None

Special study on current topics related to in Computer Engineering.

CSS496 Special Studies in Computer Engineering II 3(3-0-6)

Prerequisite: None

Special study on current topics related to in Computer Engineering.

CSS499 Extended Computer Engineering Training 6(0-40-0)

Prerequisite: Senior standing or consent of Head of School
Extensive on-the-job training of at least 17 weeks at a selected organization that provides Computer Engineering services - an individual comprehensive research or practical project related to the training must be intensively conducted under close supervision of faculty members and supervisors assigned by the training organization. At the end of the training, the student must submit a report of the project and also give a presentation.

EC210 Introductory Economics 3(3-0-6)

Prerequisite: None

A study of the principles of micro and macro economics with applications in basic economic problems; factors that influence supply and demand of products; consumer behavior; important features of perfect and imperfect competitive markets; analysis of Gross National Product, determination of National Income, fiscal and monetary policies; importance of international trade and finance on balance of payment and national income.

ECS201 Basic Circuit Analysis 3(3-0-6)
(For non-major students)

Prerequisite: None

Current and voltage. Circuit elements. Kirchhoff's laws. Resistive circuits. Circuit analysis techniques such as node analysis, mesh analysis, superposition, and Thevenin's and Norton's equivalent circuits. Inductance and capacitance. First-order circuits and their responses. Second-order circuits and their responses. Sinusoidal steady-state analysis. Three-phase circuits. Mutual inductance and ideal transformers. Network responses: natural frequencies, network functions, frequency responses, resonance. Fourier series and applications to network analysis. Introduction to computer-aided circuit analysis and design.

ECS203 Basic Electrical Engineering 3(3-0-6)
(For non-major students)

Prerequisite: None

A service course covering electrical engineering principles and technology for students with major outside electronics and communication engineering. Topics include electrical signals, basic circuit theory, DC and AC circuit analysis, Kirchhoff's law, Thevenin theorem, three-phase circuits, basic electronic devices and circuits, fundamental of operational amplifiers, feedback and control, fundamentals of power systems, DC and AC motors and generators, transformers, loss and efficiency of DC/AC machinery, household/industry wiring and preview of electrical communication systems.

ECS204 Basic Electrical Engineering Laboratory 1(0-3-0)
(For non-major students)

Corequisite: Taking (ECS201 or ECS203) in the same semester or consent of Head of School

Laboratory practice and experimental studies on topics covered in ECS201 or ECS203.

ECS210 Basic Electrical Engineering Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ECS216 or consent of Head of School

Laboratory practice and experimental studies on topics covered in ECS216.

ECS213 Electrical Engineering Mathematics 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

First-order and higher-order ordinary differential equations (ODE's); series solution of ODE's; systems of ODE's; partial differential equations; boundary value problems; vector spaces; basis and dimensions; Cayley-Hamilton theorem; functions of matrices; state-space representation; difference equations; computer-aided software for computation.

ECS216 Circuit Analysis 3(3-0-6)

Prerequisite: None

Current and voltage; circuit elements; Kirchhoff's laws; resistive circuits; circuit analysis techniques such as node analysis, mesh analysis, superposition, and Thevenin's and Norton's equivalent circuits; inductance and capacitance; first-order circuits and their responses; second-order circuits and their responses; sinusoidal steady-state analysis; phasor diagram; three-phase circuits; computer-aided software for circuit analysis.

ECS217 Computer Tools in Electrical Engineering 1(0-3-0)

Prerequisite: None

Basic descriptive geometry: points, lines, planes and their relationships and basic developed views; computer graphics: methods of creating, storing, manipulating, presenting and animating two and three dimensional objects; familiarization with graphical softwares; softwares and tools for electrical engineering: MATLAB, PSPICE, LaTeX, etc.

ECS218 Data Structures, Algorithms, and Object Oriented Programming 3(2-2-5)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Problem-based learning; Concepts of data structures; basic data structures; stacks, queues, linked lists, trees, etc. recursion, hash tables, sorting and searching algorithms; Concepts of Object-oriented Programming; class, inheritance and message passing; Practice in C++ and JAVA programming languages.

ECS231 Electronic Circuits I 3(3-0-6)

Prerequisite: Have earned credits of ECS216 or consent of Head of School

Semiconductors and their characteristics. p-n junction. Diodes and diode circuits. Bipolar junction transistors. Field-effect transistors. Transistor biasing and circuits. Analysis of transistor circuits. Transistor amplifier circuits. Frequency response of amplifiers.

ECS233 Electromagnetics 3(3-0-6)

Prerequisite: Have earned credits of (MAS117 and SCS139) or consent of Head of School

Static electric fields. Conductors and dielectrics. Capacitance. Convection and conduction currents. Static magnetic fields. Inductance. Magnetic materials and magnetic circuits. Time-varying electric and magnetic fields. Maxwell's equations. Electromagnetic waves and transmission lines. Introduction to waveguides and antennas.

ECS261 Electrical Measurement and Instrumentation 3(3-0-6)

Prerequisite: Have earned credits of (ECS201 or ECS216) or consent of Head of School

Units. Measurement standards. Errors in measurements. Basic instruments and their operation principles: ammeters, voltmeters, ohmmeters, wattmeters, oscilloscopes, signal generators, and signal analyzers. Instrument calibrations. Impedance measurements. Transducers and their applications. Digital techniques in measurements. Noise in measurements.

ECS281 Signals and Systems 3(3-0-6)

Prerequisite: Have earned credits of (ECS213 or MAS215) or consent of Head of School

Continuous-time and discrete-time signals and systems. Linear systems and their properties. Fourier analysis of continuous-time and discrete-time signals and systems. Sampling and Convolution, reconstruction of signals. Laplace transform and its applications to continuous-time system analysis. Z-transform and its applications to discrete-time system analysis.

ECS300 Electronics and Communication Engineering Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Practical training in a private sector or governmental departments in related fields of electronics and communication engineering for not less than 240 hours during summer vacation of the third year. Students must submit a report at the end of the training period. A satisfactory (S) grade or an unsatisfactory (U) grade will be given based on the student's performance, quality of the report, and supervisor's comments.

ECS306 Basic Electrical Machines and Power Systems 3(3-0-6)

Prerequisite: Have earned credits of (ECS201 or ECS203 or ECS216) or consent of Head of School

Basic concepts in power system analysis such as phasors, complex power, power factor improvement, three-phase circuits. Voltage, current and power calculations in single phase and three phase systems. Introduction to Magnetic Circuits and Transformers. Basic concept of DC and AC Rotating Machines. Induction motor and synchronous generator: principles, characteristic, operations, and applications.

ECS307 Basic Electromechanical Energy Conversion Laboratory 1(0-3-0)

Prerequisite: Have earned credits of (ECS306 or ECS308) or consent of Head of School

Laboratory practice and experimental studies on topics covered in ECS306 or ECS308.

**ECS308 Basic Electromechanical Energy 3(3-0-6)
Conversion**

Prerequisite: Have earned credits of (ECS201 or ECS203 or ECS216) or consent of Head of School

Introduction to magnetic circuits. Basic principles of transformers, efficiency, and connections. Basic concepts of DC and AC rotating machines. Characteristics of DC generators, motors, speed control, and applications. Synchronous and induction machines: principles, characteristics, operations, and applications. Three phase and single phase induction motors. Methods of starting single-phase induction motors.

ECS315 Probability and Random Processes 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

Random experiments, events, probability, discrete and continuous random variables, probability density functions, cumulative distribution functions, functions of random variables, expectations; central limit theorem, law of large numbers, central limit theorem; introduction to random processes, random noise, Gaussian random process, autocorrelation, and power spectral density.

ECS320 Electronic Circuits Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ECS322 or consent of Head of School

Laboratory practice and experimental studies on topics covered in ECS231 or ECS322.

ECS322 Electronic Circuits II 3(3-0-6)

Prerequisite: Have earned credits of ECS231 or consent of Head of School

Problem-based learning; Introduction to differential amplifiers and current mirrors. Operational Amplifiers-741 op-amp circuits, feedback amplifiers, frequency responses, Bode plots, stability, phase compensation. Comparators. Waveform generators and waveshaping. Active filters. Switched-capacitor filters. Power electronic circuits: Regulated power supplies, regulators, and power amplifiers.

ECS323 Physical Electronics 3(3-0-6)

Prerequisite: Have earned credits of ECS231 or consent of Head of School

Quantum mechanical principles. Atomic structure. Crystal structure. Energy band theory. Energy bands and charge carriers in semiconductors and metals. Equilibrium and transport properties of semiconductors. p-n junction and diode equations. Diodes, bipolar and field-effect transistors. Physical principles of other semiconductor devices of current interest.

ECS332 Principles of Communications 3(3-0-6)

Prerequisite: Have earned credits of ECS281 or consent of Head of School

Corequisite: Taking (ECS315 or IES302) in the same semester or consent of Head of School

Signal analysis and processing in communication systems. Principles of amplitude, angular, and pulse modulations. Digital modulation techniques. Noise in communication systems and its effects. Data transmission. Introduction to telecommunications.

ECS341 Mobile Application Programming3(2-2-5)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Problem-based learning; principles of mobile application development; programming languages, for mobile devices, such as Linux, JAVA, .NET, C/C++, Mac; syntax and library usage; hands-on practice on a suitable software development kit (SDK); current and future trends of mobile applications.

ECS352 Telecommunications 3(3-0-6)

Prerequisite: Have earned credits of ECS332 or consent of Head of School

The structures and principles of telecommunication systems. Signal transmission in telecommunication systems. Telecommunication networks. Circuit switching and packet switching. Performance estimation. Congestion control.

ECS363 Mechatronic Instrumentation 3(3-0-6)

Prerequisite: Have earned credits of (ECS203 or ECS216) and (MES310 or MES211) or consent of Head of School

Analysis, characteristics and applications of instruments used in engineering mechatronics including transducers, sensors, actuators, etc. Measurement principles. Integrated sensors actuators. Programmable Logic Control (PLC) Data Acquisition Systems.

ECS364 Introduction to Mechatronics 3(3-0-6)

Prerequisite: None

Introduction to integration of mechanical, electrical, and computer systems for information processing and control of machines and devices. Basic electronics, signal processing, micro-controller and microprocessor, sensors and actuators. Control architecture in mechatronic systems. Overview of electro-mechanical design and embedded systems in topics of current interest in mechatronics.

ECS370 Digital Circuit Laboratory 1(0-3-0)

Corequisite: Taking ECS371 in the same semester or consent of Head of School

Laboratory practice and experimental studies on topics covered in ECS371.

ECS371 Digital Circuits 3(3-0-6)

Prerequisite: None

Number systems and codes. Logic signals and gates. Electronic circuits of logic gates. Logic gate families. Logic gate characteristics. Arithmetic circuits. Combinational logic circuits. Sequential logic circuits. Programmable logic devices. Introduction to A/D and D/A conversions. Introduction to digital integrated circuits.

ECS380 Feedback Control Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ECS381 or consent of Head of School

Laboratory practice and experimental studies on topics covered in ECS381.

ECS381 Feedback Control Systems 3(3-0-6)

Prerequisite: Have earned credits of (ECS201 or ECS216) or consent of Head of School

System representation. Mathematical models of systems. Closed-loop and open-loop control systems. Transfer functions. Signal flow graphs. Stability of linear control systems. Stability analysis techniques. Time-domain analysis and frequency-domain analysis of control systems. Time-domain design and frequency-domain design of control systems. Compensations. Introduction to computer-aided control analysis and design. Although MAS215 is not a required course, the knowledge gained from this would be of great benefit to students of ECS381 and is therefore recommended.

ECS382 Microprocessors 3(3-0-6)

Prerequisite: Have earned credits of ECS371 or consent of Head of School

Microprocessor architecture, instruction sets assembly language programming, microprocessor interfacing, applications, introduction to DSP processors, practical projects and assignments.

ECS386 Introduction to Embedded System 3(3-0-6)

Prerequisite: Have earned credits of ECS370 or consent of Head of School

Concepts of timing and clocks; task-modeling and real-time operating system; processors; signal digitization and conditioning; memory; interfacing; state-machine and concurrent processes; encoding and flow control; formal verification.

ECS396 Project Development 1(0-3-0)

Prerequisite: Senior standing or consent of Head of School
Practical projects or problems in communications for individual students or groups of students under supervision of faculty members. Students are required to submit and present the project proposal to their project committee appointed by the program.

