كلية الهندسة

FACULTY OF ENGINEERING

Department of Mechanical Engineering

MEC011 Engineering Drawing (1)

3 Cr. Hrs. = (*1* LCT + *3* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite - - -

Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and vice versa. Derivation of views and sections from given views. Sectioning views: (half, removed, rotates, offset and partial sectioning). Introduction of assembly drawing. Computer aided drafting (CAD).

MEC012 Engineering Drawing (2)

3 Cr. Hrs. = (*1* LCT + *3* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite MEC011

AutoCAD fundamentals, Roaming facilities, create new drawings, Modifying Commands, create layers and assign properties, Create and set text styles with different fonts and Dimensions, Isometric, 3D Plotting.

MEC013 Technical Report Writing

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite - - -

Typography and writing, Formal report components, types of engineering reports, content and appearance, communication types, nonverbal communication, memo, letter, email and social media, infographics in reports and presentations, types of graphs, how to evaluation written material and oral presentations.

MEC014 Engineering and Technology History

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite - - -

Provide students with an understanding of the historical development of Engineering with relation to societal expectations of the period, Interaction between human society and Engineers to develop and guide the advancement of engineering technology; with society posing problems for Engineers to solve and Engineers developing new technology that changed the course of human history, and helped shape the world we live in, General philosophy behind Engineering work to fulfil the needs of society (water, electricity, technological improvements etc.), The role of engineers in society from a humanistic perspective, Other relevant philosophical analyses of Engineering as a skill and profession such as, aesthetics, creativity, the epistemology of Engineering and more. Examples from the contributions of Arab Scientists in different fields.

MEC041 Production Engineering

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

This course aims to provide engineering students with a simple introduction and general knowledge about engineering parts, their materials, and primary production processes and manufacturing

technologies. It includes engineering materials classification, characteristics, and materials selection for different applications. Production processes such as casting, joining and metal forming processes. Some manufacturing processes of polymers, machining processes of metals. Machining processes of wood and Measuring instrumentations. In addition, a brief view on new materials (e.g. Nano-materials, metallic glass… etc.) and advanced processing techniques (e.g., CNC, high deformation rate, water jet cutting…. etc.) is provided.

MEC111 Mechanical Engineering Drawing

3 Cr. Hrs. = (*1* LCT + *3* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite **MEC012**

In the tutorial these contents will be covered: Introduction to Machine parts and assembly drawing, Types of threaded fasteners and washers, Internal and external Thread Standards, definitions and drawings, Bearing drawings, types of fittings, Fits and Tolerances, Geometrical Tolerances, Surface Finish. Exercises on assembly drawings such as: crane hook, stuffing box, valves, grinding wheel drive, worm and worm gear, machine vice, hand press, transmission shaft, …, etc. In the Lab. These contents will be covered: Introduction to solid modeling on a CAD software such as Solid-works, Inventor, or any other CAD, Sketcher workbench, Solid work-features: applied features, pattern features, fillets, design tables. 3D Modeling techniques;3D Part design, Parametric part design. 3D Assembly. 3D animation. Drafting and 2D drawings: basics, cross sections, dimensions, fits and tolerance. Sheet metal design; Weldment features.

MEC112 Machine Construction

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MEC111**

Loading Diagrams, General concepts of Stress and Strain, Types of Stresses (Normal Stresses and Shear Stresses), Combined Stresses, Theories of Elastic Failure, Safety Factor. Constructional details as affected by manufacturing, assembly, and strength considerations, Connections (Centering, Flanged, Riveted, Keyed, Splined, Screwed), Power Screw and its joints, Seals, Springs, Stress Concentrations, Reverse Engineering.

MEC120 Manufacturing Technology

4 Cr. Hrs. = (*3* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **MEC041**

Machining: Principles of machining, turning machines and processes, drilling machines and processes, Shaping and planning machines and processes, Milling machines and processes, Methods of tools and work piece fixation, Machining time, Introduction to Non-conventional machining processes. Forming: Introduction includes mechanical behavior of the materials, Plastic deformation, Effect of temperature on plastic behavior, Types of forming processes: Hot, Cold, Massive or sheet metal work, Metal forming processes: Forging and its types, Rolling, Extrusion, Types of drawing (rod, wire, tube, and deep), Sheet metal work (shearing, pressing, blanking, spinning, bending, coining, etc.), Brief explanation to forming machines and equipment. Used.

MEC121 Manufacturing Technology

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC041**

Machining: Principles of machining, turning machines and processes, drilling machines and processes, Shaping and planning machines and processes, Milling machines and processes, Methods of tools and work piece fixation, Machining time, Introduction to Non-conventional machining processes. Forming: Introduction includes mechanical behavior of the materials, Plastic deformation, Effect of temperature on plastic behavior, Types of forming processes: Hot, Cold, Massive or sheet metal work, Metal forming processes: Forging and its types, Rolling, Extrusion, Types of drawing (rod, wire, tube, and deep), Sheet metal work (shearing, pressing, blanking, spinning, bending, coining, etc.), Brief explanation to forming machines and equipment. Used.

MEC131 Metallurgy and Material Testing

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **PHY111**

This course provides a general treatment of the principles and problems of engineering materials and testing with specific reference to the mechanical properties. It also covers the common methods of static and dynamic testing: tension, compression, bending, shear, hardness, impact, creep and fatigue. Other topics are also included namely the types of fracture and the nondestructive testing of materials.

MEC151 Thermal Energy

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Fundamental concepts of energy, Thermal System, Types of thermal energy, Heat Exchange with the Surroundings, Transmission of thermal energy, Thermal Conduction, Thermal Conductivity, Thermal Radiation, Thermodynamic Properties, Internal Energy, Applications of thermal energy, Heat Engines, Refrigerator and Heat Pump, Solar energy, Thermal Energy Storage.

MEC211 Mechanics of Machines and Vibrations

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC221**

Mechanisms: Definitions, open-chain systems, closed-chain systems constraints, degrees of freedom, reference frames, inversions of four linkages (lower pair) mechanisms, slotted lever mechanism, steering mechanisms, inversions of mechanisms, Hook's joint, and synthesis of mechanisms. Kinematics: Kinematics of rigid bodies, position analysis, velocity analysis, acceleration analysis, rotation representations, Euler angles, rotation matrix, homogeneous transformation matrix, direct and inverse kinematics. Dynamics: Equilibrium of machines, D'Alembert's principle, force analysis, power analysis, Friction and inertia-effects, center of percussion, flywheel design. Cams: Types of cams, types of followers, kinematics and kinetics of cam. Gears: Concept of gear motion transmission, gear geometry and gear trains. Introduction, Vibration of single degree of freedom systems (free, damped, forced), Vibration isolation, Vibration of two degree of freedom systems (free, forced), Vibration absorber, Torsional vibrations (free, forced), Equivalent torsional systems.

MEC212 Machine Elements Design

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MEC112**

Introduction to Design Concepts, General Concepts of (Deflection, Buckling and Thermal Stresses), Design for Fatigue, Design of Machine Elements (Bolts, Power Screws, Rivets, Keys, Welded Joints, Springs), Design of Power Transmission Elements (Shafts, Couplings, Gears, Belt Drives, Chain Drives), Selection of Bearings, Design of Pressure Cylinders. Use of interactive Finite Element computer programs for problem solving is illustrated and used.

MEC213 Stress Analysis

3 Cr. Hrs. = (*2* LCT + *1* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC131**

Principles of statics and its application on deformable bodies. Stress and strain. Elastic behavior of simple elements under axial loading, bending and twisting. Principal stresses, Normal Stresses and Shear Stresses, Combined Stresses, Beams deflection. Statically indeterminate beams, Thermal Stresses.

MEC231 Engineering Economy

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MAT112**

Origins of engineering economy, Principles of engineering economy, Design and manufacturing processes and EE, Cost estimation and cost terminology, Accounting, Balance sheet, Profit loss statement, Concept of equivalence, Money time relationships, Simple and compound interest rates, Single amounts and uniform series, Increasing and decreasing gradient, Application of money, Time relationships, Present value, Internal rate of return, External rate of return, Payback period, Evaluation of alternatives for different useful life and study period, Depreciation methods, Replacement analysis, Determination of the economic life of challenger and defender, Engineering economy techniques for evaluation of public projects.

MEC235 Nanotechnology Basics and Health Risk

2 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **- - -**

Introduction to Nano technology, engineering of Nano-materials with emphasis on structural, optical, photonic, magnetic and electronic materials. Synthetic methods and analytical characterization with design for applications.

MEC251 Fluid Mechanics

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MAT112, MAT121**

This course will provide the student with a basic understanding of fluid properties, fluid statics and dynamics, and fluid flow. The flow of incompressible fluids in pressure systems constitutes the major portion of this course. Fluid measurement is covered both in the lecture and the laboratory portion of the course.

MEC252 Heat and Mass Transfer

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC151**

Thermal Conduction: The General Equation, Steady One Dimensional Conduction, Conduction without Heat Generation, Plane Wall, Composite Plane Wall, Composite Plane Wall Subjected to Convection, Overall Heat Transfer Coefficient, Cylindrical Shell, Composite

Cylindrical Wall Subjected to Convection, Spherical Shell, Composite Spherical Shell Subjected to Convection, Extended Surfaces (Fins), Conduction with Uniform Internal Heat Generation, Conduction with Variable Thermal Conductivity, Steady Two Dimensional Conduction, Unsteady One Dimensional Conduction (Transient Conduction), Periodic Conduction. Convection: Types of Convection, Dimensionless Groups, Dimensional Analyses, Buckingham's Pi Theory, Dimensionless Groups in Convection, Natural Convection, Forced Convection. Heat Exchanger: Heat Exchanger Types, Logarithmic Mean Temperature Difference, Effectiveness of Heat Exchangers. Thermal Radiation: Basic Concepts, Stefan-Boltzmann Law, Planck's Law, Radiation Properties of Real Surfaces, Emissivity and Absorptivity, Kirchhoff's Law, Emissivity of Real Surfaces, Gray Surfaces, Selective Surfaces, Heat Exchange by Radiation, Heat Exchange between Two Planes, Heat Exchange between Two Cylinders or Spheres, Heat Exchange between Gray Surfaces, View Factors. Mass Transfer, Fick's Law of Diffusion, Mass Transfer Rate from a Pool of Liquid, and from a Liquid Droplet.