ECS398 Electronics and Communication 6(0-18-0) Engineering Project

Prerequisite: Have earned credits of ECS396 or consent of Head of School

The continuation of ECS396 to the completion stage of the project. Students are required to submit complete project reports and present project results to their project committee.

ECS399 Extended Electronics and Communication Engineering Training 6(0-40-0)

Prerequisite: Senior Standing or consent of Head of School
Full-time research or practical training under close supervision of faculty members and assigned supervisors from the Electronics and/or Communication Engineering-related company for at least 17 weeks. Evaluation based on the project achievement, project report, and final oral presentation.

ECS424 Analog Integrated Circuits 3(3-0-6)

Prerequisite: Have earned credits of ECS322 or consent of Head of School

Output stages and power amplifiers. BJT and MOS circuits of operational amplifiers. Advanced current mirrors and op-amps. Comparators. Voltage references. Data conversion, sample and holds, Nyquist-rate digital-to-analog converter circuits, Nyquist-rate analog-to-digital converter circuits, Oversampling converters. Translinear principles. Analog multipliers and dividers. Phase-locked loops (PLL). Precision rectification.

ECS425 Digital Integrated Circuits 3(3-0-6)

Prerequisite: Have earned credits of ECS322 or consent of Head of School

Design principles of digital integrated circuits. NMOS inverters, pseudo NMOS, pass transistors, CMOS inverters, transmission gates. Logic families and their characteristics. Sources of propagation delay. Noise margins. Dynamic loads. Crosstalk. Transmission line effects. Advanced design concepts, Programmable gate arrays (PLAs).

ECS427 Introduction to VLSI Design 3(3-0-6)

Prerequisite: Have earned credits of (ECS371 and ECS322) or consent of Head of School

Introduction to design and fabrication of very large scale integrated systems using NMOS and CMOS technologies. CAD tools and computer-aided design. Use of state-of-the-art design methodologies and tools. Testing and design for testability. Modularity, parallelism, local communications, fault tolerance.

ECS441 Communication Electronics 3(3-0-6)

Prerequisite: Have earned credits of ECS322 or consent of Head of School

RF and power amplifiers, oscillators, phase-locked loops, filters, carrier modulators and demodulators, analog-to-digital and digital-to-analog converters, examples of commercially available integrated circuits for communication systems.

ECS442 Microwave Principles 3(3-0-6)

Prerequisite: Have earned credits of ECS233 or consent of Head of School

Problem-based learning; Maxwell's equations and boundary conditions, transmission-line theory, s-parameters, using Smith charts, impedance matching, microwave transmission line and waveguides, microwave resonators and filters, microwave network analysis, power dividers and directional couplers, microwave measurement and applications.

ECS450 Signal Processing and Communication Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ECS332 and ECS472 or consent of Head of School

Sampling and reconstruction of signals, digital filter design and hardware implementation, real-time filtering, AM-FM modulation/demodulation, basic digital communication technique, spectrum analysis, power measurement, DSP system simulation.

ECS451 Data Communications and Networks 3(3-0-6)

Prerequisite: None

Network models, OSI layers and protocols, TCP/IP, VOIP, wide-area and local-area networks, routing algorithms and switching techniques, networking equipment, such as ATM, router, and bridge.

ECS452 Digital Communication Systems 3(3-0-6)

Prerequisite: Have earned credits of ECS332 or consent of Head of School

Fundamental digital transmission concepts. Sampling Theorems. Random and nonrandom signals, low pass random signals. Baseband and carrier digital transmission systems. Quantization. Source coding. Pulse code modulation, delta modulation. Bandpass digital modulation techniques: principles of ASK, PSK, FSK, performance comparisons, and spectral analysis. Channel Coding methods for error detection and correction. Synchronization subsystems. Time-division multiple-access systems.

ECS453 Satellite Communication Systems 3(3-0-6)

Prerequisite: Have earned credits of ECS332 or consent of Head of School

Introduction to space communications and frequency used. Satellite orbits and their effect on communication systems design. Communication satellites and their principal subsystems. Multiple access. Earth stations. Satellite networks. Techniques in satellite communications.

ECS455 Mobile Communications 3(3-0-6)

Prerequisite: Have earned credits of ECS332 or consent of Head of School

Principles of cellular radio, mobile radio propagation and channel modeling, multiple access methods, physical and logical channels, digital mobile communication systems: TDMA, GSM, CDMA, WCDMA, multi-carrier and OFDM systems.

ECS456 Optical Communications 3(3-0-6)

Prerequisite: Have earned credits of ECS233 or consent of Head of School

Problem-based learning; Characteristics of lightwave propagation in optical fibers. Types of optical fibers. Optical transmitters and receivers. Optical filters and amplifiers. Optical components: optical divider and combiner, coupler, lens switches. Optical communication systems. Coding, multiplexing, demultiplexing, switching, and wavelength conversion. Optical network architectures.

ECS462 Antennas 3(3-0-6)

Prerequisite: Have earned credits of ECS233 or consent of Head of School

Problem-based learning; Basic definitions and theorems, formulation of the radiation problems, isotropic point source, power and field patterns, directivity and gain, radiation impedance, wave polarization, radiation from current elements. Analysis and design of linear wire antenna, linear array antenna, Uda-Yagi antenna, log-periodic antenna, aperture antenna. Antenna measurement techniques.

ECS465 Biomedical Instrumentation 3(3-0-6)

Prerequisite: Have earned credits of ECS261 or consent of Head of School

Overviews of the human body. Electrodes and biotransducers. Bioelectric amplifiers. Instrumentation for heart and brain parameters. Magnetic resonance imaging. Medical laboratory instrumentation. Medical ultrasound. Bioelectric and biomagnetic measurement. Biochemical measurement. Chemical transducers: electrochemical, optical, and biosensor based chemical transducers, etc. Continuous measurement of chemical qualities. Computers in biomedical equipment. Optical based chemical equipment for environment monitoring.

ECS472 Digital Signal Processing 3(3-0-6)

Prerequisite: Have earned credits of ECS281 or consent of Head of School

Discrete-time signals and systems. Linear time-invariant systems and their properties. Sampling of continuous-time signals and convolution. IIR and FIR filter designs. Effects of finite word length. The discrete Fourier transform. Fast Fourier transform algorithms. Relations between Fourier Transform (FT), Discrete-frequency FT (DFFT) or Fourier series, Discrete-time FT (DTFT), and Discrete FT (DFT: Discrete both time & frequency).

ECS475 Digital Image Processing 3(3-0-6)

Prerequisite: Have earned credits of ECS281 or consent of Head of School

Digital image fundamentals. Image transformations. Image enhancement. Image restoration. Image compression. Image segmentation. Representation schemes and descriptors.

ECS477 Signal Processing for Communication Systems 3(3-0-6)

Prerequisite: Have earned credits of ECS472 or consent of Head of School

Problem-based learning; Speech coding and decoding, image coding and decoding, transmultiplexers, filter banks, channel estimation, channel equalization, synchronization, array processing, power spectral estimation, adaptive filtering, ADC and DAC algorithms.

ECS478 Introduction to Computer Vision 3(3-0-6) and Pattern Recognition

Prerequisite: None (ECS475 Digital Image Processing is recommended.)

Optics and image acquisition. Image sequence processing. Stereo vision. Texture segmentation. Multivariate data analysis. Discriminant functions. Unsupervised learning and clustering. Self-organizing map (SOM). 3-D medical imaging (computed tomography), Range data and surface analysis. 3-D structure analysis.

ECS481 Introduction to Robotics 3(3-0-6)

Prerequisite: Have earned credits of ECS381 or consent of Head of School

Operation principles, analysis, and design of robots. Mechanical manipulators: kinematics, dynamics, trajectory planning, and control. Robotic vision and visual feedback. Robot programming languages. Control algorithm design. Current topics of interest from the literature.

ECS483 Linear System Theory 3(3-0-6)

Prerequisite: Have earned credits of ECS381 or consent of Head of School

Mathematical description of systems. State-space description of linear dynamical systems. Controllability and observability. Stability analysis. Stabilizability and detectability. State feedback and observers. Introduction to optimal control.

ECS485 Dynamic Systems and Control 3(3-0-6)

Prerequisite: Have earned credits of MES351 or consent of Head of School

Mathematical modeling of mechanical, electrical, pneumatic, hydraulic and combined physical systems using unified approach such as Bond graph technique. Introduction state-variables, system response, stability using Laplace transform technique. System characteristics: controllability and observability. Open and closed loop responses of control systems. Solution to state equation by direct analysis and digital computer methods.

ECS486 Embedded System Development Project 3(2-2-5)

Prerequisite: Have earned credits of ECS386 or consent of Head of School

Problem-based learning; hands-on experience on embedded system design; embedded programming using high-level programming language; applications of real-time operating system for embedded system; hardware and software co-design techniques and verification techniques; system testing.

ECS491 Electronics and Communication 1(0-3-0) Engineering Seminar I

Prerequisite: Senior standing or consent of Head of School
Presentation and discussion of recent advances and research in electronics and communication engineering by guest lecturers, faculty, and students. Topics may vary from semester to semester. S/U grading.

ECS492 Electronics and Communication 1(0-3-0) Engineering Seminar II

Prerequisite: Senior standing or consent of Head of School
Presentation and discussion of recent advances and research in electronics and communication engineering by guest lecturers, faculty, and students. Topics may vary from semester to semester. S/U grading.

ECS493 Special Topics in Electronics and Communication Engineering I 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other electronics and communication engineering courses. Topics may vary from semester to semester.

ECS495 Special Topics in Electronics and Communication Engineering II 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other electronics and communication engineering courses. Topics may vary from semester to semester. Topic covered is different from ECS493.

ECS496 Special Study in Electronics and Communication Engineering I 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in an exchange program. It is designed for topics related to current development and fundamental knowledge in electronics and communication engineering technologies, but not presently offered as either a required or technical elective.

ECS497 Special Study in Electronics and Communication Engineering II 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in an exchange program. It is designed for topics related to current development and fundamental knowledge in electronics and communication engineering technologies, but not presently offered as either a required or technical elective.

EL070 English Course 1 0(3-0-6)

Prerequisite: Language Institute placement

A non-credit course designed for those students with low English command and unable to enroll directly into English Foundation Course (The assessment criteria are 'S' for Satisfactory or 'U' for Unsatisfactory and will not be counted towards the students' total credits and GPA).

A preparatory course designed to enable students to cope up with real English use of four basic integrated skills of listening, speaking, reading and writing.

EL171 English Course II 3(3-0-6)

Prerequisite: Have earned credits of EL070 or Language Institute placement

An intermediate English course designed to promote four integrated skills to develop students' English proficiency at a higher level.

EL172 English Course III 3(3-0-6)

Prerequisite: Have earned credits of EL171 or Language Institute placement

An upper-intermediate English course to enable students to use integrated skills at a more sophisticated level than the prior course especially in speaking and writing.

EL210 English for Engineering I 3(3-0-6)

Prerequisite: Have earned credits of EL172

A course to practice English skills in engineering contexts with an emphasis on reading, writing, listening and speaking. Texts, selected passages and other materials of medium length on engineering are included.

GTS101 Skills Development for Technical Studies 3(3-0-6)

Prerequisite: None

Development of techniques for effective study in college. Covers time management, motivation, taking notes from books and lectures, memory training, and reading strategies. Studying for and taking exams, using libraries, teaching/learning styles, and basic strategies for learning any new content.

GTS111 Mathematical Analysis for Management Science 3(3-0-6)

Prerequisite: None

Elementary matrices - matrix addition, matrix multiplication, matrix inversion, applications in population dynamics; probability - sets and counting, Venn diagrams, permutation and combination; statistics - describing data, numerical measures, probability distributions, uniform probability distributions, conditional probabilities and tree diagrams, discrete probability distributions, binomial probability distributions, normal probability distributions and normal approximation to the binomial distribution.

GTS112 Linear Algebra 3(3-0-6)

Prerequisite: Have earned credits of GTS111 or consent of Head of School

Matrices and systems of linear equations; Hermitian matrices and unitary matrices; LU factorizations; determinant; Cramer's rule; vector spaces; linear independence; bases; dimensions; rank of matrices; orthogonality; eigenvalues and eigenvectors; reduction of matrices to diagonal forms.

GTS116 Mathematics for Technologists I 3(3-0-6)

Prerequisite: None

Introductory calculus: a course on the differential and integral calculus of functions of one variable. Topics include limits and continuity of functions, origin and definition of the derivative, exponential and logarithmic forms, origin and definition of anti-derivative; integral calculus; indefinite integrals. Taylor's Theorem for a function of two variables; introduction to differential equations.

GTS117 Mathematics for Technologists II 3(3-0-6)

Prerequisite: Have earned credits of GTS116 or consent of Head of School

Introduction to vectors, curves, and surfaces in space; partial differentiation; directional derivatives and the gradient vector; integration, techniques of integrations and logarithmic functions. Three-dimensional analytic geometry. Differential and integral calculus of functions of two or three variables: partial derivatives, multiple integrals, Lagrange multipliers, and Green's Theorem.

GTS121 General Science I 3(3-0-6)

Prerequisite: None

An introduction to chemistry; the gaseous state. States of matter and solutions. Chemical equilibrium. Acids and bases. Electrochemistry. Vectors. Forces. Friction. Moment of inertia. Momentum and energy.

GTS122 General Science II 3(3-0-6)

Prerequisite: None

Interplay of structure and function, particularly at the molecular, cellular, and organismal level of organization. Study of the characteristics of the major groups of plant and animal life. Introduction to the principles and applications of microbiology, with a study of the general characteristics of microorganisms and their applications.

GTS132 Introduction to Biological Science 3(3-0-6)

Prerequisite: None

Interdisciplinary study of the living world, covering a variety of topics ranging from biological molecules and metabolism of organic compounds, genes, and their functions to more complex topics in human biology, biotechnology, bioinformatics, and other applications.

GTS133 Environmental Studies 3(2-2-5)

Prerequisite: None

The ecology of natural systems, ecosystems, and growth. Food production and land use. Extinction and genetic resources. Sources of energy, energy utilization and related environmental issues. Control of pest and weeds. Water resources and water pollution. Air pollution. Solid waste. The environment and human health.

GTS201 Standardized English Tests 2(2-1-3)

Prerequisite: Have earned credits of EL172 or consent of Head of School

This course will prepare students to take standardized English tests. The structure and content of each test will be examined in detail in order to familiarize students with the different sections. Different types of questions will be considered and students will learn how to answer each type. A review of speaking, listening, reading, and writing skills will be covered. Sample tests will be given for each skill, including reading, writing, listening, and speaking.

GTS202 English Language Structures 3(3-0-6)

Prerequisite: Have earned credits of EL172 or consent of Head of School

The course aims to further develop students' English proficiency. The course emphasizes academic writing from basic sentences and paragraphs to more complex structures. The English structures covered in this course will aid the students in preparing for standardized English examinations.

GTS210 Mathematics for Technologists III 3(3-0-6)

Prerequisite: Have earned credits of GTS117 or consent of Head of School

This course includes the study of vectors in the plane and space, systems of linear equations, vectors, vector spaces, linear transformations, inner products, eigenvalues and eigenvectors.

GTS212 Calculus for Technologists I 3(3-0-6)

Prerequisite: None

Limits and continuity of functions. Derivatives, rules of differentiation - product and quotient rules, higher order derivatives, chain rule. Derivative of implicit functions. Applications of differentiation. Indefinite integration and techniques of integration - integration by substitution, integration by parts, trigonometric substitution, integration by partial fractions.

GTS213 Calculus for Technologists II 3(3-0-6)

Prerequisite: Have earned credits of GTS212 or consent of Head of School

Applications of integration - areas, consumer surplus. Separable differential equations - population growth, flow processes, finance and investment models, sequence and series-power series, Taylor and Maclaurin series. Functions of several variables. Partial derivatives-chain rule, optimization.

GTS231 Law and Technology 3(3-0-6)

Prerequisite: None

Study of relations between law and technology - exploration of issues in both private and public laws pertaining to the application of technology. Implications of technology on law development internationally. Legal issues involving e-commerce, e-contracting, intellectual property, privacy, torts, consumer protection, product liability, professional negligence, professional liability, environmental and natural resources, legal principles on common commercial transaction and business organizations.

GTS302 Technical Writing 2(2-1-3)

Prerequisite: Have earned credits of EL172 or consent of Head of School

Students learn and practice writing and presentation of technical reports, which include reports of laboratory experiments, in-depth technical reports, overview articles of technical topics for the general public, as well as executive summaries.

GTS303 Communications in Business 2(2-1-3)

Prerequisite: Have earned credits of EL172 or consent of Head of School

This course teaches the organizational skills needed to prepare for writing business/marketing ideas. First, ideas are organized. These ideas are transformed into well written short paragraphs. Next, the paragraphs are edited. Students participate in editing other students' writings. Students present some of their original work to the rest of the class through poster presentations and short speeches. In addition, students are required to produce a business/marketing style resume.

GTS401 Intensive English Proficiency 6(6-0-12)

Prerequisite:

1. Student has completed all course work according to respective curriculum.

2. Student has taken at least 5 times an acceptable English proficiency test (TOEFL, TU-GET, IELTS, TOEIC, or Institutional TOEFL).

3. Student should have a minimum score of 400 for paper-based TOEFL, or equivalent score when using other tests.

Students who pass this course will have similar English skills to those students who satisfy the English Proficiency requirement. The course content will be based primarily on the Institutional TOEFL (ITP) exam; however, materials may be drawn from other tests (e.g., IELTS or TOEIC). Strategies for answering the different types of exam questions will be discussed and practiced in class. Special emphasis will be placed on helping students improve their individual weaknesses in the listening, reading, or structure sections of the exam. An S (satisfactory) or U (unsatisfactory) grade is given.

IES201 Industrial Engineering Mathematics 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

This course presents elementary differential equations and numerical methods for industrial engineers. Emphases are placed on first-order ordinary differential equations; linear ordinary differential equations of higher order; power series representation and gamma functions; Laplace and inverse transform methods; mathematical modeling, computers, and error analysis; fundamentals of unconstrained and constrained optimizations such as golden-section search, quadratic interpolation, gradient methods, and linear programming; least-squares regression; interpolation. Some heuristic algorithms such as Simulated Annealing, Particle Swarm Optimization, etc., will also be introduced. The implementation of these techniques using mathematical software packages, e.g., MATLAB and/or LINGO, for Industrial Engineering applications will also be covered.

IES301 Manufacturing Tools and Operations 3(2-3-4)

Prerequisite: None

This course emphasizes fundamentals of engineering and measurement, particularly the correct and safe use of machine tools. Students are provided with hands-on experience in fitting, welding, foundry, and fabrication.

IES302 Engineering Statistics 3(3-0-6)

Prerequisite: Have earned credits of (MAS117 or GTS117) or consent of Head of School

This course discusses fundamentals of probability, discrete and continuous probability distributions, conditional probability, moment generating functions, discrete and continuous random variables, sampling distributions, hypothesis testings of the means, variances, and proportions. Regression analysis will also be introduced.

IES303 Engineering Management and Cost Analysis 3(3-0-6)

(For Non-Industrial Engineering Students)

Prerequisite: None

The course presents a broad and fundamental view of management system (in both its classical and modern aspects), including its structures and functions of interrelated departments. Philosophy and quantitative aspects of inventory management, quality assurance, project management, etc. are emphasized. Students are also introduced to basic concepts and applications of an economic evaluation of engineering projects. Topics covered include interest formulas, time value of money, economic decision making involving several alternatives, etc. This course is not intended for industrial engineering students.

IES304 Industrial Engineering Training 0(0-0-0)

Prerequisite: Junior standing

Students are provided with on-the-job training at selected modern industrial or service facilities. The purpose of the course is to allow the students opportunities to observe how industrial engineers function, to learn how to collaborate with co-workers, and to develop self-responsibility. The training period must not be less than 240 hours. Students must submit a report at the end of the training period. A Satisfactory (S) or Unsatisfactory (U) grade will be given based on student's performance, quality of the report, and supervisor's comments.

IES305 Industrial Engineering Project I 1(0-3-0)

Prerequisite: Senior standing or consent of Head of School

The first course in the senior project course series. A student team will be given a real world problem which they must determine appropriate approaches and actions to obtain feasible solutions. This involves establishment of initial contacts, project proposal development, preliminary data collection, data analysis, verification of the results, and practical implementation. A presentation of the progress and a submission of the status report are due at the end of the semester.

IES312 Methods Analysis and Work Measurement 3(3-0-6)

Prerequisite: None

This course emphasizes the measurement and evaluation of work methods and how improvement can be introduced. Topics include visual and micromotion study techniques, motion economy, time study, and work sampling. The development and use of standard time data and computerized techniques will be covered.

IES313 Industrial Plant Design 3(3-0-6)

Prerequisite: None

Modern methods applied to facility layout and location design are discussed. Logistics of motion of people and materials, flow analysis, plant layout, and material handling techniques are covered. Students will study the mathematical approaches and computer packages applicable for solving facility layout and location problems.

IES315 Methods Analysis and Work Measurement Laboratory 1(0-3-0)

Corequisite: Taking IES312 in the same semester or consent of Head of School

This laboratory course demonstrates a practical use of modern apparatus available for motion and time study applications. Process charts and a time study board will be utilized to not only analyze manufacturing and service operations, but also to improve productivity.

IES321 Operations Research I 3(3-0-6)

Prerequisite: Have earned credits of (MAS210 and IES302) or consent of Head of School

Basic operations research models, algorithms, and their applications are discussed in this course. Topics covered are linear programming and its extensions; transportation model; game theory; network flow analysis; queueing theory; and simulation modeling.

IES323 Production Planning and Control 3(3-0-6)

Prerequisite: None

A study of the components and functions of integrated production, planning, and control systems. Consideration is given to material, equipment, and manpower requirements for optimizing continuous and intermittent manufacturing operations. Topics discussed include demand forecasting, hierarchical production planning, capacity planning, line balancing, operation sequencing, and scheduling, etc.

IES324 Production Sequencing and Scheduling 3(3-0-6)

Prerequisite: Have earned credits of IES323 or consent of Head of School

This course discusses techniques of sequencing and scheduling for job shops, flow lines, and other general manufacturing and production systems. Both deterministic and stochastic models are introduced.

IES331 Quality Control 3(3-0-6)

Prerequisite: Have earned credits of IES302 or consent of Head of School

Methods used to achieve higher product quality, to prevent defects, to locate chronic sources of trouble, to measure process capability, and to use inspection data to regulate manufacturing processes are emphasized. Preparation of statistical control charts and selection of suitable sampling plans are discussed. Total quality control, quality control circles, and ISO 9000 standards are also studied.

IES332 Factory Automation and Control Methods 3(3-0-6)

Prerequisite: None

This course discusses the design, automation, and integration of supporting subsystems in the overall manufacturing environment. These subsystems include flexible manufacturing system (FMS) cells, robotic cells, automated warehousing (AS/RS), automated material handling systems (conveyor,

AGV, etc), and automated inspection systems. Their functional characteristics and computerized controls are covered. Additionally, the course discusses linear and proportion-integral-differential (PID) control systems, system reliability analysis, open and closed loop control systems, system response, etc.

IES334 Industrial Robotics and Applications 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Intended to provide students with a knowledge of robotics in manufacturing systems. The field of robotics is studied with emphasis given to the role of programmable robots in manufacturing. Students will obtain hands-on experience about hardware and software available for various industrial robot systems.

IES335 Metrology 3(3-0-6)

Prerequisite: Have earned credits of SCS139 or consent of Head of School

This course is a problem-based course on metrology. This course involves the principles and applications of precision or fine measuring equipment, e.g., optical, laser, and electro-magnetic devices. Standards and accuracy of measurement are also discussed.

IES336 Industrial Instrument and Controlling Systems 3(3-0-6)

Prerequisite: None

This course covers principles and applications of instruments, particularly measuring and controlling instruments, employed in various kinds of industrial processes and manufacturing. Measuring instruments are typically used for electrical measurement, distance measurement, color detection, pressure measurement, level measurement, and temperature measurement. Additionally, this course includes mechanical and electrical controlling device such as Programmable Logic Control (PLC). The driving system is also mentioned. Finally, the design of measuring and controlling systems is discussed to integrate all industrial instruments mentioned in the course together.

IES341 Engineering Economy 3(3-0-6)

Prerequisite: None

Introduction to the principles of engineering economics for utilization and evaluation of capital investments. This course covers time value of money, net present value, rate of return, depreciation, and selection of the best economic investment alternative. Decisions involving multiple choice replacement, uncertainty, and risk will also be discussed.

IES342 Industrial Cost Analysis and Control 3(3-0-6)

Prerequisite: None

The course provides an understanding of the tools and techniques applicable for cost analysis and control. Topics

discussed include financial analysis of the accounting system, standard costs, variance analysis, cost-volume-profit relationships, cost estimation, and utilization of accounting data for control of operations.