MEC253 Thermodynamics

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***1*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **MEC151, MEC252**

Thermodynamic activity in solid and liquid systems, Gibbs free energy of solutions, entropy and enthalpy, binary phase diagrams, equilibrium constant, reaction equilibrium in gases, heats of reactions, stoichiometric phases with complex gas phases, mixed gas thermodynamics, Ellingham diagrams.

MEC254 Flow Machines and Advanced Fluid Dynamics

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***1*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite **- - -**

Identifying all energy resources: thermal, chemical, nuclear, kinetic, gravitational field, magnetic field, electric field. Rank and classification of different energies. Regenerative energy resources: solar, wind, biomass, wave energy, geothermal. Possible energy conversions. Cautionary and safety measures and introduction to environmental issues.

MEC255 Energy Resources

3 Cr. Hrs. = (***2*** LCT + ***2*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***180*** – ECTS = ***6***

Prerequisite **MEC151**

Identifying all energy resources: thermal, chemical, nuclear, kinetic, gravitational field, magnetic field, electric field. Rank and classification of different energies. Regenerative energy resources: solar, wind, biomass, wave energy, geothermal. Possible energy conversions. Cautionary and safety measures and introduction to environmental issues.

MEC271 Automatic Control

4 Cr. Hrs. = (***3*** LCT + ***1*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***210*** – ECTS = ***8***

Prerequisite **- - -**

Identifying all energy resources: thermal, chemical, nuclear, kinetic, gravitational field, magnetic field, electric field. Rank and classification of different energies. Regenerative energy resources: solar, wind, biomass, wave energy, geothermal. Possible energy conversions. Cautionary and safety measures and introduction to environmental issues.

MEC272 Energy Resources

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **MEC151**

Identifying all energy resources: thermal, chemical, nuclear, kinetic, gravitational field, magnetic field, electric field. Rank and classification of different energies. Regenerative energy resources: solar, wind, biomass, wave energy, geothermal. Possible energy conversions. Cautionary and safety measures and introduction to environmental issues.

MEC273 Hydraulics and Pneumatics Control

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Physical principles and fundamentals of fluidic control systems, applications of pneumatic and hydraulic systems. Hydraulic control system components: power units, reservoirs, filters, piping and hoses, accumulators, pumps (positive versus non-positive displacement pumps, vane pumps, gear pumps, variable displacement pumps, piston pumps, swashplate pumps, pump control systems), valves (spool valve, poppet valve, pilot-operated valves, pressure control valves, flow control valves, check valves, sequence valves, proportional valves, servo valves, cartridge valves, etc.), actuators (motors and cylinders), hydraulic and electrohydraulic circuits design, interfacing and control. Case studies from industry, heavy and earthmoving equipment. Pneumatic systems: service unit, compressors (piston, screw, rotary), filters, air dryers, lubricators, pressure regulation valves, control valves, etc., electro-pneumatic circuits design and control using sequential approaches.

MEC314 Mechanical System Design

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC212**

Drum and disc brakes: Mechanical advantage, Assisted brake systems. Introduction to chassis design, Chassis types. Belts: Stresses, Design, Load carrying capacity, Pulleys, Shafts, Clutches, Design of springs, Hydraulic coupling, Gears: Spur, Helical, Worm, Bevel. Gearbox: Gear ratios, Torque distribution, Shifts.

MEC321 Doe and Quality Control

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MAT211**

History of quality control Quality definitions and concepts, Process capability analysis, Theory of control charts, Statistical control charts for attributes, Statistical control charts for variables, Acceptance sampling: Principles and concepts, Acceptance sampling by attributes, Acceptance sampling by variables.

MEC324 Operations Research

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MEC041**

Linear programming: Formulation, Graphical solution, Simplex method, and Duality and sensitivity analysis, Transportation models: Transportation algorithm, Assignment problem and transshipment problem, Network models: Minimal spanning tree algorithm, Shortest route problem and Maximum flow problem, Branch and bound algorithm.

MEC328 Revenue Management Pricing

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

Introduction to Revenue Management and Pricing, Supply and demand, Revenue Management, Capacity Management, Segmentation, Competitive Factors, Forecasting and Budgeting, Pricing, Dynamic pricing strategies, Pricing under uncertainty, Risk analysis, Strategic decisions in revenue management.

MEC329 Industrial Robotics

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite MEC271

Introduction to robotics: history of robotics, types of robotics (Serial, parallel, walking, bipedal, etc.), robotics applications, Transformation. Kinematics analysis: generalized coordinates, rotation representations, Euler angles, rotation matrix, homogeneous transformation matrix, Denavit Hartenberg rules, forward and inverse kinematics, Jacobian matrix, singularities. Trajectory planning: trajectory generation problem, joint and Cartesian planning, cubic polynomial, higher order polynomials. Dynamics analysis: joint space dynamics, Newton-Euler algorithm, inertia tensor, Lagrange equations, inverse and forward dynamics. Control: computed torque techniques, joint space control, PD control stability, trajectory tracking.

MEC331 Modern Ferrous and Non-Ferrous Making

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite MEC336

Types of Metals, History of metals making, Status of steel and nonferrous metal making in Egypt and world, Steel, Aluminum, copper, Magnesium and Titanium production and consumption, metals making fundamentals: Solution thermodynamics, Role of slag in steelmaking, properties of slag. Steel making fundamentals: Steelmaking reactions such as oxidation of carbon, silicon, manganese, iron, phosphorous and chromium, Numerical problems, Role of refractory. Steel making practice: Bessemer and open-hearth steel making, Blast furnace iron making, Basic oxygen steel making, Electric furnace steel making and vacuum treatment, ladle metallurgy, deoxidation and teeming practice, ingot production, ingot defects and remedies, testing of steel products, inspection of steel products. Clean steel, ingot and continuous casting, final finishing operations like heat treatment and deformation processing.

MEC332 Biochemistry for Nano Technology

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite - - -

to study Nano technology, engineering of Nano-materials with emphasis on structural, optical, photonic, magnetic and electronic materials. Synthetic methods and analytical characterization with design for applications. to link with Biochemistry, and applications of Nanotechnology.

MEC333 Glass, Ceramics, and Binding Materials

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite - - -

Structure of amorphous and crystalline polymeric materials, mechanical, electrical and optical properties and their modification through processing, Newtonian and non-Newtonian behavior, viscoelastic behavior, viscosity, review on destructive and non-destructive testing, mechanical analysis (DMA, TMA), quick overview on polymer processing technologies.

MEC334 Polymer Materials

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **CHE342**

Structure of amorphous and crystalline polymeric materials, mechanical, electrical and optical properties and their modification through processing, Newtonian and non-Newtonian behavior, viscoelastic behavior, viscosity, review on destructive and non-destructive testing, mechanical analysis (DMA, TMA), quick overview on polymer processing technologies.

MEC335 Corrosion and Failure Analysis

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC131**

Introduction, corrosion types, atmospheric corrosion, principles of cathodic protection, corrosion by soils, corrosion by water and steam, localized corrosion, fundamentals of inhibitors, stress corrosion, metallurgical factors affecting corrosion, at high temperature, alloy behavior at high temperature, coatings, corrosion testing, materials for corrosive environments, analysis of corrosion failure. General approaches of Failure Analysis: data and sample collection, preliminary examination, nondestructive inspection, macroscopic and microscopic examination of metallographic sections and fractured surfaces, modes of failure (ductile, brittle) causes of failure (overloads, fatigue, creep, corrosion, wear, elevated temperature failures, etc.), solve the problems of cracks' initiation and propagation, writing a standardized failure technical report, and failure prevention recommendations.

MEC336 Materials Characterization

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Introduction to characterization, characterization techniques, principles, analysis and applications: optical metallography, measurements and analysis, quantitative analysis, SEM, EDX, TEM, x-ray diffraction, AFM, introduction to thermal analyses methods (TGA, DSC, DMA, DTA) etc.

MEC341 Measurement and Instrumentation

2 Cr. Hrs. = (*1* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **ELE112**

Characteristics of Sensors, Flow rate Measurement Principles, Orifice-Meter, Venturi-Meter, Coriolis Flow Meter, Turbine Flow Meter, Rotameter, Velocity Measurements, Pitot Tube, Vane Anemometer, Hot Wire Anemometer, Laser Doppler Anemometer, Particle Image Velocimetry, Pressure Measurement, Manometer, Bourdon Tube Gauge, Piezoelectric Sensor, Temperature Measurement, Thermometer, Thermocouple, Thermistor, Optical Pyrometer, Rotational Speed Meters, Tachometer, Torque Measurement, Strain Gauges, Gas Analysis, Electro-Chemical Gas Analyzer, Accuracy, Precision, Statistical Methods Error Analysis and Uncertainty.

MEC342 Additive Manufacturing 1

3 Cr. Hrs. = (*2* LCT + *1* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC121**

Additive Manufacturing (AM) is driving a paradigm shift in design and manufacturing. Provides a comprehensive overview of AM, from process physics and material chemistry to process and technology development. Explores new engineering and product design degrees of

freedom enabled by AM. Topics include fundamentals of polymer, metal and composite AM processes; process capabilities such as rate and resolution; material properties and their dependence on material characteristics, process parameters and machine designs; existing and new applications of AM; and a perspective on current and future technical challenges in AM.

MEC343 Micro and Nanosystem Computer-Aided Design

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Modeling and simulation. Lumped versus distributed approaches. Review of differential-equation systems, constitutive relations, boundary conditions, and solvers for complex, coupled transport problems pertinent to micro and nano-systems. Coupling strategies. Numerical schemes for nonlinear systems. Basic modeling and simulation of micro and Nano-systems, and fluidic systems. Relevant nanotechnology applications: optical, thermal, mechanical, and fluidic microstructures, and nanoscale devices.

MEC344 Additive Manufacturing II

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC342**

Additive Manufacturing (AM) is driving a paradigm shift in design and manufacturing. Provides a comprehensive overview of AM, from process physics and material chemistry to process and technology development. Explores new engineering and product design degrees of freedom enabled by AM. Topics include fundamentals of polymer, metal and composite AM processes; process capabilities such as rate and resolution; material properties and their dependence on material characteristics, process parameters and machine designs; existing and new applications of AM; and a perspective on current and future technical challenges in AM.