IES343 Safety Engineering 3(3-0-6)

Prerequisite: None

The principles and practices of safety engineering in product and facilities design are discussed. Among the topics treated are safe practices and hazard control, safety standards and codes, inspection procedures, governmental regulations, and safety statistics. The Occupational Safety and Health Act (OSHAct) and Thai legislation will be examined and compared. Engineering ethics, moral principles, and social responsibility are also covered.

IES345 Project Feasibility Study 3(3-0-6)

Prerequisite: Have earned credits of IES341 or consent of Head of School

This course is a problem-based course on a project feasibility study. Fundamental concepts of a project feasibility study is discussed in detail. The course emphasizes essential qualitative and quantitative aspects of the feasibility study such as marketing evaluation, proposal development (preparation and presentation), economic analysis, project planning and scheduling, etc.

IES351 Maintenance Engineering 3(3-0-6)

Prerequisite: None

The course emphasizes the concepts and utilizations of maintenance as applicable to industrial and service systems. Examples of topics included are industrial safety and productivity aspects of maintenance, reliability of system components, preventive and emergency maintenance, scheduling of maintenance activities, etc.

IES353 Pollution Control and Waste Treatment 3(3-0-6)

Prerequisite: None

Discussion of the physical, chemical, and biological processes which influence the extent of air, water, and land pollution; methods for monitoring, controlling, and preventing pollution; methods of waste treatment; chemical wastes and hazardous wastes.

IES361 Manufacturing Process Design 3(3-0-6)

Prerequisite: Have earned credits of IES301 or consent of Head of School

Introduction to the theory and practice of manufacturing processes. Study covers various types of casting, and metal forming processes and technologies. This course emphasizes process selection and design of cost effective manufacturing processes. Linkage between process design, and production planning and control is considered.

IES362 Manufacturing Engineering Laboratory I 1(0-3-0)

Prerequisite: Junior standing

This course provides hands-on exercises on CAD/CAM, CNC machine programming and control (lathe and milling), and robot programming and control.

IES363 Manufacturing Engineering Laboratory II 2(1-3-2)

Prerequisite: Senior standing

The laboratory course provides practical integration between measuring and controlling instrument used in a manufacturing environment. Physical property measuring such as pressure, temperature, and level is focused on. Mechanical and electrical control devices, such as Programmable Logic Control (PLC), are emphasized.

IES364 Manufacturing Processes and Technologies 3(3-0-6)

Prerequisite: Have earned credits of IES361 or consent of Head of School

This course covers non-traditional manufacturing processes and technologies for metal parts, and those for plastic and composite-material parts. Manufacturing processes for electronic devices, and printed circuit boards are studied.

IES365 Jig, Fixture, and Mold Design 3(3-0-6)

Prerequisite: Have earned credits of (IES301 and MES302) or consent of Head of School

This course covers fundamentals of jig, fixture, and mold design. The topics include types, classifications, functions, and applications of jig, fixture, and mold, and also design economics. Computer aided design (CAD) concept is introduced to develop jig, fixture, and mold. Hands-on exercises of CAD are provided.

IES371 Engineering Management 3(3-0-6)

Prerequisite: None

This course is specifically designed for industrial engineering students to appreciate the applications of industrial engineering techniques in managing both manufacturing and service systems. Students learn the fundamentals of engineering economics and gain an understanding of the management process. Major topics covered include concepts and theories of modern management, capital investment justification methods, project organization and management, legal, quality, and staffing issues.

IES372 Materials Management and Inventory Control 3(3-0-6)

Prerequisite: Have earned credits of IES323 or consent of Head of School

This course emphasizes the philosophy of materials management and quantitative techniques used in controlling inventories in an organization. Classifications of inventory from different perspectives are presented. Both deterministic and probabilistic inventory models are discussed. Modern materials management systems, e.g., MRP-II and JIT, are also studied.

IES374 Management Information Systems 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Structure and design of computer-based information systems are discussed. Topics included are computer hardware and software, database models, database management systems, system analysis, design, and implementation.

IES376 Logistics and Supply Chain Management 3(3-0-6)

Prerequisite: None

This course is specifically designed for students to understand the principles of logistics and supply chain management. Major topics include logistic planning, cooperation and management in the supply chain, transportation, material purchasing and inventory control, packaging, integration between production planning and distribution among partners in the chain, and information systems. The present and future roles of logistics in the supply chain management are also discussed.

IES391 Applied Statistical Methods 3(3-0-6)

Prerequisite: Have earned credits of IES302 or consent of Head of School

This course emphasizes statistical analysis techniques and their applications. Topics discussed include a review of hypothesis testing, goodness-of-fit tests, regression analysis, and analysis of variance. Special attention is given to their applications in engineering fields.

IES392 Systems Simulation 3(3-0-6)

Prerequisite: Have earned credits of IES302 or consent of Head of School

This course is a problem-based course on systems simulation. This course introduces the application of discrete time simulation modeling for the analysis of complex manufacturing and service systems, using case examples in warehousing, material handling, banking, etc. Applications of continuous time and combined discrete-continuous simulation modeling will also be illustrated. Students will gain first-hand practice on how to use state-of-the-art simulation software through a series of laboratory exercises or a realistic semester project.

IES394 Artificial Intelligence in Industrial Engineering 3(3-0-6)

Prerequisite: None

To provide insight into concepts and techniques of intelligent systems. Topics covered include search methodologies, knowledge representation, components of knowledge-based systems, design of knowledge bases, and inferencing. Applications of knowledge-based systems in design of products, processes, systems as well as machine diagnostics, production planning and scheduling will also be introduced.

IES395 Special Topics in Industrial Engineering I 3(3-0-6)

Prerequisite: None

This course is designed for topics related to industrial engineering, but not presently offered as either a required or technical elective.

IES396 Special Topics in Industrial Engineering II 3(3-0-6)

Prerequisite: None

This course is designed for topics related to industrial engineering, but not presently offered as either a required or technical elective. Topics covered are different from IES395.

IES401 Industrial Engineering Project II 6(0-18-0)

Prerequisite: Have earned credits of IES305 or consent of Head of School

A continuation of IES305. An individual student or a team of students will work on the individual or group projects assigned to them. The projects can be intensively conducted in industry or within the institute. After a project is completed, students are responsible for submitting their final report and giving a presentation.

IES402 Special Study in Industrial Engineering I 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in an exchange program. It covers new topics or areas of study related to industrial engineering, but not presently offered as either a required or technical elective. Topics covered are different from IES403.

IES403 Special Study in Industrial Engineering II 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in an exchange program. It covers new topics or areas of study related to industrial engineering but not presently offered as either a required or technical elective. Topics covered are different from IES402.

IES404 Extended Industrial Training 6(0-40-0)
(For Extended Industrial Training Track)

Senior standing or consent of Head of School

Students are provided with extensive on-the-job training at selected modern industrial facilities. The purpose of the course is to allow the students opportunities, to work and intensively conduct an individual research or practical project for at least 17 weeks under the close supervision of faculty members and main supervisors assigned by the training company. After the project is completed, students are responsible for submitting their final reports and giving a presentation.

ITS100 Introduction to Computers and Programming 3(2-3-4)

Prerequisite: None

Computer system components and organization. Hardware and software interaction. Introduction to data processing and databases. Algorithms and programming languages. Programming in high-level languages. Program design and development. Practical laboratories are essential parts of the course, designed to develop students' programming skills and understanding of computer system. These skills are important foundations for other technical courses.

ITS101 Programming and Algorithms 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

High-level programming languages. Types, control flows, iteration, functions and procedures. Program structure. Storage allocation. String processing. Recursive programs. Algorithm design. Program debugging.

ITS102 Object Oriented Programming 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Concepts of object oriented programming and introduction to software engineering principles. Topics include data structure fundamentals; abstraction; encapsulation; inheritance; polymorphism; overloading; pointer and reference variables; recursion and various important algorithms. Modeling and application with classes, member functions, constructors and destructors, public, private and protected access, static and non-static members, virtual functions and standard I/O.

ITS103 Object-oriented Programming Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Hands-on practice and experiments of topics in object-oriented programming.

ITS201 Discrete Mathematics 3(3-0-6)

Prerequisite: None

Sets and Projections. Boolean algebras. Relations. Automation. Formal grammars. Graphs and algorithms.

ITS221 Data Structures and Algorithms 3(3-0-6)

Prerequisite: Have earned credits of ITS102 or consent of Head of School

Concepts of data structures; data structures and programming; basic data structures: stacks, queues, linked lists, trees, graphs, etc.; recursion; hash tables; sorting and searching algorithms.

ITS224 Numerical Computation 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Basic concepts of problem analysis, computation, and solution. Using computers to find numerical solutions of scientific equations. Algorithms. Programming methods. Polynomial interpolation; numerical differentiation, numerical integration.

ITS227 Algorithm Design 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Definitions of algorithm, analysis of algorithm, divide and conquer, dynamic programming, graph algorithms, greedy algorithms, state space searches, NP-completeness and intractability. Hands-on practice on algorithm design and implementation.

ITS229 Human Computer Interface Design 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Design concepts of hardware and software interface. Overview of the trends in human interfaces design. Graphical user interface, interactive software design. Hardware technology for human interfaces.

ITS231 Data Structures and Algorithms Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ITS221 or Corequisite: Taking ITS221 or consent of Head of School
Hands-on practice and experiments of topics on data structures and algorithms

ITS300 Information Technology Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Practical training in the private sector or governmental departments in the field of Information Technology. Not less than 240 hours during the summer vacation of the third year. Students must submit a report to his/her supervisor who will decide for the final grade of either satisfactory (S) or unsatisfactory (U).

ITS322 Database Systems 3(3-0-6)

Prerequisite: None
Database systems architectures; relational data models; query languages; database security, integrity, and concurrency.

ITS323 Introduction to Data Communications 3(3-0-6)

Prerequisite: None
An overview of basic knowledge related to the process of data exchange between computers. Topics include analog and digital data transmission systems, various network topologies, client-server models, and structure/mechanism of the 5-layer simplified OSI model: application, transport, network, data-link, and physical layers.

ITS327 Computer Network Architectures and Protocols 3(3-0-6)

Prerequisite: None
Network models; OSI layers; transmission media; local area networks; design concepts of protocols; routing algorithms; applications of networks.

ITS329 System Analysis and Design 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Software models and software modeling methodologies. Basic abstraction mechanisms in software modeling. Modeling techniques, process, and languages. Software development process. Object-oriented system analysis and design. Hands-on practice on software development process and system analysis and design.

ITS335 IT Security 3(3-0-6)

Prerequisite: None

Introduction to computer security and cryptography: security services, threats and attacks, encryption, authentication, digital signatures. Software security: } database security, security of general purpose operating systems, trusted operating systems, malicious software, safe programs. Network security: firewalls, intrusion detection systems, Internet security protocols, Denial-of-Service attacks. Security management: organizational policies, physical security, planning and risk analysis, emergency response and disaster recovery, security audits, legal and ethical issues.

ITS336 Artificial Intelligence 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Overview of current research and applications of artificial intelligence. Introduction to the languages of artificial intelligence such as Prolog or LISP. Search techniques. Knowledge representation, reasoning, inference. Machine learning. Expert systems.

ITS341 Management Information Systems 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Structure and design of computer-based information systems. Topics included are computer hardware and software, database models, database management systems, system analysis, design and implementation.

ITS342 Computer Animation 3(2-3-4)

Prerequisite: Have earned credits of CSS221 or consent of Head of School

Introduction to techniques for computer animation such as keyframing, procedural methods, motion capture, and simulation. Overview and implementation of story-boarding, scene composition, lighting and sound track generation. 2D & 3D images and animations application software.

ITS344 Web and Business Application Development 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Introduction to integrated web-based system, concepts of web programming on business application development, programming with an emphasis on business applications. Transaction processing systems and management support systems. Principles of web-based application design; including programming structures, data structures, program testing, debugging, implementation of programs with graphical user interfaces and event driven code.

ITS351 Database Programming Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ITS231 or consent of Head of School

Hands-on practice and experiments of topics on database programming. Practical Usage of database design tools. Designing user interface for database applications. Programming database applications. Security and access in database programming. Efficient use of SQL for complicated tasks and teaching a 3GL database language. Usage of triggers, stored procedures and functions for efficient and more secure implementations of database applications.

ITS352 Networking Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ITS323 or CSS331 or consent of Head of School

Hands-on practice with the administration of computer networks and the development of computer network applications. Topics include: configuring network interfaces, designing and building switched and routed networks, monitoring network activities, and programming client/server applications.

ITS353 Graphic and Game Programming Laboratory 1(0-3-0)

Prerequisite: Have earned credits of ITS231 or consent of Head of School

Hands-on practice and experiments of topics on graphic design and modeling. Applications of graphic on game programming. Game programming. Graphic design tools. Design of user interface for game applications. Design of game applications.

ITS400 Project Development 1(0-3-0)

Prerequisite: Senior standing or consent of Head of School
Practical projects or problems in Information Technology for individual students or groups of students under supervision of faculty members. Students are required to submit and present the project proposal to their project committee appointed by the school.

ITS403 Information Technology Project 6(0-18-0)

Prerequisite: Senior standing or consent of Head of School
Practical projects or problems in information technology for individual student or group of students under supervision of faculty members. Students are required to submit and present the project report to their project committee appointed by the school.

ITS412 Tele-services and Services Architecture 3(3-0-6)

Prerequisite: Have earned credits of ITS327 or
Corequisite: Taking ITS327 in the same semester or consent of Head of School

In modern telecommunications, service providers experience market expansion and changes in service provisioning technologies. This course aims at presenting students with an architectural foundation, which is based on the

convergence of computer, telecommunication, an digital content technologies. Topics include Intelligent Networks, Common Object Request Broker Architecture (CORBA), and common service architectures available in several telecommunication standards.

ITS413 Internet Technologies and Applications 3(3-0-6)

Prerequisite: Have earned credits of ITS327 or
Corequisite: Taking ITS327 in the same semester or consent of Head of School

An overview of Internet technologies and applications. Topics to be covered include TCP/IP first generation (IPv4), TCP/IP new generation (IPv6), integration with ATM, new infrastructures (e.g., Internet 2, gigapops, IP over SONET, and IP over WDM), IP telephony, video over IP, multimedia applications over IP.

ITS423 Data Warehouses and Data Mining 3(3-0-6)

Prerequisite: Have earned credits of ITS322 or consent of Head of School

The course will introduce data warehousing and data mining, and study their principles, algorithms, implementations, and applications. Topics include data warehousing technology: data cube methods, data warehouse construction and maintenance; data mining techniques: characterization, association, classification, clustering, and similarity-based mining.

ITS424 Electronic Commerce 3(3-0-6)

Prerequisite: None

The course will introduce students to the underlying economic aspects of the electronic marketplace in order to provide them with an understanding of its foundations for the development of new business models. Topics included are electronic commerce and the Internet, characteristics of digital products and processes, product information, market efficiency, copyright protection, and electronic payment systems.

ITS432 Mobile Application Programming 3(2-3-4)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Problem-based learning; principles of mobile application development; programming languages, for mobile devices, such as JAVA, .NET, C/C++, Object-C; syntax and library usage; hand-on practice on a suitable software development kit (SDK); current and future trends of mobile applications.

ITS441 Accounting Information Systems 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

An introduction to information systems for accounting and finance, including their role, in identifying, recording, and classifying financial transactions; characteristics of various

types of accounts; accounting principles and concepts for measuring financial transactions; preparation of financial statements. Also covers financial analysis and the basic principles of financial management in the allocation and acquisition of funds.

ITS442 Entrepreneurship for IT Business Development 3(3-0-6)

Prerequisite: None

Technology viability assessment, legal issues associated with forming a new company, competitive positioning, market analysis and market opportunity assessment, product life-cycle planning, marketing strategy, organization management, intellectual property management, patenting, technopreneurship, business plan, venture capital, entrepreneurial ethics.

ITS481 Topics in Hardware and Communications I 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Hardware and Communications.

ITS482 Topics in Hardware and Communications II 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Hardware and Communications.

ITS483 Topics in Hardware and Communications III 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Hardware and Communications.

ITS484 Topics in Software Technology I 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Software Technology.

ITS485 Topics in Software Technology II 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Software Technology.

ITS486 Topics in Software Technology III 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Software Technology.

ITS487 Topics in Computer Information Systems I 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Computer Information Systems.

ITS488 Topics in Computer Information Systems II 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Computer Information Systems.

ITS489 Topics in Computer Information Systems III 3(3-0-6)

Prerequisite: Consent of Head of School

Topics of current interest in Computer Information Systems.

ITS495 Special Studies in Information Technology I 3(3-0-6)

Prerequisite: None

Special study on current topics related to Information and Communication Technology

ITS496 Special Studies in Information Technology II 3(3-0-6)

Prerequisite: None

Special study on current topics related to Information and Communication Technology

ITS499 Extended Information Technology Training 6(0-40-0)

Prerequisite: Senior standing or consent of Head of School
Extensive on-the-job training of at least 16 weeks at a selected organization that provides information technology services - an individual comprehensive research or practical project related to the training must be intensively conducted under close supervision of faculty members and supervisors assigned by the training organization. At the end of the training, the student must submit a report of the project and also give a presentation.

MAS116 Mathematics I 3(3-0-6)

Prerequisite: None

Mathematical induction; functions; limits; continuity; differential calculus - derivatives of functions, higher order derivatives, extrema, applications of derivatives, indeterminate forms; integral calculus - integrals of functions, techniques of integration, numerical integration, improper integrals; introduction to differential equations and their applications; sequence and series - Taylor's expansion, infinite sums.

MAS117 Mathematics II 3(3-0-6)

Prerequisite: Have earned credits of MAS116 or consent of Head of School

Analytic geometry in calculus - polar and curvilinear coordinates; three-dimensional space - vectors, lines, planes, and surfaces in three-dimensional space; function of several variables; calculus of real-valued functions of several variables and its applications - partial derivatives, extremes of functions, functions of higher derivatives, Lagrange multipliers; topics in vector calculus - line and surface integrals, Green's theorem.

MAS210 Mathematics III 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

Linear algebra - vector spaces, linear transformation, matrices, determinants, systems of linear equations, Gaussian elimination, eigenvalue problems, eigenvalues

and eigenvectors, diagonalization, complex matrices; introduction to complex analysis - complex numbers, analytic functions, complex integration, conformal mapping; calculus of variations; introduction to tensor analysis - Cartesian tensors and their algebra.

MAS215 Differential Equations 3(3-0-6)

Prerequisite: Have earned credits of MAS117 or consent of Head of School

Ordinary differential equations of the first order; linear ordinary differential equations of higher order - matrix notation, homogeneous solutions, method of variation of parameters; general ordinary differential equations - series solutions, Bessel functions, Laplace transformation; Fourier analysis - Fourier series, integrals and transforms; partial differential equations - methods of separating variables, applications of Laplace and Fourier transforms; applications to initial-value and boundary - value problems.

MES211 Thermofluids 3(3-0-6)

Prerequisite: Have earned credits of (SCS138 or GTS121) or consent of Head of School

Concepts of system, state and process. Energy and energy equations. Second law of thermodynamics, reversibility and entropy Thermodynamic cycles. Continuity and momentum equations. Velocity and flow measurement. Fluid flow in pipes. Fluid machinery. Modes and concepts of conductive, convective and radiative heat transfer. Engineering heat transfer equations and applications.

MES231 Engineering Mechanics 3(3-0-6)

(For non-mechanical engineering students)

Prerequisite: Have earned credits of SCS138 or consent of Head of School

Force systems; resultants; equilibrium; trusses; frames and machines; internal force diagrams; mass and geometric properties of objects; fluid statics; kinematics and kinetics of particles and rigid bodies; Newton's second law of motion.

MES300 Engineering Drawing 3(2-3-4)

Prerequisite: None

Introduction to basic principle of engineering drawing including lettering, applied geometry, orthographic drawing and sketching, sectional views and conventions, detail drawing, assembly drawing, dimensioning, three dimensioning, basic descriptive geometry dealing with points, lines & planes and their relationships in space and basic developed views. Introduction to Computer Graphics.

MES302 Introduction to Computer Aided Design 2(1-3-2)

Prerequisite: Have earned credits of MES300 or consent of Head of School

Use of industrial Computer Aided Design Software for detail design and drafting in various engineering fields such as in mechanical, civil, and electrical engineering. Introduction to three-dimensional wireframe, surfacing and solid modeling using CAD tools.

MES303 Mechanical Engineering Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Students are required to obtain practical training in the field of mechanical engineering at selected private sectors or governmental departments for not less than 240 hours during summer vacation of the third year. The objective is to allow the students to have opportunities to experience actual working conditions other than what is learned in the classrooms and laboratories. Students must submit a report at the end of the training period. A Satisfactory (S) or Unsatisfactory (U) grade will be given based on student's performance, quality of the report and supervisor's comments.

MES310 Thermodynamics 3(3-0-6)

(For non-mechanical engineering students)

Prerequisite: None

Definitions and basic concepts. SI units. Properties of pure substances and ideal gases. Heat and work. First and second laws of thermodynamics and their applications. Entropy. Power and refrigeration cycles and equipment including gas turbine, internal combustion engines and steam power plant. Basic heat transfer.

MES311 Thermodynamics 3(3-0-6)

Prerequisite: None

Basic concepts. Work and heat. Zeroth law of thermodynamics, temperature and its measurement. The first law of thermodynamics and energy. Pure substances and their properties. The first law for steady flow process and enthalpy. The second law of thermodynamics and thermodynamic heat engines. Reversibility and irreversibility. Entropy. Ideal gas. Mixtures.

MES312 Combustion and Emission Control 3(3-0-6)

Prerequisite: Have earned credits of MES311 or equivalent or consent of Head of School

Properties of fossil fuels. Production of synthetic fuels from biomass, coal, oil shales and tar sands. Stoichiometry, Combustion processes and emission control in boilers and furnaces, internal combustion engines and gas turbines.

MES313 Internal Combustion Engines 3(3-0-6)

Prerequisite: Have earned credits of (MES310 or MES311) or Consent of Head of School

Internal combustion engine fundamentals, spark-ignition and compression-ignition engines, fuels and combustion, ignition systems, ideal fuel air cycle, supercharging and scavenging performance and testing, lubrication.

MES321 Heat Transfer 3(3-0-6)

Prerequisite: Have earned credits of (MES211 or MES310 or MES311) or consent of Head of School

Steady-state conduction. Natural convection. Forced convection. Thermal radiation. Unsteady-state conduction. Combined heat transfer problems. Condensation and boiling heat transfer. Heat exchangers.

MES331 Solid Mechanics I 3(3-0-6)

Prerequisite: Have earned credits of SCS138 or consent of Head of School

Concepts of internal force and stress and deformation and strain. Analysis of stress and strain, Mohr's circles for stress and strain, stress-strain relationship. Stress and strain in thin-walled pressure vessels. Thermal stresses. Energy method. Torsion of circular shaft, thin-walled tubes, and close-coiled helical spring. Shear force, bending moment and bending stress in beams. Deflection of beams.

MES332 Solid Mechanics II 3(3-0-6)

Prerequisite: Have earned credits of MES331 or consent of Head of School

Generalized concepts of strain and Hooke's law. Thick-walled cylinders and shrink fits. Rotating discs. Open-coiled helical springs and impact loads. Axisymmetric bending of circular plates. Buckling of columns. Use of Mohr's circles for transformation of stress and strain, yield and fracture criteria. Virtual work and energy methods.

MES333 Design of Machine Elements 3(3-0-6)

Prerequisite: Have earned credits of MES331 or consent of Head of School

Theories of failure for static and dynamic loading. Design of mechanical components such as rotating shafts, bearing, welding, screw, springs and power transmission devices. Introduction to the use of computer as a tool in problem solving of mechanical design.

MES341 Fluid Dynamics 3(3-0-6)

Prerequisite: Have earned credits of SCS138 or consent of Head of School

Motion of fluid particles and stream lines. Momentum equations and applications. Energy equations and applications. Laminar and turbulent internal flows. Flow of fluid around a body. Boundary layers. Similarity and dimensional analysis. Theories and designs of centrifugal and axial-flow pumps, fans, water turbines and cavitation. Flows in open channels. Compressible flow.

MES342 Refrigeration and Air Conditioning 3(3-0-6)

Prerequisite: Have earned credits of ((MES310 or MES311) and (MES211 or MES341)) or consent of Head of School

Refrigeration cycles and properties of refrigerants. Evaporative cooling and cooling towers. Refrigeration load estimation. Design of refrigeration systems. Equipment selection and design. Psychometric properties and processes of air. Criteria for thermal comfort. Cooling load estimation. Design of air-conditioning systems. Equipment selection and design.