MEC353 Thermal Power Engineering

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **MEC151**

Thermal System, Control Volume, States of the Working Medium, Processes and Cycles, Calculation of Work, Heat Exchange with the Surroundings, Ideal Gases, Equation of State, Pure Substances, Phase Equilibrium, Tables of Thermodynamic Properties, First Law of Thermodynamics on Steady State Steady Flow Open Systems, and Applications such as simple Steam Rankine cycle, Brayton cycle, Diesel cycle, Otto cycle (introduction to Internal Combustion Engines), Heat transfer of electrical and electronic devices.

MEC354 Modelling and Simulation of Power Systems

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Fuel Bonding Energies, Chemical Structure Change due to Oxidation, Fuel Heating Values, Adiabatic and Non-Adiabatic Combustion Temperatures, Concentrations of Combustion Products under Chemical Equilibrium Conditions, Rates of Chemical Reactions, Stabilization of Premixed Flames, Laminar Flame Speed, Turbulent Flame Speed, Flame Stabilization at Higher Flow rates, Reaction Zones in Non-Premixed Flames, Diffusion Flame Length, Diffusion Flame Blowout Limits, Combustion Efficiency and Flame Generated Pollution, Liquid Fuel Sprays, Atomizers, Time of Fuel Droplet Evaporation, Physical and

Chemical Ignition Delays, Combustion of Solid Fuels on Grates, Pulverized Coal Combustion, Proximate and Ultimate Analysis of Coal, Detonation and Explosives.

MEC355 Combustion

3 Cr. Hrs. = (*2* LCT + *0* TUT + *3* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC353**

Fuel Bonding Energies, Chemical Structure Change due to Oxidation, Fuel Heating Values, Adiabatic and Non-Adiabatic Combustion Temperatures, Concentrations of Combustion Products under Chemical Equilibrium Conditions, Rates of Chemical Reactions, Stabilization of Premixed Flames, Laminar Flame Speed, Turbulent Flame Speed, Flame Stabilization at Higher Flow rates, Reaction Zones in Non-Premixed Flames, Diffusion Flame Length, Diffusion Flame Blowout Limits, Combustion Efficiency and Flame Generated Pollution, Liquid Fuel Sprays, Atomizers, Time of Fuel Droplet Evaporation, Physical and Chemical Ignition Delays, Combustion of Solid Fuels on Grates, Pulverized Coal Combustion, Proximate and Ultimate Analysis of Coal, Detonation and Explosives.

MEC363 System Psychology and Biomechanics

1 Cr. Hrs. = (*1* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *75* – ECTS = *2*

Prerequisite **- - -**

Introduction to Biomechanics of human movement, fundamentals of biomechanics and qualitative analysis, introduction to psychology.

MEC372 Sensors and Measurement Systems

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC341 OR ELE212**

To build a measuring system for frequently occurring mechanical measurement problems by selecting or designing the appropriate measuring system components. to analyze the components of measurement systems for mechanical quantities. to compare and critically evaluate measurement systems by combining the knowledge of measuring systems with the knowledge of dynamic mechanical systems and phenomena. During the practice oriented lab sessions, the student increases his/her experimental skills in designing and analyzing measuring systems. The student can in cooperation with others, within the frame work of lab sessions investigate and solve measurement problems and report about it. During two exercise sessions, the student acquires knowledge about the solution strategies needed to analyze measuring systems for mechanical quantities and to calculate the necessary parameters.

MEC381 Gait Analysis and Locomotion

2 Cr. Hrs. = (*1* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **- - -**

History of gait analysis and locomotion, techniques for gait analysis such as: kinematics, markerless gait capture, pressure measurement, kinetics, and dynamic electromyography. Applications of gait analysis.

MEC391 Industrial Project

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **100 CH**

The project is to be completed within the student's junior year. The student is requested to consider a simple engineering problem that is materials engineering related. The student should analyze the problem and find a systematic approach towards solving the problem. Practical work to achieve the goals are accomplished, the stages and results are analyzed. By the end the student is requested to submit a technical

report and make an oral presentation to persuade the audience of his approach.

MEC411 Introduction to Bio Engineering

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **CHE142**

Bioengineering is the application of the life sciences, physical sciences, mathematics and engineering principles to define and solve problems in biology, medicine, health care and other fields. This course provides an introduction to biotechnology and its application in a variety of medical, clinical and science disciplines. Topics covered include GLP, GMP, solution chemistry, spectroscopy, chromatography, basic microbiology techniques and DNA and protein purification/separation techniques. This course emphasizes basic laboratory skills essential for beginning level employment in clinical, pharmaceutical and biotechnology laboratories.

MEC412 Introduction to Nanosystems Design

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Introduction to the engineering design process: problem definition and needs analysis; process synthesis, analysis, optimization and troubleshooting; safety and environmental protection in design; written and oral communication for design reports. Students form four-person design teams and start a team-oriented project based on the knowledge and skills acquired in previous courses and on co-operative work terms, culminating in a design proposal presentation.

MEC428 Industrial Communication and Network Systems

1 Cr. Hrs. = (*1* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *45* – ECTS = *2*

Prerequisite **MEC325**

Introduction. Design and fabrication issues of MEMS/NEMS devices. Fundamentals of mechanics, micromechanical beams and damping, Electrostatic, mechanical, thermal, piezo-resistive, piezoelectric sensing and actuation principles. MEMS Fabrication. CAD tools for MEMS design. Designing simple MEMS devices.

MEC429 Industrial Automated Assembly Mechanisms

1 Cr. Hrs. = (*1* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *75* – ECTS = *2*

Prerequisite **- - -**

An overview of robotics and manufacturing automation technology and principles. Topics include: automatic production and assembly, sensors, actuators and drives, mechanization of part handling, industrial robots, and vision systems. Emphasis will be on the planning, design and implementation of automation systems and mechanisms.

MEC432 Material and Process Selection

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MEC131**

Understanding materials, their properties and behavior is fundamental to engineering design, and a key application of materials science. Written for all students of engineering, materials science and design, Materials Selection in Mechanical Design describes the procedures for material selection in mechanical design in order to ensure that the most

suitable materials for a given application are identified from the full range of materials and section shapes available.

MEC433 Polymeric Processing Techniques

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC131**

Introduction to the concepts of composite materials, matrix, reinforcement and interface, engineering matrices and reinforcements, production techniques for common reinforcing fibers, intrinsic properties of matrix materials and fibers, mechanical properties and fabrication of engineering composites including MMCs PMCs and CMCs, introduction to the mechanics of composites, rule of mixtures, methods for interfacial characterization.

MEC434 Composite Materials

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC336**

The use of heat treatment to produce required metallurgical properties, Cooling curves and equilibrium diagrams, Heat treatment of steels, phase transformations (e.g., martensitic transformations), Hardenability, Strength, and Toughness, Case hardening, Carburizing, and Nitriding, De-carburizing, Re-heat treatment, Re tempering, Annealing, and Normalizing, Heat treatment of Aluminum alloys, Annealing, Solution treatment, Natural ageing, Artificial ageing, Over ageing, Explanation of the heat treatment of Aluminum alloys, Control testing.

MEC435 Heat Treatment

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

The use of heat treatment to produce required metallurgical properties, Cooling curves and equilibrium diagrams, Heat treatment of steels, phase transformations (e.g., martensitic transformations), Hardenability, Strength, and Toughness, Case hardening, Carburizing, and Nitriding, De-carburizing, Re-heat treatment, Re tempering, Annealing, and Normalizing, Heat treatment of Aluminum alloys, Annealing, Solution treatment, Natural ageing, Artificial ageing, Over ageing, Explanation of the heat treatment of Aluminum alloys, Control testing.

MEC436 Phase Transformation and Thermodynamics of Materials

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **- - -**

The use of heat treatment to produce required metallurgical properties, Cooling curves and equilibrium diagrams, Heat treatment of steels, phase transformations (e.g., martensitic transformations), Hardenability, Strength, and Toughness, Case hardening, Carburizing, and Nitriding, De-carburizing, Re-heat treatment, Re tempering, Annealing, and Normalizing, Heat treatment of Aluminum alloys, Annealing, Solution treatment, Natural ageing, Artificial ageing, Over ageing, Explanation of the heat treatment of Aluminum alloys, Control testing.

MEC441 Computer Integrated Manufacturing

2 Cr. Hrs. = (*1* LCT + *1* TUT + *2* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **CSC014, MEC121**

Introduction, Computer aided design (CAD) systems, computer aided graphical modeling, Cad database, computer aided manufacturing (Cam) systems, computer aided process planning (CAPP) systems, robotics systems, group technology and cellular manufacturing systems, automated material handling systems, automated inspection systems, flexible manufacturing systems (FMS).

MEC442 Microfabrication and Thin-Film Technology Laboratory

4 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *7*

Prerequisite - - -

Introduction to Microfabrication and Thin-film Technology, modern CMOS technology, Wafer fabrication, Clean room wafer cleaning and gettering, Lithography, Thermal oxidation, Dopant diffusion, Ion implantation, Thin film deposition, Etching.

MEC451 Solar Energy and Voltaics

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite MEC272

Intensity of Solar Radiation within the Outer Space, Calculation of the Solar Intensity on the Earth, Availability and Usability of Solar Energy, Measurement of the Solar Intensity, Direct and Diffuse Radiation, Reflection from the Ground, Solar Angles, Shades, the Equation of Time, Incidence Angle on Horizontal and Inclined Surfaces, Theory of the Flat Plate Collector, Transmission through Glass, Heat Loss Calculations, Collector Performance, Solar Energy Concentrators, Point and Line Concentrators, Cylindrical Trough, Parabolic Trough, Parabolic Dish, Central Receiver, Heliostat, Heliostat Optimum Placement, Sun Beam Tracking, Shadowing and Blocking, Concentration Ratios, Fresnel Lens, Thermal performance, Heat Transfer Coefficients, Receiver Efficiency.

MEC452 Renewable Energy Resources Interfacing

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite MEC272

Storage technologies: Supper Capacitors: structure, ratings, characteristics, use with the wind power plant, fuel cells, Superconducting magnetic energy storage (SMES): structure, operation, Batteries: types, characteristics and operation, charge and discharge, Flywheels energy storage. Interface technologies: Concept of Distributed Generation, Type of interface, Interconnection standards, static synchronous generators, control of active power and voltage regulation, Wind turbines and photovoltaic interface topologies.