MES350 Engineering Statics 3(3-0-6)

Prerequisite: Have earned credits of SCS138 or consent of Head of School

Method of solving engineering problem using fundamental principles of mechanics, resultant and resolution of forces and couples, equilibrium of particles, rigid bodies and various structures, concept of friction, centroid, mass center and center of gravity, moment of inertia of area and mass, virtual work.

MES351 Engineering Dynamics 3(3-0-6)

Corequisite: Taking SCS138 in the same semester or consent of Head of School

Dynamics of particles: velocity, acceleration, force, momentum, laws of motion, work, power, energy, impulse, impact of elastic bodies, projectiles, circular motion. Dynamics of rigid bodies: moment of inertia and radius of gyration of various rigid bodies, rigid-body motion, force and acceleration, work and energy, impulse and momentum.

MES352 Mechanics of Machinery 3(3-0-6)

Prerequisite: Have earned credits of MES351 or consent of Head of School

Kinematics and dynamics of machines; displacement velocity, acceleration, and force analysis of linkage, cams and gear systems. Balancing of rotating and reciprocating machine parts; gyroscopic effects, critical speeds; energy variation in machinery. Mechanism design.

MES371 Material Science for Engineers 3(3-0-6)

Prerequisite: None

The course discusses properties and structure of material including metals, alloys, ceramics, polymers, wood, concrete, composites, and solid-state materials. Study of microstructures in relationship with mechanical properties of materials and phase equilibrium diagrams. Effects of production processes on microstructure of materials, degradation and failure analysis.

MES381 Measurements and Instrumentation 3(3-0-6)

Prerequisite: Have earned credits of (MES310 or MES311) or consent of Head of School

Measurements of temperature, pressure, time, speed, area, volume and measuring devices. Fluid flow measurements. Power measurements. Heating values of fuels, calorimeter and exhaust gas analysers. Data monitoring and acquisition systems.

MES382 Vibration and Noise Control 3(3-0-6)

Prerequisite: Have earned credits of MES351 or consent of Head of School

Vibration: linear system equation, free and forced responses, systems with two degrees of freedom. Behaviour of sound waves. Sources of environment noise and vibration and their impacts. Instrumental and practical measurement. General physiological and subjective responses to noise and vibration. Regulations, criteria, methods and techniques to reduce and control environmental noise and vibration.

MES383 Hydraulic and Pneumatic Control 3(3-0-6)

Prerequisite: Have earned credits of MES341 or consent of Head of School

Static and dynamic modeling of hydraulic and pneumatic components and systems. Energy and power transfer and impedance matching concepts. Dynamic performance and stability of open and closed-loop servodrives. Introduction to hydraulic and pneumatic control system design.

MES390 Basic Mechanical Engineering Laboratory 1(0-3-0)

(For non-mechanical engineering students)

Prerequisite: Have earned credits of (MES211 or MES310 or MES311) or consent of Head of School

A service course for students with major outside mechanical engineering. Experimental practices cover fluid mechanics, heat transfer, thermodynamics, combustion and emission, mechanism, physical and mechanical properties of materials. Technical notes on the experimental tests have to be submitted for grading.

MES391 Mechanical Engineering Laboratory I 2(1-3-2)

Prerequisite: Have earned credits of (MES310 or MES311) or consent of Head of School

Students are required to conduct tests and experiments on physical and mechanical properties of materials, mechanisms, fluid mechanics, thermodynamics and heat transfer, combustion and internal combustion engines. Reports or technical notes on the tests and experiments have to be submitted for grading.

MES392 Mechanical Engineering Laboratory II 2(1-3-2)

Prerequisite: Have earned credits of (MES310 or MES311) or consent of Head of School

Students are required to conduct tests and experiments on physical and mechanical properties of materials, mechanisms, fluid mechanics, thermodynamics and heat transfer, combustion and internal combustion engines. Reports or technical notes on the tests and experiments have to be submitted for grading.

MES403 Mechanical Engineering Project I 1(0-2-1)

Prerequisite: Senior standing or consent of Head of School
Students are required to present seminars on current development of mechanical engineering to their classmates and faculty members. The seminars may lead to senior projects later on. The reports of the seminars have to be submitted for grading.

MES405 Special Studies in Mechanical Engineering I 3(3-0-6)

(For Foreign Exchange Track)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in the exchange program. It is designed for topics related to mechanical engineering, but not presently offered as either a required or technical elective.

MES406 Special Studies in Mechanical Engineering II 3(3-0-6)

(For Foreign Exchange Track)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in the Exchange Track. It is designed for topics related to mechanical engineering, but not presently offered as either a required or technical elective.

MES407 Mechanical Engineering Project II 6(0-18-0)

(For Senior Project Track)

Prerequisite: Senior standing or consent of Head of School
A final course involving individual or group projects including design, analysis and implementation of mechanical systems selected from various interesting areas within mechanical engineering. Students are required to propose their projects during the first semester of their senior year. After a project is completed, students are responsible for submitting their final report and giving a presentation.

MES408 Extended Mechanical Engineering Training 6(0-40-0)

(For Extended Training Track)

Prerequisite: None

Students are provided with extensive on-the-job training at selected modern mechanical engineering facilities. The purpose of the course is to allow the students opportunities, to work and intensively conduct an individual research or practical project for at least 17 weeks under the close supervision of faculty members and main supervisors assigned by the training company. After the project is completed, students are responsible for submitting their final report and giving a presentation.

MES413 Advanced Thermodynamics 3(3-0-6)

Prerequisite: Have earned credits of (MES211 or MES311) or consent of Head of School

Review on basic concepts and definitions, the first-law and energy, the second law and entropy. Thermo-mechanical availability and irreversibility. Availability equation for a control mass and applications. Energy and mass equations for a control volume and applications. Second law efficiencies for control mass and control volume applications. Chemical availability. Energy analysis of engineering cycles. Thermoconomics.

MES422 Thermal System Design 3(3-0-6)

Prerequisite: Have earned credits of (MES321 and MES341) or consent of Head of School

Design procedure. Comparison between a workable system and optimum system. Equation fitting for equipment and processes characterization. Modeling of equipment and processes based on physical laws. Simulation of thermal systems. Selected optimization techniques such as Lagrange multiplier, search methods, linear programming, etc.

MES434 Mechanical System Design 3(3-0-6)

Prerequisite: Have earned credits of MES333 or consent of Head of School

Mechanical engineering system design involving practical problems in various industries. Students, working in groups, will investigate the design methodology and process from concept through final design including detailed analysis of all mechanical components of the system, by which knowledge of all engineering disciplines, is required. Projects are proposed from various areas of study within mechanical engineering. Students submit a final report and present their projects at the end of semester.

MES444 Renewable Energy Resources 3(3-0-6)

Prerequisite: None

Global and regional resources, conversion technologies and economics of renewable energy such as hydropower, biomass energy, solar energy, wind energy and geothermal energy.

MES462 Turbomachinery 3(3-0-6)

Prerequisite: Have earned credits of ((MES310 or MES311) and MES341)) or consent of Head of School

Review of thermodynamics of compressible flow. Principles, designs and applications of centrifugal and axial flow machines, i.e. centrifugal turbine and compressor, axial flow turbine and compressor, impulse and reaction steam turbine and Laval nozzle. Steam and gas turbine plants: theories, applications, performance characteristics of practical cycles. Erosion problems in steam and gas turbine components.

MES471 Electrical Energy Management 3(3-0-6)

Prerequisite: Senior or junior standing or consent of Head of School

Basic concepts. Management of electrical energy. Distribution circuits and equipment. Electrical tariff. Load and demand management. Power factor and loss management. Applications of thermodynamics to the analysis of electromagnetic circuits, transformer, motor and generator.

MES473 Energy Economics 3(3-0-6)

Prerequisite: None

Depletion of energy resources. Energy pricing. Fiscal instruments of energy policy. Uncertainty and energy policy. Energy analysis and energy policy. Environmental policy and energy development. Energy analysis and energy policies of selected countries. Energy project appraisal.

MES474 Thermal Energy Management 3(3-0-6)

Prerequisite: Senior or junior standing or consent of Head of School

Efficient uses of thermal equipment and systems such as boilers and steam equipment, evaporator and condenser, pre-heater and economiser, dryers and drying systems, etc.

MES481 Power Plant Engineering 3(3-0-6)

Prerequisite: None

Energy conversion principles and availability concept, fuels and combustion analysis and component study of gas turbine and internal combustion engine power plants, combined cycle and cogeneration, hydro power plant, nuclear power plant, control and instrumentation, power plant economics, and environmental impacts.

MES482 Power Generation and Environment 3(3-0-6)

Prerequisite: None

Thermal power plants: steam turbine, gas turbine, and cogeneration, hydropower plants, nuclear safety and waste treatment, atmospheric, land and water environment for power plants, introduction to environment impact assessment for power plants

MES483 Dynamic Systems and Control 3(3-0-6)

Prerequisite: Have earned credits of MES351 or Consent of Head of School

Mathematical modeling of mechanical, electrical, pneumatic, hydraulic, and combined physical systems using a unified approach, such as the Bond graph technique. Introduction to state-variables, system response, stability using Laplace transform technique. System characteristics: controllability and observability. Open and closed loop responses of control systems. Solution to state equation by direct analysis and digital computer methods.

MES493 Extended Mechanical Engineering 3(1-6-2) Laboratories

Prerequisite: Have earned credits of (MES391 and MES392) or consent of Head of School

Students are required to conduct extended tests and experiments on thermo-fluid systems such as fluid machinery systems, gas turbines, refrigeration and air conditioning systems, etc. Component modeling and system simulation are expected in the reports submitted for grading.

MES494 Special Topic in Mechanical Engineering I 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other mechanical engineering courses. Topics may vary from semester to semester and will not be the same as the one offered in Special Topic II, MES495.

MES495 Special Topic in Mechanical Engineering II 3(3-0-6)

Prerequisite: None

New topics or areas of study not offered in other mechanical engineering courses. Topics may vary from semester to semester and will not be the same as the one offered in Special Topic I, MES494.

MTS211 Principles of Business 3(3-0-6)

Prerequisite: None

This subject provides a broad overview of the world of business preparing students for various business-related subjects. It offers a comprehensive introduction of every aspect of business and the environment in which business operates. Emphasis is placed upon business organizations in general, including the objectives and overall responsibilities of business enterprises within their social and economic context. The fundamentals of business which span the range of all functional areas—management, accounting, marketing, operations, information systems, finance and legal studies will be introduced. Students will learn the language of the business world and the legal forms of business. Additionally, topics in small business and entrepreneurship will also be covered.

MTS212 Principles of Management 3(3-0-6)

Prerequisite: None

A study of organization and management trails, evolution of thoughts and theory of management. Management functions, which are planning, organizing, directing, and controlling, are emphasized for human factors in organization and management ethics.

MTS231 Statistical Methods for Managers 3(3-0-6)

Prerequisite: Have earned credits of (GTS111 or MAS117) or consent of Head of School

This course introduces fundamentals of probability and statistic: descriptive statistics, probability, discrete random variables and probability distributions, continuous random variables and probability distributions, point estimation, interval estimation, tests of hypotheses, analysis of variance, and regression analysis.

MTS232 Production and Operations Management 3(3-0-6)

Prerequisite: None

This course is intended to present various functions in modern manufacturing and service organizations that are important to their business operations. These functions include defining operations strategy, decision analysis, designing the operating system, facility design, project management, supply-chain management, forecasting, capacity and aggregate planning, inventory management, scheduling, and quality management.

MTS233 Introduction to Supply Chain Management 3(3-0-6)

Prerequisite: None

This course introduces the general principle of domestic and international supply chain systems. Major topics include introduction to logistics, transportation, production planning, inventory control, purchasing and procurement, packaging, supply chain integration, and information technology for supply chain management.

MTS234 Basic Electrical Engineering for Technologist 3(2-2-5)

Prerequisite: None

The course covers electrical engineering principles and technology as well as laboratory practices and experimental studies. Topics included are basic circuit theory, DC and AC circuit analysis, Kirchoff's law, Thevenin theorem, DC and AC measurements, electronic devices and circuits.

MTS251 Economics for Business and Management 3(3-0-6)

Prerequisite: Have earned credits of EC210 or consent of Head of School

An overview of the modern market economy as a system for dealing with the problem of scarcity; Operation and decision-making of economic units; Concepts of supply, demand and resource allocation; analysis of various market structures; economic policy.

MTS252 Materials Science 3(3-0-6)

Prerequisite: None

The course introduces a wide range of industrial materials, under the two main categories of structural and functional materials. Traditional and engineered structural materials discussed include metallic alloys, ceramics, polymers and composites. For the functional materials, semiconductors, superconductors, magnetic materials, and smart materials will be presented. Finally, failure and properties degradation are discussed.