MEC453 Wind Storage

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite MEC272

Storage technologies: Supper Capacitors: structure, ratings, characteristics, use with the wind power plant, fuel cells, Superconducting magnetic energy storage (SMES): structure, operation, Batteries: types, characteristics and operation, charge and discharge, Flywheels energy storage. Interface technologies: Concept of Distributed Generation, Type of interface, Interconnection standards, static synchronous generators, control of active power and voltage regulation, Wind turbines and photovoltaic interface topologies.

MEC454 Hydroelectric Energy

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite - - -

Tunneling system - Hydropower station - Optimization. Estimation of state and maintenance of electrical equipment - Hydropower

generators; Construction and design - Designing of electrical system in power-plant. Dimensioning of the turbine - Dynamical dimensioning and governing stability - Operation and maintenance of turbine - Efficiency measurements in laboratory and in field.

MEC455 Geothermal Energy

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite - - -

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MEC456 Propane and Natural Gas Energy

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite - - -

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MEC457 Nuclear Energy

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

overview of energy recourses and energy use. Production methods for electric power, thermal energy and cooling, and their consequences on the environment. Energy use in industry and buildings. Energy flexibility and transportation in district heating systems. Technology, distribution and infrastructure in the Nordic electric power system. The physics involved in electric power transmission, and the trade in the Nordic electric power market (Norpol). Energy balance and environmental accounts.

MEC463 Energy and Environment

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite - - -

overview of energy recourses and energy use. Production methods for electric power, thermal energy and cooling, and their consequences on the environment. Energy use in industry and buildings. Energy flexibility and transportation in district heating systems. Technology, distribution and infrastructure in the Nordic electric power system. The physics involved in electric power transmission, and the trade in the Nordic electric power market (Norpol). Energy balance and environmental accounts.

MEC471 Microcontroller and Embedded Systems

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ELE111, MEC271

Introduction to Embedded Systems. Microcontroller architectures. Interrupt signals and routines. Interface circuits. Analog and Digital Peripherals programming: Digital I/OS, Timers, ADC and Communication Peripherals, Low power modes of operation.

MEC472 Mechatronic Systems Design

3 Cr. Hrs. = (*2* LCT + *0* TUT + *4* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite MEC472 -MEC273

Mechatronic product development process, Product requirements and needs (customer and engineering requirements/specifications), design constraints, modular mechatronic systems and hierarchy. Mechatronics design methodology: traditional approaches, VDI 2206, V-model, nested Vmodel, simplified examples and case studies. Selections of mechanisms, actuators, sensors, and controllers, actuator and motor

sizing. Essential tools for the mechatronics system design using the V-model: MATLAB/SIMULINK, LabVIEW, PROTEUS VSM, SOLIDWORKS, microcontrollers, etc. packages. Design and implementation of mechatronic systems via mini-projects.

MEC473 Design of Autonomous Systems

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC329**

Introduction to autonomous systems: autonomous versus automatic systems, automated and autonomous human-centered technical systems, semi-autonomy, autonomous behavior. Perception: multi-sensor fusion, localization, navigation and mapping, obstacle recognition and detection. Planning and actuation: task decomposition, reactive behavior, preplanned knowledge and skill-based behavior. Knowledge-base: facts and procedures, acquisition, exploration, skill transfer, learning. Autonomous systems architecture: behavioral principles, expert systems, knowledge-bases, multi-level control concepts. Applications of autonomous systems.

MEC474 Modeling and Simulation of Mechatronics Systems

1 Cr. Hrs. = (*1* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *75* – ECTS = *2*

Prerequisite **MEC271**

Automation history and applications, Automation vs Mechanization, Automation system architecture and components, Design of combinational and Sequential logic systems, Hardware considerations and wirings of automated systems. Computer based automation, Human Machine Interfaces (HMIs); PLC based automation (PLC): hardware, wiring, programming Languages (Ladder diagram (LLD), function block (FB), structured text, and sequential functional chart (SFC)), Analogue Modules and Special Functions. Communications and Networks within automation systems; Supervisory Control and Data Acquisition (SCADA); Distributed Control Systems (DCS); Internet of Things (IoT) based Industrial Automation; Automation Systems Security. Applications and case studies relevant to the mechatronics and mechanical Engineering such as flexible manufacturing systems (FMS), Computer integrated manufacturing (CIM), Manufacturing and production systems, Digital factory, Power systems, Oil and gas industry, …etc.

MEC475 Advanced Automatic Control

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC271**

Basic concepts, Dynamical systems, time-driven versus event driven control systems. State space modelling fundamentals, controller design, pole placement, controllability, observability, state feedback, observers design, state estimation. Digital control fundamentals, Digital control systems: digitization, analysis of discrete systems, Z-transform, pulse transfer function, the stability of a digital system, digital control systems design, digital state Space-Design and tune a digital PID controller, Discrete event systems control, Hybrid control systems design.

MEC481 Rehabilitation of Robots

2 Cr. Hrs. = (*1* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *60* – ECTS = *4*

Prerequisite **- - -**

Rehabilitation Robotics gives an introduction and overview of all areas of rehabilitation robotics, perfect for anyone new to the field. It also summarizes available robot technologies and their application to different pathologies for skilled researchers and clinicians. The editors have been involved in the development and application of robotic

devices for neurorehabilitation for more than 15 years. This experience using several commercial devices for robotic rehabilitation has enabled them to develop the know-how and expertise necessary to guide those seeking comprehensive understanding of this topic.

MEC491 Graduation Project 1

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **130CH**

Under supervision, the student should approach his graduation project within his Senior year. The purpose of this graduation project is to provide students with an opportunity to engage in an activity that will allow them to demonstrate their ability to apply the knowledge and skills they have gained throughout their years in the educational system. The project is designed to ensure that students are able to apply, analyses, synthesize, and evaluate information and to communicate significant knowledge and understanding. Problems/ topics to be considered should be materials engineering oriented, in any of the related disciplines offered by the faculty.

MEC492 Graduation Project 2

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **MEC491**

This graduation project may be seen as a continuation of the first part (MEC 491: Graduation Project) of a major topic, or it might be a new subject that the student is considering proving his competence in materials engineering practice.

Department of Physical Engineering

PHE511 Nuclear Reactor Physics

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

basic and advanced knowledge in modern reactor physics. The main part of the course is devoted to neutron diffusion theory, theory of nuclear fission and their industrial applications (power generation). The lectures give also an insight into new ideas to transmute nuclear wastes with help of particle accelerators. A historical survey of the milestones of nuclear physics since 1900 is also given in an introduction to the lectures. The course gives also some practical understanding of reactor operation through the laboratory exercises conducted at the departmental reactor simulator and probably at a research reactor.

PHE512 Radiation, Protection, Dosimetry and Detectors

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

nuclear- and radiation physics as a tool for calculating and estimating the dose absorbed in the body after being exposed by radioactive material in a specific situation. Together with knowledge about the interaction between matter and radiation, the biological effects of radiation, and knowledge about the current regulations on radiation protection, the student will in addition be able to use these tools to make adequate choices for radiation protection in situations that will occur in their future courses, and in their future professional career.

PHE513 Nuclear Power Safety

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

The course addresses both fundamentals of safety design and methods for safety analysis of nuclear power plants, with emphasis on Light Water Reactors. Topics covered include. safety characterization and safety features of nuclear power plants. reactor safety principles and criteria. design-basis and beyond-design-basis events. accident phenomena, including severe accidents. safety systems, containment performance. deterministic safety analysis (basic elements). accident modeling simulation codes. probabilistic safety analysis (basic elements). analysis of operation transients, accidents and severe accidents. emergency operation procedure, accident management. safety issues and safety issue resolution. operating experience, regulation and safety culture.

PHE514 Nuclear Reactor Technology

4 Cr. Hrs. = (*4* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

The course is focusing on the design and analysis of a nuclear reactor with special attention to safety, economy and environment. Example of topics which are covered in the course: nuclear reactor design and principles of reactor analysis. core design, core operation and fuel design. core reactivity and poisoning. thermal-hydraulics of water-cooled reactors. thermal limits in fuel under reactor operation. materials in nuclear systems.

PHE515 Sustainable Energy Transformation Technologies

4 Cr. Hrs. = (*4* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite *- - -*

Teaching and Learning Methods.

PHE516 Renewable Energy Technology

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

The purpose of this course is to provide an engineering assessment of renewable energy resources, including technologies for harnessing them within the framework of simple to advanced energy systems. Course content is divided into the following blocks: Biomass & Biofuels. Wind Power. Solar Energy. Hydropower. Energy Storage.

PHE517 Nuclear Physics

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Nuclear forces and the structure of the nucleon. Nucleon-nucleon interactions. The deuteron. Nuclear stability. Overview of nuclear models. Nuclear decay (radioactivity). Nuclear reactions. Nuclear astrophysics (nucleosynthesis, stellar processes) Interactions of ionizing radiation in matter. Principles for detection of ionizing radiation. Particle accelerators and their applications. Nuclear energy production (fission, fusion). Nuclear medicine. Material analysis and other applications of nuclear physics.

PHE518 Radiation Damage in Materials

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Mechanisms for generation of point defects - Hardening, swelling and embrittlement – Solubility – Diffusion – Clustering - Molecular dynamics, Monte Carlo and rate theory simulations.

PHE519 Leadership for Safe Nuclear Power Industry

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Safety and quality - Organization in nuclear technology - Communication and media - Leadership and theory of organization.

PHE521 Small Reactors

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Fuel economy in small reactors: Enrichment and control rod worth. Passive safety in small reactors: Reactivity feedback, natural convection and decay heat removal. Severe accidents: Source term and radiological impact on environment. Cost analysis: Capital cost, fuel cost and costs for operation and maintenance.

PHE522 Generation Iv Reactors

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite *- - -*

Physics of breeding - Safety parameters in fast neutron systems - Liquid metal and gas coolants - Fuels for fast reactors - Radiation damage in fast neutron spectra - Core design.

PHE523 Elements of the Back-End of the Nuclear Fuel Cycle: Geological Storage in Precambrian Bedrock

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Nuclear energy and nuclear fuel cycle primer. Petrology and mineralogy. Plate tectonics. Metamorphism. Quaternary geology. Hydrogeology in soil. Hydrogeology in fractured bedrock. Hydro-geochemistry. The KBS method. Social aspects of storing of nuclear waste.

PHE524 Thermal-Hydraulics in Nuclear Energy Engineering

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

The course is focusing on the thermal and thermodynamic processes in nuclear systems. Examples of the covered topics: transport equations of mass, momentum and energy, flow in pipes, mechanisms for heat transfer, convection, boiling and condensation, critical heat flux, laminar and turbulent flows, two-phase flows, critical flow, reaction forces.

PHE525 Nuclear Reactor Dynamics and Stability

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite *- - -*

The course is focusing on the dynamic features of a nuclear power plant. Examples of the topics that are covered in the course: nuclear reactor kinetics and dynamics, point-reactor kinetic and dynamics models, reactivity feedbacks and reactivity coefficients, reactor stability – instability mechanisms, instabilities of two-phase flows.

PHE526 Monte Carlo Methods and Simulations in Nuclear Technology

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

Theory of Monte Carlo methods - General variance reduction techniques - Pseudo-random and quasi-random sequences - Monte Carlo simulation of particle transport - Monte Carlo simulation of nuclear reactors - Variance reduction techniques in Monte Carlo reactor physics - Trends in Monte Carlo reactor physics - Monte Carlo in other fields like nuclear medicine, radiation protection etc.

PHE527 Compact Reactor Simulator- Exercises in Reactor Kinetics and Dynamics

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite *- - -*

The course addresses fundamentals of numerical analysis and numerical solution of ODE's and PDE's arising in nuclear engineering. Topics covered include. Solution of linear equations using direct, stationary and non-stationary iterative methods. Solution of system of non-linear equations using iterative methods. Solution of eigenvalue problems. Numerical integration and differentiation. Consistency, stability and convergence of discretized equations. Truncation error analysis. Von Neumann stability analysis. Lax-Richtmyer equivalence theorem. Finite difference discretization of ODE's. Numerical solution of initial value and boundary value ODE's. Finite difference and finite volume discretization of PDE's. Numerical solution of PDE's arising in nuclear engineering.

PHE528 Numerical Methods in Nuclear Engineering

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite *- - -*

The course addresses fundamentals of numerical analysis and numerical solution of ODE's and PDE's arising in nuclear engineering. Topics covered include. Solution of linear equations using direct, stationary and non-stationary iterative methods. Solution of system of non-linear equations using iterative methods. Solution of eigenvalue problems. Numerical integration and differentiation. Consistency, stability and convergence of discretized equations. Truncation error analysis. Von Neumann stability analysis. Lax-Richtmyer equivalence theorem. Finite difference discretization of ODE's. Numerical solution of initial value and boundary value ODE's. Finite difference and finite volume discretization of PDE's. Numerical solution of PDE's arising in nuclear engineering.

PHE551 Nuclear Medicine Procedures

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite *- - -*

The following is an incomplete list of topics covered in the course. Scientific knowledge. Hypothesis testing. Observations and measurements. Experiments. Models. Statistical reasoning. Causes and explanations. Philosophy of social science. Philosophy of technology. Risk and risk assessment. Research ethics.

PHE611 Theory and Methodology of Science (Natural and Technological Science)

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite *- - -*

The following is an incomplete list of topics covered in the course. Scientific knowledge. Hypothesis testing. Observations and measurements. Experiments. Models. Statistical reasoning. Causes and explanations. Philosophy of social science. Philosophy of technology. Risk and risk assessment. Research ethics.

PHE612 Research Methodology in Physics

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite *- - -*

The course will be conducted in seminar form, where invited speakers will discuss various aspects of the topics above. As a student, you should, apart from actively taking part in the seminars, also read, form an opinion on, and present a scientific paper. The presentations will be done under conference-like forms, during two days at the end of the course. There too, you are expected to take part actively, thus contributing to the quality of the seminar, and also you get the opportunity to listen to well-prepared presentations from a broad spectrum of research fields.

PHE613 The Nuclear Fuel Cycle

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Short overview of quantum mechanics and atomic structure. Atomic collisions, cross-sections, rate coefficients. Elastic collisions, classical and wave mechanical. The Born approximation. Interatomic potentials.

The Thomas-Fermi model. A universal interatomic potential. Plasma resistivity. Stopping cross-sections, sputtering and backscattering at surfaces. Inelastic collisions with classical and semi-classical model. Ionization, recombination, charge exchange, and Bremsstrahlung. Effective Z, radiation losses, equilibria, transport and energy confinement time. Use of data for atomic processes in models that treat fusion plasma physics problems.

PHE614 Atomic Physics for Fusion

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

Derivation of the neutron transport equation (NTE), fundamental properties of NTE, solution methodology for NTE, including approximations. Sn-method for numerical solution of NTE. Derivation of the kinetic equation, its properties and solution methods.

PHE615 Plasma Physics

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

General theory and its application on nuclear materials will be interleaved throughout the run of the course. Since the students may have varying need to refresh some concepts fundamental to the course, such as different nuclear reactor designs or general university chemistry, those parts will largely be in the form of self-studies. The lectures will center on how such knowledge can be complemented and extended to describe less common materials under extreme conditions and explain complex physico-chemical processes in the reactor core. The lectures will also detail the principles and methods for fuel manufacture and reprocessing.

PHE616 Neutron Transport Theory

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

Derivation of the neutron transport equation (NTE), fundamental properties of NTE, solution methodology for NTE, including approximations. Derivation of the kinetic equation, its properties and solution methods.

PHE617 Chemistry and Physics of Nuclear Fuels

4 Cr. Hrs. = (*3* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *195* – ECTS = *8*

Prerequisite - - -

Radiation therapy involves the therapeutic use of controlled doses of radiation for cancer treatment in hospitals. This reading-tutorial course consists of 24 modules covering various aspects of Radiotherapy Physics. Course notes are available via the internet and a list of recommended text books. Topics include: units and definitions of physical quantities used in radiotherapy, radiobiological basis for radiotherapy, compartment analysis, measurement of radiation for radiotherapy, Bragg-Gray theory, absorbed dose. measurements, depth-dose profiles, field correction factors, calibration of ionization chambers for photon and electron beams, quality assurance protocols, treatment machines (linacs), treatment planning overview, beam data specification and acquisition, treatment planning: photons and electrons, single and multiple beams, conformal and intensity modulated RT, other beams: proton therapy, simulators and ancillary techniques, simulations, dosimetry and therapeutic techniques using unsealed sources, brachitherapy, shielding calculations in medical equipment installations.

PHE618 Physics of Radiation Therapy

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

units and definitions of physical quantities used in radiotherapy, radiobiological basis for radiotherapy, compartment analysis, measurement of radiation for radiotherapy, Bragg-Gray theory, absorbed dose measurements, depth-dose profiles, field correction factors, calibration of ionization chambers for photon and electron beams, quality assurance protocols, treatment machines (linacs), treatment planning overview, beam data specification and acquisition, treatment planning: photons and electrons, single and multiple beams, conformal and intensity modulated RT, other beams: proton therapy, simulators and ancillary techniques, simulations, dosimetry and therapeutic techniques using unsealed sources, brachitherapy, shielding calculations in medical equipment installations.

PHE631 Radiation Damage in Materials

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Mechanisms for generation of point defects - Hardening, swelling and embrittlement – Solubility – Diffusion – Clustering - Molecular dynamics, Monte Carlo and rate theory simulations.

PHE633 Advanced Material Analysis

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

Crystal structures, Diffusion in metals, Solidification of metals, Equilibrium diagrams, Heat treatment of metal alloys, Defects in materials, Strengthening of materials, Advanced materials, Properties and applications (ceramics, polymers, composites), Materials selection.

PHE634 Environmental Modelling

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

Fundamentals of environmental modelling and mathematical quantification. Fundamental definitions and principles of model constructions. Causality modelling. General formulation of mass balances and their applications within environmental modelling. Model descriptions and coupling of chemistry and transport for water quality problems. Training in the use of numerical modelling tools. Practice in reading environmental modelling texts and manuals and in evaluating modelling work. Examples of modelling water quality, global and local element cycles, and ecosystem dynamics. Project work within environmental modelling.

PHE638 Reactor Control

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

The course will cover the following topics: • Nuclear reactor kinetics – the time dependent neutron transport equations; prompt and delayed neutrons. • Approximations to the neutron transport equations; point kinetics; space-time kinetics – the generalized modal model and the Improved Quasi Static (IQS) method. • The critical reactor, delayed super-criticality, prompt criticality, the sub-critical reactor. • Analytical approximations for the point kinetics model. Reactivity feedback mechanisms Doppler, coolant and power feedback; Xenon poisoning and reactor dynamics. • Transfer function representation of a reactor; the in-hour equation; the reactor transfer function with feedback. Xenon stability and Xenon oscillations. • Reactor control mechanisms and

devices, bulk power control; spatial power control, load following. • Control system for CANDU and LWR reactors.

PHE641 Leadership for Safe Nuclear Power Industry

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

Safety and quality. Organization in nuclear technology. Communication and media. Leadership and theory of organization.

PHE642 Nuclear Plant Systems and Operation

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

The course consists of an individual assignment with a topic that is decided by examiner. It should normally constitute a specialization within the chosen field of technology and be at the level of second-cycle studies. The course should correspond to 15 weeks of full-time studies. The work will be presented in a written report and an oral presentation at an open seminar.

PHE643 Regulatory Affairs and Licensing Concepts

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

The course consists of an individual assignment with a topic that is decided by examiner. It should normally constitute a specialization within the chosen field of technology and be at the level of second-cycle studies. The course should correspond to 15 weeks of full-time studies. The work will be presented in a written report and an oral presentation at an open seminar.

PHE651 Radiopharmacology

3 Cr. Hrs. = (*3* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *135* – ECTS = *6*

Prerequisite - - -

The course consists of an individual assignment with a topic that is decided by examiner. It should normally constitute a specialization within the chosen field of technology and be at the level of second-cycle studies. The course should correspond to 15 weeks of full-time studies. The work will be presented in a written report and an oral presentation at an open seminar.