MTS254 Introduction to Management Science 3(3-0-6)

Prerequisite: Have earned credits of GTS111 or consent of Head of School

This course discusses the application of quantitative methods in solving management problems. Topics discussed include linear programming modeling, graphical method for solving linear programming problems, graphical methods for sensitivity analysis, assignment problems, network models, integer linear programming, goal programming, analytic hierarchy process, decision analysis, project management, simulation, and forecasting models.

MTS301 Management Technology Training 0(0-0-0)

Prerequisite: Junior standing or consent of Head of School
Students are provided with on-the-job training at selected industrial or service organizations. The purpose of this course are to allow the students opportunities to learn through hands-on experience how various modern technologies can be applied to manage facilities and systems. Moreover, students will learn how to collaborate with co-workers, coordinate project activities, and develop self-responsibility. The training period must not less than 240 hours. Students must submit a written report at the end of the training period. Satisfactory (S) or unsatisfactory (U) grade will be given based on the student's performance, the quality of the report, and the supervisor's comments.

MTS302 Extended Management Technology Training 6(0-40-0)

Prerequisite: Senior standing or consent of Head of School
This extended management technology training provides students with intensive on-the-job training at selected industrial or service organizations. The training period must not be less than 480 working hours. This intensive training will enable students to work with company personnel to solve real problems, not simulated ones. Students will gain

hands-on experience on how various modern technologies are applied to manage facilities and systems. Moreover, they will learn how to collaborate with colleagues, coordinate project activities, and develop self-responsibility. In addition to a designated supervisor at the company, a faculty member will be assigned to co-supervise the student's training program. An approved industrial project is expected to be carried out by the student. At the end of the training period, the student must give an oral presentation of his/her work and submit a written report of the assigned project to the company and the MT Program.

MTS304 Extended Engineering Management Training 6(0-40-0)

Prerequisite: Senior standing or consent of Head of School
The extended engineering management training provides students with intensive on-the-job training at selected industrial or service organizations. The training period must not be less than 480 working hours. This intensive training will enable students to work with company personnel to solve real problems, not simulated ones. Students will gain hands-on experience on how various modern technologies are applied to manage facilities and systems. Moreover, they will learn how to collaborate with colleagues, coordinate project activities, and develop self-responsibility. In addition to a designated supervisor at the company, a faculty member will be assigned to co-supervise the student's training program. An approved industrial project is expected to be carried out by the student. At the end of the training period, the student must give an oral presentation or his/her work and submit a written report to the assigned project to the company and the EM Program.

MTS309 Engineering Management Training 0(0-0-0)

Prerequisite: Junior Standing or consent of Head of School
Students are provided with on-the-job training at selected industrial or service organizations. The purpose of this course is to allow the students opportunities to learn through hands-on experience how various modern technologies can be applied to manage facilities and systems. Moreover, students will learn how to collaborate with co-workers, coordinate project activities, and develop self-responsibility. The training period must not less than 240 hours. Students must submit a written report at the end of the training period. Satisfactory (S) or unsatisfactory (U) grade will be given based on the student's performance, the quality of the report, and the supervisor's comments.

MTS311 Fundamental Financial Accounting 3(3-0-6)

Prerequisite: None

A study of the evolution of accounting; the functions of accounting in identifying, recording, and classifying financial transactions; characteristics of various types of accounts; the accounting principles and concepts for measuring these financial transactions; a preparation of financial statements; the usefulness and limitations of accounting information as well as preparation of financial statements for an entity with incomplete accounting records.

MTS312 Principles of Marketing 3(3-0-6)

Prerequisite: None

The course introduces the definition and roles of marketing as one of business functions. Modern marketing concepts, marketing system, consumer behavior, marketing mix, tools for marketing management and responsibility and ethics of marketers are discussed.

MTS313 Organizational Behavior 3(3-0-6)

Prerequisite: Have earned credits of (MTS211 and MTS212) or consent of Head of School

This subject provides an introduction to the study of individual and group behavior from an organizational as well as an individual perspective. Basic principles from psychology and sociology will be presented, with an emphasis on their application to management of organizations. The subject purposes to explore specific subject areas: group processes, decision making, motivation, leadership, organizational culture, power and politics, conflict and negotiation, and communication as well as other relevant and important issues facing organizations today. It will teach tomorrow's managers to develop, train, and motivate high-performance employees.

MTS314 International Trade and Business 3(3-0-6)

Prerequisite: Have earned credits of MTS211 or consent of Head of School

The course includes international and globalization of business; global trade; global trade theories; global business environment (cultural, political, social, etc.), international competitiveness, international operations, international marketing, international financial management, expatriate managers, global strategic planning, strategy adaptations (marketing, human resources, etc.).

MTS331 Economic Decision Analysis 3(3-0-6)

Prerequisite: None

This course provides fundamental concepts and tools for economic decision-making for business projects. The topics include money-time relationship and equivalence,

cash flow analysis, minimum attractive rate of return (MARR) of an investment, several methods for investment appraisal such as present worth analysis (PW), annual worth analysis (AW), internal and external rate of return analysis (IRR and ERR), benefit and cost ratio (B/C), etc., effect of inflation, depreciation techniques, impact of depreciation and tax on decision analysis, sensitivity analysis and risk analysis for investment alternatives.

MTS332 Quality Management 3(3-0-6)

Prerequisite: Have earned credits of MTS231 or consent of Head of School

This course focuses on quality control and management in both manufacturing and service environments. The topics cover statistical process control (SPC) concepts and practices in several types of control charts and sampling plans, including analytical tools such as check sheet, Pareto chart, cause-and-effect diagram, etc., management, quality and productivity relationship, concepts of quality assurance and total quality management (TQM).

MTS333 Production and Inventory Management 3(3-0-6)

Prerequisite: Have earned credits of (GTS212 or MAS116) or consent of Head of School

The focus of this course is to point out the relationship between inventory and production in management aspect. Various qualitative and quantitative topics for production and inventory management for both dependent and independent demands are discussed such as economic order quantity (EOQ), economic lot sizing (EPS), just in time (JIT), materials requirement planning (MRP), manufacturing resources planning (MRP II), enterprise resources planning (ERP), production planning, and capacity planning.

MTS334 Applications of Business Statistics 3(3-0-6)

Prerequisite: Have earned credits of MTS231 or consent of Head of School

This course emphasizes on applications of statistical analysis techniques. Topics discussed include a review of hypothesis testing, analysis of variance, regression analysis, and other fundamental methods of statistics. The applications of business statistical tools will be covered.

MTS335 Enterprise Planning and Control Systems 3(3-0-6)

Prerequisite: None

The design, analysis and implementation of enterprise-wide resource planning and control systems; demand forecasting, aggregate planning, decision support models for production planning, master scheduling, shop floor control; application of information technologies such as ERP and MRP II to operations planning and control.

MTS336 Operations Scheduling 3(3-0-6)

Prerequisite: None

This course emphasizes models for sequencing and scheduling activities including: static and dynamic problems; deterministic and stochastic models, single machine processing; parallel machine processing; flow-shop and job-shop scheduling, project scheduling, workforce scheduling, exact and heuristic solution methods, and applications in manufacturing environments.

MTS337 Transportation and Logistics Management 3(3-0-6)

Prerequisite: None

This class will provide the theories, tools, techniques and technologies to manage the transportation and logistics system and how the transportation and other supply chain drivers such as inventory and facility work together to improve supply chain and logistic system profit. The topics included are: introduction to logistics management, supply chain drivers, roles of logistics in supply chain, transportation modes (motor, railroad, air, water, and intermodal modes), inventory models with transportation choices, global transportation, designing of distribution network, information technology in transportation, logistic strategies and other advanced topics in logistics and supply chain management.

MTS338 Warehouse Operations Management 3(3-0-6)

Prerequisite: None

Fundamental operations in warehouse management including roles of warehousing, warehouse technology such as bar codes, radio frequency identification (RFID) for inventory control system, modern warehouse operations, classifying products, materials handling equipments and system, racking and shelving, the aisle width decision, information technology for warehouse operations, health and safety issues.

MTS339 Purchasing and Supply Management 3(3-0-6)

Prerequisite: None

An overview of the procurement and purchasing activities in a supply chain are discussed. Discussion topics include supplier evaluation and selection, pricing, negotiation, contracts, inventory management, quality, buying decisions and plans, cost analysis, purchase agreements, and purchasing analysis of capital equipment, services, institutional and government purchases.

MTS340 Introduction to Inventory Management 3(3-0-6)

Prerequisite: None

Introduction of inventory management, types of inventory, inventory problem classifications; inventory cost; independent demand systems; deterministic and probabilistic models; single order quantities, dependent demand systems, material requirement planning (MRP), just-in-time (JIT), inventory valuation.

MTS351 Management Systems Optimization 3(3-0-6)

Prerequisite: Have earned credits of ((GTS112 or MAS210), MTS231 and MTS254) or consent of Head of School

Basic operations research models and their applications are introduced. The course covers topics on linear programming, simplex method, duality and sensitivity analysis, transportation model, nonlinear programming, deterministic dynamic programming, deterministic inventory models, game theory, probabilistic dynamic programming, probabilistic inventory models, queuing models, and Markovian decision processes.

MTS381 Business Information Systems 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Topics included are strategic uses of information systems; information systems in business functions; computer hardware and software; telecommunications and networks; electronic commerce; data and knowledge management; decision support systems; intelligent systems; and systems development.

MTS382 Database Systems and Applications 3(3-0-6)

Prerequisite: Have earned credits of ITS101 or consent of Head of School

Logical data models, relational database systems, structured query language (SQL), conceptual modeling; database design, Web-connected databases, transaction management, data warehousing, data mining, database administration issues, focuses on the use/management of business data in areas such as finance, accounting, production, and etc.

MTS383 E-Business 3(3-0-6)

Prerequisite: Have earned credits of ITS101 or consent of Head of School

This course offers the learning that is needed to develop electronic business. Topics include: developing a strategy; business-to-consumer (B2C) and business-to-business (B2B) marketing; pricing; customer relationship management (CRM); supply chain management; bar codes and radio

frequency identification (RFID) for inventory management system; planning, developing, and maintaining Web sites and supporting information systems; business processes; online payments; international, legal, privacy, and security issues. A unique feature is an ongoing project within the course that provides an opportunity to develop electronic commerce implementation plans.

MTS384 Information Systems Software 3(3-0-6)

Prerequisite: None

Students will learn how to use selected up-to-date information systems software programs and apply them to help to manage primary functions of a business organization. A review of core business operations is also provided prior to the learning of software applications.

MTS386 Distributed and Collaborative Computing 3(3-0-6)

Prerequisite: None

Distributed computing concept. Social networks and their applications. Tools for collaborative computing, such as Google Documents, Google Site, and Blogger. Introduction to Web application development. Introduction to Web Services and Service-Oriented Architecture. Introduction to Cloud Computing.

MTS387 Business Data Communications and Networking 3(3-0-6)

Prerequisite: Have earned credits of MTS386 or consent of Head of School

Introduction to data communications. Network layers: applications, transport, network, data links, and physical connections. Network technologies: Local Area Networks, Wireless Local Area Networks, Backbone Networks. Introduction to network security.

MTS388 Business Information Systems Analysis 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Systems development life cycle, project planning, investigation, requirements definition, systems specifications, alternative selection. Tools and techniques of object-oriented development and structured development.

MTS389 Application Programming for Technologists 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Introduction to business programming, programming processes, programming environments, object-oriented and event-oriented models, and database programming.

MTS391 Special Topics in Management Technology 3(3-0-6)

Prerequisite: None

This course is designed for topics related to Management Technology, but not presently offered as either a required or technical elective.

MTS392 Current Topics in Management Technology I 3(3-0-6)

Prerequisite: None

This course is designed for current topics related to Management Technology, but not presently offered as either required or elective courses.

MTS393 Current Topics in Management Technology II 3(3-0-6)

Prerequisite: None

This course is designed for current topics related to Management Technology, but not presently offered as either required or elective courses. Topics covered are different from MTS392.

MTS394 Introduction to Research Methodology in Management Technology 3(3-0-6)

Prerequisite: Have earned credits of MTS231 or consent of Head of School

This course gives a comprehensive introduction to the subject of research methods in management technology. The topics include introduction to Research Methodology, Basic Terminology, Ethical Considerations in Research, Problem Definition, Literature Review, Research Proposal, Collecting primary data, Sampling and Fieldwork, Tools and Techniques for Analyzing Research Data, Communicating Research Findings. Students will have hands-on experience in conducting a research.