PHE652 Technology of Nuclear Medicine

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

The course consists of an individual assignment with a topic that is decided by examiner. It should normally constitute a specialization within the chosen field of technology and be at the level of second-cycle studies. The course should correspond to 15 weeks of full-time studies. The work will be presented in a written report and an oral presentation at an open seminar.

PHE691 Degree Project in Physics, Second Cycle

4 Cr. Hrs. = (*1* LCT + *0* TUT + *9* LAB + *0* OTH) – SWL = *270* – ECTS = *8*

Prerequisite - - -

The course consists of an individual assignment with a topic that is decided by examiner. It should normally constitute a specialization within the chosen field of technology and be at the level of second-cycle studies. The course should correspond to 15 weeks of full-time studies. The work will be presented in a written report and an oral presentation at an open seminar.

Department of Biomedical Engineering

BME211 Structure and Function of the Body

2 Cr. Hrs. = (*2* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

structures and functions of normal human anatomy using a body systems approach. Learners will have the opportunity to demonstrate competency of select course objectives with the online simulated laboratory software. Provides a flexible, online introduction to the concepts of General Anatomy and Physiology.

BME213 Biochemistry

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite - - -

Biochemical processes: Cells, Water, and Buffers/ Energy/ Structure and function/ Catalysis/ Flow of Genetic Information/ Metabolism I/ Metabolism II/Signaling/ Synthesis of Concepts in Biochemistry. Detailed understanding of the structure and function of biological tissues as relevant to their mechanical behavior. Particular tissues to be studied include membranes, skin, ligaments and tendons, blood vessels, skeletal muscle, cardiac muscle, smooth muscle, and blood. The student will learn the origins of the material behavior of these tissues, as well as appropriate constitutive frameworks for representing their material behavior. Relevant concepts from continuum mechanics, formulate continuum mechanics models of biomechanical systems with appropriate boundary conditions.”.

BME222 Biomechanics 2: Biological Tissues

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

detailed understanding of the structure and function of biological tissues as relevant to their mechanical behavior. Particular tissues to be studied include membranes, skin, ligaments and tendons, blood vessels, skeletal muscle, cardiac muscle, smooth muscle, and blood. The student will learn the origins of the material behavior of these tissues, as well as appropriate constitutive frameworks for representing their material behavior. Relevant concepts from continuum mechanics, formulate continuum mechanics models of biomechanical systems with appropriate boundary conditions.”.

BME224 Introduction to Medical Imaging

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *-1* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Common imaging methods used in hospitals today -- i.e., x-ray, CT, MRI, and ultrasound -- as well as discuss emerging techniques, such as photoacoustic imaging. The basic principles, instrumentation, and applications of each imaging modality.

BME311 Biomedical Sensors

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Signal theory, Pressure measurements, Flow measurements, Motion and force measurements, Temperature and heat flow measurements, Bioelectrical and bio-magnetic measurement techniques, Chemical measurement techniques.

BME312 Biomedical Engineering Design

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite BME211

Selected topics in Biomedical Engineering design are presented in an interactive project laboratory format. Project experiences will introduce students to relevant topics in biomedical engineering including problem solving, team design, innovation, information technology, engineering, medical ethics, and social responsibility.

BME313 Introduction to Bio Engineering

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite BME211

a wide range of engineering techniques, anatomy and physiology, medicine, healthcare and the personal and societal context in which patients and their careers live, and in which health-services and the healthcare industry operates. This module aims to provide an overview of technologies, and provide an awareness of the diverse challenges that form the background to research, development and use of Healthcare Technologies.

BME315 Biomedical Systems Analysis

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite BME312

Applications of linear and control systems analysis to the dynamics of physiological systems and their responses to diagnostic and therapeutic interventions. Emphasis will be placed on respiratory, cardiovascular, and neuromuscular physiology and interactions of those systems with medical devices. Numerical models will be used to investigate these topics.

BME320 Biomechanics 1: Movement

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

This course explains how human movement is achieved through the complex and highly coordinated mechanical interaction between bones, muscles, ligaments and joints within the musculoskeletal system. Emphasis is placed on the mechanical properties and structural behaviors of the spine and major joints.

BME321 Magnetic Resonance Imaging

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Foundations, concepts and procedures of Clinical Magnetic Resonance Imaging.

BME322 System Psychology and Biomechanics

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Fundamental background of tissue optics; Understanding of physics, strengths, and limitations of various existing bio-optical imaging technologies; Knowledge of emerging bio-optical imaging technologies for anatomic and functional studies.

BME323 Modern Optical Microscopy and Imaging

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Metal, ceramic, and polymeric implant materials, with an emphasis on structure-property relationships that enable their applications as medical devices. Interactions of materials with the body.

BME324 Intermediate Fluid Mechanics

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Biomedical materials selection and design. Structure-property relationships of biomedical materials and their interaction with biological systems will be addressed. Applications of the concepts developed include blood-materials compatibility, biomimetic materials, hard and soft tissue-materials interactions, drug delivery, tissue engineering, and biotechnology.

BME325 Biomaterials and Medical Devices

2 Cr. Hrs. = (*2* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Strategies of tissue engineering, and will focus on the diseases that tissue engineering can address. Each lecture will identify a specific disease process (coronary artery disease, stroke, diabetes, etc.) and describe tissue engineered scaffolds that can alleviate the disease. Students will learn the underlying pathology of the disease; understand the latest advances in tissue engineering for treating the disease; and discuss prospective research areas for novel biomaterials to modify the disease process. In addition, students will gain an appreciation for clinical trials of tissue engineered scaffolds, as well as commercialization of tissue engineering.

BME326 Intro to Biomedical Signals and Electrical Circuits

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Anatomy and physiology, Medical terminology, Radiation, Nuclear medicine procedures, Radio-pharmacology, Physics, Ethics.

BME327 Biological Performance of Materials

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Interactions between cells and tissues for applications in biotechnology and biomaterials development, with a focus on applications for the selection, design, and fabrication of materials for medical implants, devices and drug delivery. Topics include surface and interfacial properties of materials, surface characterization, protein adsorption, cell adhesion, foreign body response, immunomodulation, nanotechnology, gene delivery and in-vitro and in-vivo testing of biomaterials.

BME328 Tissue Engineering

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

History of Tissue Engineering; Tissue Engineering Industry; Tissue / Organ Structure and Function; Tissue Engineering Strategies; Regulatory Issues; Tissue Engineering Design; Cells as Design Elements; Stem and Progenitor Cell Technologies; Cell- and Soluble Factor-Based Signals as Design Elements; Extracellular Matrix as a Critical Design Element; Tissue Development, Repair, and Regeneration; Tissue Transplantation; Polymeric Biomaterials; Cell and Tissue Mechanics; Molecular Delivery and Transport.

BME329 Nuclear Technology in Medicine

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Nuclear medicine technology uses radiopharmaceuticals (radioactive drugs) and specialized equipment to help diagnose and treat diseases. The Nuclear Medicine Technology (NMT) program is a two-year, full-time program where students are trained as nuclear medicine technologists, ready to work with patients and medical staff in clinical nuclear medicine settings.

BME333 Microbiology and Immunity

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

“General Bacteriology morphology and structure, classification of bacteria, bacterial physiology and growth, bacterial genetics, gene cloning general methods for identification of bacteria. Components of the immune system, (. 5%) (10%) innate immunity, complement, acquired immunity (humoral and cell mediated), protective immunity, tumor immunology, hypersensitivity, autoimmunity,”.

BME391 Industrial Project

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite 100 CH

The project is to be completed within the student’s junior year. The student is requested to consider a simple engineering problem that is materials engineering related. The student should analyze the problem and find a systematic approach towards solving the problem. Practical work to achieve the goals are accomplished, the stages and results are analyzed. By the end the student is requested to submit a technical report and make an oral presentation to persuade the audience of his approach.

BME421 Bioregenerative Engineering

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Foundations, principles, and technologies of molecular, cellular, and tissue regenerative engineering.

BME422 Regenerative Engineering Applications

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Fundamentals of human disorders; engineering aspects of regenerative medicine; application of regenerative engineering to human disease.

BME491 Graduation Project 1

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **130 CH**

Under supervision, the student should approach his graduation project within his Senior year. The purpose of this graduation project is to provide students with an opportunity to engage in an activity that will allow them to demonstrate their ability to apply the knowledge and skills they have gained throughout their years in the educational system. The project is designed to ensure that students are able to apply, analyses, synthesize, and evaluate information and to communicate significant knowledge and understanding. Problems/ topics to be considered should be materials engineering oriented, in any of the related disciplines offered by the faculty.

BME492 Graduation Project 2

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **BME491**

This graduation project may be seen as a continuation of the first part (MEC 491: Graduation Project) of a major topic, or it might be a new subject that the student is considering proving his competence in materials engineering practice.

Department of Electrical Engineering

ELE111 Electrical Circuits

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **PHY211**

Electrical Circuits variables and elements, Simple resistive circuits, Analysis of electrical circuits, ohm's law, Kirchhoff's laws, series parallel equivalent, star delta transformation, source transformation, Network theorems: Mesh current method, Nodal voltage method, Thevinin's equivalent, Norton's equivalent, superposition principles. Sinusoidal steady state analysis, Phasor diagram representation, Applications of network theorems on alternating current circuits, Electric power in alternating current circuits, complex power calculations, power factor, circuits with nonlinear resistances, Transients in electrical circuits.

ELE112 Electronic Circuits

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **PHY211**

Electrical Circuits variables and elements, Simple resistive circuits, Analysis of electrical circuits, ohm's law, Kirchhoff's laws, series parallel equivalent, star delta transformation, source transformation, Network theorems: Mesh current method, Nodal voltage method, Thevinin's equivalent, Norton's equivalent, superposition principles. Sinusoidal steady state analysis, Phasor diagram representation, Applications of network theorems on alternating current circuits, Electric power in alternating current circuits, complex power calculations, power factor, circuits with nonlinear resistances, Transients in electrical circuits.

ELE113 Electrical Drawing

3 Cr. Hrs. = (*1* LCT + *2* TUT + *3* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite **MEC012**

Engineering drawing techniques and skills. Conventional lettering and dimensioning. Geometric constructions. Theories of view derivation. Orthographic projection of engineering bodies. Derivation of views from isometric drawings and vice versa. Derivation of views and sections from given views. Sectioning views: (half, removed, rotates, offset and partial sectioning). Introduction of assembly drawing. Computer aided drafting (CAD).

ELE211 Electromagnetic Fields

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MAT112, PHY211**

Vector Analysis, Coulomb's law, Electrical field intensity, Electric flux, Gauss' law, Divergence, Electric energy and potential, Electric Conductors, Electrical resistance, Dielectric material, Electric Capacitance, Electric field plotting, Poisson's equation, Laplace's equation, Steady magnetic fields, Ampere's law, Magnetic Forces, Magnetic Materials, Magnetic Circuits, Inductance, Time varying magnetic fields, Maxwell's equations, Measurement of electromagnetic fields, hazards of electromagnetic fields, Shielding of electromagnetic fields.

ELE212 Electrical Measurements and Measuring Instruments

3 Cr. Hrs. = (**2** LCT + **1** TUT + **2** LAB + **0** OTH) – SWL = **165** – ECTS = **6**

Prerequisite **ELE112**

Measurement errors, Accuracy, Statistical analysis, Static Calibration, Resolution and Precision, Dynamic Response, Moving coil instruments, Moving iron instruments, Electro-dynamic instruments, Induction type instruments, Current and voltage measurement instruments, Measurement of power, Measurement of energy and charge, Measurement of frequency and power factor, Measurement of nonelectrical parameters, Cathode Ray Oscilloscope (CRO) applications, DC bridges, AC bridges, Resistance and capacitance measurements, Allocation of cable faults, Strain gauges, temperature transducers, Displacement, velocity and acceleration transducers, Force and pressure transducers, Light transducers, Data converters, Voltage to frequency converters, Digital measurement devices: Digital AVO meters, Digital frequency meters.

ELE213 Industrial Electronics

3 Cr. Hrs. = (**3** LCT + **1** TUT + **1** LAB + **0** OTH) – SWL = **165** – ECTS = **6**

Prerequisite **ELE111**

PN Junctions: construction and operation, I-V equation, biasing, circuit applications. Bipolar Junction Transistor (BJT): construction and operation, Types, I-V characteristics. Metal Oxide Semiconductor Field Effect Transistors (MOSFETs): construction and operation, I-V characteristics, biasing techniques. Logic gates using CMOS. FET applications: MOSFET as a resistance, MOSFET as a constant current source. Operational Amplifiers (OP-AMPs): difference amplifier, OP-AMP specifications, frequency characteristics. OP-AMP applications: adder, subtracter, integrator, differentiator, electronic analogue computation, I to V and V to I converters, comparators, Schmitt trigger, OP-AMP oscillators. Sensors and transducers. Digital to Analog Converters (DACs) and Analog to Digital Converters (ADCs). Introduction: the importance of microcontrollers, the roles and functions of microcontrollers. Acquaintance with microcontrollers and their simulators and debuggers. Understanding different addressing modes. Programming, debugging, and simulating assembly language programs. Developing a prototype for an embedded system. Interrupts and serial I/O. Memory Expansion. Microcontroller interfaces. Interfacing techniques. Interfacing requirements. A typical microcontroller system is utilized in this course with typical software-based applications. Interfacing with USB, I2C, SPI, CAN, LIN.

ELE231 Introduction to Embedded Systems

2 Cr. Hrs. = (**2** LCT + **1** TUT + **1** LAB + **0** OTH) – SWL = **120** – ECTS = **4**

Prerequisite **ELE233**

Introduction: the importance of microcontrollers, the roles and functions of microcontrollers. Acquaintance with microcontrollers and their simulators and debuggers. Understanding different addressing modes. Programming, debugging, and simulating assembly language programs. Developing a prototype for an embedded system. Interrupts and serial I/O. Memory Expansion. Microcontroller interfaces. Interfacing techniques. Interfacing requirements. A typical microcontroller system is utilized in this course with typical software-based applications. Interfacing with USB, I2C, SPI, CAN, LIN.

ELE232 Fundamentals of Communication Systems

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Basic concepts of communications. Communication system elements. Channel bandwidth. Analog modulation: AM, FM, and PM. FDM. Super-heterodyne receiver. Pulse modulation: PAM, PCM, PTM. Nyquist theorem. Line coding. Eye pattern. Generative/non-regenerative repeaters, Passband digital modulation: ASK, FSK, PSK.

ELE233 Control Engineering

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ELE213

Basic concepts of communications. Communication system elements. Channel bandwidth. Analog modulation: AM, FM, and PM. FDM. Super-heterodyne receiver. Pulse modulation: PAM, PCM, PTM. Nyquist theorem. Line coding. Eye pattern. Generative/non-regenerative repeaters, Passband digital modulation: ASK, FSK, PSK.

ELE234 Logic Design

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Review on number systems: positional notation, binary number systems, number base conversion, octal and hexadecimal, negative numbers, and coded number systems. Switching functions: main operators, postulates and theorems, analysis and synthesis of switching functions, incompletely specified functions. Design using NAND and NOR gates. Storage devices: bit storage, set-reset FF, clocked SR FF, positive and negative-edge triggered SR-FF, JK-FF, race-around condition, master slave JK-FF, D-FF, T-FF, excitation table. Sequential circuits: state table and transition diagram, design of digital sequential systems, incompletely specified states, counters, shift registers. Miscellaneous topics: adders, subtractors, decoders, coders, multiplexer/demultiplexer, memories (ROM, PLA, RAM).

ELE235 Industrial Networks

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

The course is presented through a layered top-down approach starting from the application layer down to the physical layer, focusing on basic networking concepts and typical application layer examples. Focusing on the Internet and the fundamentally important issues of networking, this course provides a foundation for students interested in computer science and electrical engineering, without requiring extensive knowledge of programming or mathematics. A typical outline of the course goes by the following sequence: * Application layer (e.g., e-mail, the Web, PHP, wireless Web, MP3, and streaming audio) * Transport layer essentials and requirements. * Network layer functions and fundamentals of routing, congestion control, QoS, IPv4, and IPv. * Data link layer and MAC Sublayer with emphasis on gigabit Ethernet, 80. 11, broadband wireless, and switching. * Physical layer (e.g., copper, fiber, wireless, satellites, and Internet over cable) The course dissects and depicts the principles associated with each layer and then focuses on Fieldbus networks, Control Area Networks (CAN, LIN, FLEXRAY) and SCADA systems.

ELE271 Electrical Machines

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ELE112

Principle of energy conversion: Electromechanical energy conversion,

magnetically single excited systems, magnetically multi-excited systems, Torque and stored energy in magnetic fields, Multifed rotating systems. DC Machines: the generation of EMF torque, construction of DC machine, the magnetic circuit of the dc machine, armature windings, armature reaction, methods of excitation, load characteristics of dc generators and motors, efficiency, testing of dc machines. Transformers: transformer construction, fundamental laws, equivalent circuits, transformer efficiency, transformer testing, transformer connections and harmonics, auto transformers and tap changers, parallel operation, transformer cooling.

ELE272 Electrical Power Engineering

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Introduction to electric power system, application of high voltage in electric power system, overhead transmission lines: parameter calculation, modeling, performance, and mechanical design, electric power distribution, underground cables, Determination of faults in underground cables, design of electrical distribution systems, insulated electrical cables, generation of high-voltage, high-voltage measurement, electric insulation types, corona, earthing and safety, Introduction to power system planning.

ELE311 Electrical Circuits and Machines (Advanced)

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **ELE112**

Electrical Circuits: Constants and variables of electrical Circuits, elements of electrical circuits, DC circuits, Network theorems, Sinusoidal alternating current circuits at steady state, Phasor diagram representation of sinusoidal quantities, Applications of network theorems on alternating current circuits, Electric power in alternating current circuits, complex power calculations, power factor. Three phase Circuits and systems, Magnetic circuits, Transformers, DC Machines, Synchronous machines, Induction machines.

ELE312 Analog Circuits

4 Cr. Hrs. = (*3* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *225* – ECTS = *8*

Prerequisite **ELE112**

Analysis and design of single-stage and multi-stage amplifiers. Frequency response of amplifiers. Differential amplifiers. Current mirrors. Filters. Introduction to feedback. Experiments in the field of analog circuits to support the theoretical contents of the course.

ELE313 Electromagnetic Fields

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **MAT112, PHY211**

Vector Analysis, Coulomb's law, Electrical field intensity, Electric flux, Gauss' law, Divergence, Electric energy and potential, Electric Conductors, Electrical resistance, Dielectric material, Electric Capacitance, Electric field plotting, Poisson's equation, Laplace's equation, Steady magnetic fields, Ampere's law, Magnetic Forces, Magnetic Materials, Magnetic Circuits, Inductance, Time varying magnetic fields, Maxwell's equations, Measurement of electromagnetic fields, hazards of electromagnetic fields, Shielding of electromagnetic fields.

ELE314 Waveguides

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **ELE313**

The application of the concepts of modern network theory to wave-

guiding systems. Impedance transformation and matching, scattering matrix, propagation in non-isotropic media, passive microwave devices, electromagnetic resonators, measurements in microwave systems.

ELE321 Signals and Systems Fundamentals

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MAT313, ELE231, ELE232**

Classification of signals. Basic operations on signals. Systems and their properties. Linear Time-Invariant (LTI) systems. Impulse response of LTI systems. Relation between impulse response and system properties. Convolution integral and convolution sum. Differential and difference equation representation of LTI systems. Block diagram representation of LTI systems. Continuous-time Fourier series (CTFS), continuous-time Fourier transform (CTFT), sampling theory, discrete-time Fourier series (DTFS), discrete-time Fourier transform (DTFT). Laplace transform. Applications.

ELE322 Advanced Semiconductor Devices

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **ELE232**

Semiconductors review, Theory of junctions and interfaces: p-n and metal-semiconductor junctions, Oxide-semiconductor and heterojunction interfaces, Principles of bipolar transistor operation, Field effect devices: MESFET and MOSFET, Downscaling principles and Submicron devices, TFET transistors, SOI transistors, Vertical Transistors: FinFET and Surround gate FET.