MTS403 Management Technology Seminar 1(0-3-0)

Prerequisite: Senior standing or consent of Head of School
Each student group will be assigned a real-world or research-like problem as its seminar topic. Under supervision and guidance of a faculty member, the group must conduct a thorough literature review and collect published articles relevant to the assigned topic. They must develop a project proposal which will consist of the project scope, objectives, feasible approach, project activities, Gantt chart, and expected results and their contributions. The group must submit the proposal to the project advisor and give a public seminar on the assigned topic at the end of the semester.

MTS404 Engineering Management Project 6(0-18-0)

Prerequisite: Have earned credits of MTS403 or consent of Head of School

A continuation of MTS403. An individual student or a team of students will work on the senior project. The projects can be intensively conducted in industry or within the institute. After a project is completed, students are responsible for submitting their final report and giving a presentation.

MTS404 Management Technology Project 6(0-18-0)

Prerequisite: Have earned credits of MTS403 or consent of Head of School

A continuation of MTS403. An individual student or a team of students will work on the senior project. The projects can be intensively conducted in industry or within the institute. After a project is completed, students are responsible for submitting their final report and giving a presentation.

MTS411 Management Accounting 3(3-0-6)

Prerequisite: Have earned credits of MTS311 or consent of Head of School

An introductory course in cost accounting for corporate planning and management decisions. The course will focus on concepts and models for improving efficiency and promoting effectiveness through budgetary control, standard costing, and other management accounting tools for decision-making.

MTS412 Business Finance 3(3-0-6)

Prerequisite: Have earned credits of MTS311 or consent of Head of School

A study of the roles, functions and objectives of financial management, various types of business organizations and tax involved. Discussions will also cover financial analysis, basic principles in financial management in both allocation and acquisition of funds.

MTS413 Human Resources Management 3(3-0-6)

Prerequisite: Have earned credits of (MTS211 and MTS212) or consent of Head of School

This course covers the principles of human resource management, concepts and practices as well as the roles and responsibilities of a human resource manager, emphasizing the importance and usage of HRM as a strategic partner of the organization in today's world. The subject purpose is to examine the breadth of activity essential for effective people resourcing within an organization. It addresses the range of activities associated with the acquisition, management, and release of staff. Specific topics include employee recruitment, selection, orientation,

training and development, retention, performance management, rewards and compensation, benefits, counseling, employment legislation, safety and health issues, labor relations, and multinational human resources.

MTS415 Strategic Management 3(3-0-6)

Prerequisite: Have earned credits of MTS212 or consent of Head of School

This course focuses on the role of top management in integrating an organization's internal functional activities and external environmental forces. Emphasis is placed on defining economic, technological, ethical, political, and social factors affecting an organization and their consideration in setting goal and strategies. The topics considered in the course will be the relationships of organizations to their environments, the hierarchy of organizational objectives, structured and informal approaches to strategic planning, the integration of business functions, organizational structure, and policy implementation and evaluation. A significant aspect of the course is devoted to assessing the competitive dynamics of firms.

MTS431 Facility Location and Layout Planning 3(3-0-6)

Prerequisite: Have earned credits of (MTS232 and MTS351) or consent of Head of School

This course introduces quantitative techniques, both heuristic and optimization, for selecting a suitable site for facility location based on qualitative and quantitative factors. Requirements such as production process, flow of materials, activity relationships, and personnel that affect facility layout are discussed. The application of systematic layout planning will be explained in detail. Other topics such as warehouse operations, loading docks, material handling, and facility maintenance are also discussed.

MTS433 Analysis Techniques for Complex Supply Chain Management Problems 3(3-0-6)

Prerequisite: None

This course deals with real-world complex supply chain management (SCM) problems from both the individual and integrated viewpoints of the SCM components. Well-known heuristic and meta-heuristic techniques such as greedy heuristics, genetic algorithms (GA), simulated annealing (SA), ant colony optimization (ACO), etc., will be introduced. Selected SCM problems will be illustrated and their solution approaches will be explained.

MTS451 Project Management 3(3-0-6)

Prerequisite: None

This course introduces concepts of project management and techniques for planning, utilizing, and controlling of resources to accomplish specific goals. While the focus is

on technically-oriented projects, the principles discussed are applicable to the management of any project. Topics include estimation of project duration, time-cost consideration, workforce allocation, cash flow forecasting, financial and performance control, and documentation.

MTS455 Business Process Management 3(3-0-6)

Prerequisite: None

The Process Perspective; Process Management; Process Modeling, Analysis and Design; Business Process Management Framework; Business Process Management Systems (BPMS); Enterprise Process Management Program Planning; BPM Implementation Strategies; Key Skills, Roles and Responsibilities in implementing BPM; Business Process Architecture; BPM Value Proposition

MTS481 Business Process Simulation 3(3-0-6)

Prerequisite: Have earned credits of MTS231 or consent of Head of School

The study of the application of computer simulation software to business decision making problems, statistics problems, discrete-event simulation approaches, simulated data analysis, simulation variance reduction techniques.

MTS482 Principles of Decision Support Systems 3(3-0-6)

Prerequisite: Have earned credits of MTS381 or consent of Head of School

This course focuses on the use and application of Information systems to support the decision-making process with a focus on the application of information technology to the solution of management problems. Students will learn the basic concepts of decision support systems. This will involve developing conceptual knowledge of these systems as well as gaining practical experience, such as building and implementing a decision support system with software package, what-if analysis, and the use of the optimization software. Heavy emphasis is placed on using decision support systems for business decisions. Business application development techniques are applied to aid in the development of complex decision support systems.

MTS483 Information Systems Implementation 3(3-0-6)

Prerequisite: Have earned credits of MTS388 or consent of Head of School

Logical and physical design of computer-based information systems; tools and techniques that underline the design processes. Design of an enterprise information system with CASE tools. Alternative approaches to systems design with emphasis on object-oriented systems.

MTS484 Intelligent Systems for Business 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Introduction to business application of Intelligent Systems, case-based systems, rule-based systems, uncertainty management, fuzzy systems, neural networks, evolutionary computation, machine learning, data mining, and collective intelligence

MTS485 Business Intelligence Technologies and Applications 3(3-0-6)

Prerequisite: Have earned credits of ITS100 or consent of Head of School

Business intelligence technologies, tools, architectures, and methodologies for management support, decision-making and organizational performance analysis. Business intelligence applications used for strategic direction and competitive advantage.

MTS486 Introduction to Enterprise Resource Planning 3(3-0-6)

Prerequisite: None

Introduction to the integrated business planning and execution systems currently in use by most large and medium-sized organizations. The focus of this course is on fundamentals of enterprise resource planning (ERP) systems concepts, and the importance of integrated information systems in an organization. The implementation process of ERP will be discussed. The illustration of a small business firm with the functions of procurement, production, and sales business using commercial ERP software.

MTS491 Special Study in Management Technology I 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in the exchange program. It covers new topics or areas of study related to management technology, but not presently offered in general basic courses, basic courses in Science and Mathematics, compulsory courses and compulsory elective courses of the management technology curriculum. Topics covered must be different from MTS492.

MTS492 Special Study in Management Technology II 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in the exchange program. It covers new topics or areas of study related to management technology but not presently offered in general basic courses, basic courses in Science and Mathematics, compulsory courses, and compulsory elective courses of the management technology curriculum. Topics covered must be different from MTS491.

MTS493 Special Studies in Engineering Management I 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in the exchange program. It covers new topics or areas of study related to engineering management, but not presently offered in general basic courses, basic courses in Science and Mathematics, compulsory courses, and compulsory elective courses of the engineering management curriculum. Topics covered must be different from MTS494.

MTS494 Special Studies in Engineering Management II 3(3-0-6)

Prerequisite: Consent of Head of School

This course is intended for students who wish to participate in the exchange program. It covers new topics or areas of study related to engineering management, but not presently offered in general basic courses, basic courses in Science and Mathematics, compulsory courses, and compulsory elective courses of the engineering management curriculum. Topics covered must be different from MTS493.

SCS126 Chemistry for Engineers 3(3-0-6)

Prerequisite: None

Properties of gases, liquids, solids; properties of solutions; chemical equilibrium; acids and bases; electrochemistry; organic chemistry and polymer; atomic structure and bonding.

SCS138 Applied Physics I 3(3-0-6)

Prerequisite: None

Mechanics of particles and rigid-body - statics of particles and rigid bodies, analysis of simple structures, friction, work, momentum, rotation, vibrations, and waves; mechanics of fluids - properties of fluids, pressure measurement, forces on plane and curved areas, buoyancy and stability of bodies, fluid flow concepts, heat, thermal properties, and modes of heat transfer.

SCS139 Applied Physics II 3(3-0-6)

Prerequisite: Have earned credits of SCS138 or consent of Head of School

Elements of electromagnetism - electric fields and magnetic fields, dielectrics and capacitors, magnetic induction and Faraday's law of induction, inductors, electromagnetic theory and applications, AC circuits, fundamental electronics; optics - reflection, refraction, interference, diffraction, polarization, optical equipment, application of optics and LASER; modern physics.

SCS140 Pre-Mathematics and Sciences 3(3-0-6)

This course is designed for students who have insufficient background in mathematics, physics, and chemistry. Its objective is to improve basic knowledge of students to be able to study mathematics, physics, and chemistry effectively. Differential and Integral calculus, Trigonometric functions, Logarithmic functions, Limits, chain rule, L'Hopital rule; Motion in three dimensions, Rotational motion, Angular momentum, Equilibrium of rigid bodies, Fluid mechanics, Harmonic oscillation; Thermodynamics, Chemical equilibrium, Atomic structure.

SCS176 Chemistry Laboratory 1(0-3-0)

Corequisite: Taking SCS126 in the same semester or consent of Head of School

This laboratory course is designed to not only provide hands-on experience to students taking SCS126, but also strengthen the understanding of the subjects taught in the course. Through a series of laboratory exercises, students will learn how to use selected apparatus essential for chemistry experiments and how to safely handle chemical substances.

SCS183 Physics Laboratory I 1(0-3-0)

Corequisite: Taking SCS138 in the same semester or consent of Head of School

A series of physics experiments is designed to demonstrate theories taught in SCS138. Students will have opportunities to use state-of-the-art apparatus in a modern laboratory to recapitulate fundamental concepts covered in the SCS138 course.

SCS184 Physics Laboratory II 1(0-3-0)

Corequisite: Taking SCS139 in the same semester or consent of Head of School

A series of physics experiments is designed to demonstrate theories taught in SCS139. Students will have opportunities to use state-of-the-art apparatus in a modern laboratory to recapitulate fundamental concepts covered in the SCS139 course.

TU100 Civic Education 3(3-0-6)

Prerequisite: None

Study of principles of democracy and government by rule of law. Students will gain understanding of the concept of "citizenship" in a democratic rule and will have opportunity

for self-development to become a citizen in a democratic society and to take responsibility in addressing issues in their society through real-life practices.

TU110 Integrated Humanities 2(2-0-4)

Prerequisite: None

To study the history of human beings in different periods, reflecting their beliefs, ideas, intellectual and creative development. To instill analytical thinking, with an awareness of the problems that humanities are confronting, such as the impacts of: technological development, violence, wars, and various world crises so that we can live well in a changing world.

TU120 Integrated Social Sciences 2(2-0-4)

Prerequisite: None

This interdisciplinary course focuses on the fact that social sciences play an important role for society. The course explains the origins of the social sciences and the modern world, the separation of social sciences from pure sciences, and the acceptance of the scientific paradigm for the explanation of social phenomenon. It also involves the analysis of important disciplines, concepts, and major theories of social sciences by pointing out strengths and weaknesses of each one. Included is the analysis of contemporary social problems, using knowledge and various perspectives --individual, group, macro-social, national and world perspectives-- to view those problems.

TU130 Integrated Sciences and Technology 2(2-0-4)

Prerequisite: None

To study basic concepts in science, scientific theory and philosophies. Standard methods for scientific investigations. Important evolutions of science and technology influencing human lives as well as the impacts of science and technology on economies, societies and environments. Current issues involving the impacts of science and technology on moral, ethics and human values.

TU140 Thai Studies 3(3-0-6)

Prerequisite: None

Evolution of Thai society-settlement, government, economy, social values, and way of life; factors that determine Thai society and culture; artistic and technological creativity; geography and natural resources; trends in social and cultural development.