ELE335 Microprocessor-Based Automated Systems

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite **ELE322**

Numbering systems and Data representations. Basic principles of microprocessors and microcontrollers. Instruction set and microcontroller programming. Microcontroller peripherals: Digital I/O ports, Interrupts, Timer, EEPROM, Analogue ports. Signal conditioning circuits and Interfacing circuits with external devices such as seven segments, switches, and relays. Applications such as look up tables, alarming system, Pulse Width Modulation (PWM), speed control, temperature control.

ELE336 Vlsi Design

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite **ELE323**

CMOS Fabrication. CMOS scaling. IC Layout. Interconnect Capacitance and Resistance. Clock and power distribution. Data-path building blocks (Shifters, Adders, Multipliers). Semiconductor Memories. IC variability and reliability. Introduction to Input/Outputs. IC design methods. IC design economics. VHDL and FPGA design. Experiments in the field of digital circuits to support the theoretical contents of the course.

ELE337 Analog and Digital Communication Systems

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **ELE322**

Introduction to analog and digital communication systems. Random process. Noise, Noise temperature / Noise figure / Cascaded systems. Analog modulation noise performance. Digital baseband transmission

and Matched filter. ISI and bit error rate. M-ary modulation, QAM, DPSK. Digital passband system noise performance. Shannon Capacity Theorem. Color TV.

ELE338 Wireless Communication Networks

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite - - -

Review on CTFT and DTFT. Z-transform, Region of convergence, Inverse Z-transform, Properties of Z-transform, Analysis and characterization of LTI systems using Z-transform. Discrete Fourier transform. Fast Fourier transform (FFT). Structures of digital filters. FIR filter design techniques: windowing and frequency sampling. IIR filter design techniques: S-to-Z domain transformation. Introduction to Multi-rate DSP systems, Introduction to adaptive filters.

ELE371 Economics of Energy Generation, Transmission and Operation

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Load curves, Variation in demand, Load diversity. Power plant layout, Main equipment, Auxiliaries, Bus-bar arrangements. Power plant economics: Capital cost, Operating cost, Fixed charge rate, Selection of plant and size and unit size, Operation and economics of spinning reserve, economic analysis of a transmission system, tariffs, power factor, all-thermal generation allocation problem, hydro-thermal coordination, new energy resources. Transmission access fees assessment and calculations.

ELE381 Power Electronics and Motor Drives

3 Cr. Hrs. = (*2* LCT + *1* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ELE112

Introduction to power electronics devices, Single phase Rectifier circuits, three phase rectifier circuits, Ac Voltage controllers, Ac static switches, Dc to Dc Converter: buck, boost, buck-boost converters. Single phase Inverters, 3phase-bridge inverters, PWM modulation techniques. DC motor Drives: soft starting, speed control, Electric braking. AC Drives: voltage control, v/f control, rotor circuit control of induction motors, stepper motor drives.

ELE382 Advanced Power Electronics

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite ELE381

Switched mode power supplies, Voltage source converters, Interfacing of power electronics and Utility; HVDC Transmission, SVC and renewable energy, Application of resonance converters, New materials for power semiconductor devices.

ELE383 Power Systems Protection

2 Cr. Hrs. = (*2* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *120* – ECTS = *4*

Prerequisite - - -

principles and schemes for protecting power lines, transformers, buses, generators and introduces the fundamentals of wide-area monitoring and control (SCADA and EMS). It also briefly provides introduction to communication within digital substations (IEC. The course provides basic guidelines for relay protection and setting calculation. It also reviews power system faults and instrument transformers.

ELE391 Industrial Project

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **100 CH**

The project is to be completed within the student's junior year. The student is requested to consider a simple engineering problem that is materials engineering related. The student should analyze the problem and find a systematic approach towards solving the problem. Practical work to achieve the goals are accomplished, the stages and results are analyzed. By the end the student is requested to submit a technical report and make an oral presentation to persuade the audience of his approach.

ELE421 Optoelectronics

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **PHY321**

Light-matter interaction, Photons in semiconductors, level and. level lasers, gain coefficient, gain saturation, Heterojunctions, Fabry-Perot resonators, Double-heterostrcuture semiconductor lasers, Single- and multiple-quantum well lasers, DFB and DBR lasers, FP and travelling wave semiconductor optical amplifiers, Erbium doped fiber amplifiers, Light emitting diodes, Laser and LED dynamics, PIN and APD photodetectors.

ELE422 Antenna Engineering and Propagation

2 Cr. Hrs. = (*2* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **ELE322**

Fundamentals and definitions, Dipoles array synthesis and antenna arrays, Line sources, Folded dipole antennas, Micro-strip antennas, Broadband antennas: Traveling wave wire antennas, Helical antennas, Biconical antennas, Sleeve antennas, Rectangular and circular aperture antenna, Reflector antennas. Feeding networks for wire antennas, Arrays and reflectors, Antennas in communication systems, noise temperature, Atmospheric and ground effects.

ELE432 Digital Signal Processing

1 Cr. Hrs. = (*1* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *45* – ECTS = *2*

Prerequisite **- - -**

IC Processing, Clean Rooms and Clean Room Technology, Bulk Crystal growth, Epitaxial growth, Photolithography, Etching, Oxidation process, Diffusion process, Chemical vapour deposition CVD, Evaporation and multilayer coating, Ionic exchange process, Fabrication of passive and active components, Process integration and standard technologies, Layout design rules, Layout parasitics, Layout techniques, Interconnect modeling.

ELE433 Biomedical Engineering

1 Cr. Hrs. = (*1* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *75* – ECTS = *2*

Prerequisite **ELE233**

Introduction to mathematical modelling of physiological systems, Linear system approximation, Stochastic modelling, Cardiopulmonary system models, Myocardial mechanics, Cardiac energy and power analysis models, Models of gastrointestinal tract motility, Models of respiratory mechanics and chemical control of respiration.

ELE434 Integrated Circuits Technology

2 Cr. Hrs. = (*2* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **- - -**

Introduction to mathematical modelling of physiological systems, Linear system approximation, Stochastic modelling, Cardiopulmonary system

models, Myocardial mechanics, Cardiac energy and power analysis models, Models of gastrointestinal tract motility, Models of respiratory mechanics and chemical control of respiration.

ELE471 Economics of Generation, Transmission and Operation

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Load curves, Variation in demand, Load diversity. Power plant layout, Main equipment, Auxiliaries, Bus-bar arrangements. Power plant economics: Capital cost, Operating cost, Fixed charge rate, Selection of plant and size and unit size, Operation and economics of spinning reserve, economic analysis of a transmission system, tariffs, power factor, all-thermal generation allocation problem, hydro-thermal coordination, new energy resources. Transmission access fees assessment and calculations.

ELE491 Graduation Project 1

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite *130 CH*

Simplification of prosthetic hand engineering is crucial for many interests and readers, with the increased numbers of handicapped individuals overall the world. An introduction to the basic engineering concepts of designing, prototyping, and assembling of a prosthetic hand can be available for everyone in demand to this technology, which becomes more affordable and cheaper by using of 3D printing and 3D CAD modeling techniques.

ELE492 Graduation Project 2

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite *ELE491*

This graduation project may be seen as a continuation of the first part (ELE 491: Graduation Project) of a major topic, or it might be a new subject that the student is considering proving his competence in materials engineering practice.

Department of Civil Engineering

CIV111 Structural Mechanics

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **MAT121**

Introduction: types of structures, types of supports, types of loads, determinacy, equilibrium and stability of structures. Analysis of statically determinate structures: calculation of reactions, calculation of internal forces (normal force, shearing force and bending moments) for plane structures: beams, trussed beams, inclined beams, frames, closed frames, arches and trusses. Analysis of beams, frames and trusses under moving loads using the influence lines diagrams.

CIV112 Strength of Materials

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **CIV111, PHY111**

Properties of homogeneous cross section, straining actions and stresses distribution in these sections, when subjected to axial, flexural, shearing and torsional loadings. Analytical determination of combined and principal stresses.

CIV113 Structural Analysis

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Deflection using virtual work method. Analysis of statically indeterminate structures: general method of deformations (consistent deformations), three moments equation method and moment distribution method. Introduction to matrix methods: stiffness method.

CIV114 Civil Engineering Drawing

3 Cr. Hrs. = (*3* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **MEC012**

Fundamentals of technical drawing, orthographic projections, sectional views. Computer-aided drawing; Concrete structures; slabs, beams, and columns, Steel structures; building trusses and bridges. Irrigation Works; introduction to Irrigation works; Earthworks (Open Channels cross sections and projections/ changes in Bed, Berm, and Bank levels / Rotation and ends of canals), Retaining walls and abutments (types and its relationship with earth). Irrigation structures (Crossing works, heading up works, Canal ends works). Introduction to the design process.

CIV131 Surveying (1)

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite **MAT112**

Introduction to surveying science: Historical background, definitions and branches of surveying science. Introduction to national and international mapping system, linear measurements, electronic distance measurements, angular measurements, computation of coordinates, traverse (measurements, calculations, adjustments and drawing), coordinate calculations, two dimensional coordinate transformation, area calculations (regular and irregular parcel shapes) by using analytical, mechanical and graphical methods, parcel division

techniques, kinds and types of errors in surveying measurement, introduction to theory of errors.

CIV211 Concrete Structures Design (1)

3 Cr. Hrs. = (**3** LCT + **0** TUT + **1** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Methods of design; Codes; Structural systems, load determination and distribution. Behavior and limit states design of reinforced concrete section subjected to bending moments. Design using limit states method; Section subjected to bending, shear, torsion and axial force; Reinforcement details for beams. Development and curtailment of reinforcement for beams. Serviceability limits states.

CIV212 Steel Structures Design (1)

3 Cr. Hrs. = (**2** LCT + **2** TUT + **0** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

Loads on steel structures, analysis and design concepts, steel grades and types, structural systems and general layout for multipurpose halls, local buckling and steel cross sections classifications, Design of steel elements: Tension members, struts and compression members, flexural Members, lateral torsion buckling of beams, floor beams, Purlins, Crane track girders, and beam-columns. Design of bolted connections subjected to shear, tension and shear and tension, Design of welded connections subjected to shear and tension, wind bracing systems and design of column bases, Details. Construction: Tolerances, Fabrication, Erection.

CIV213 Concrete Technology (1)

3 Cr. Hrs. = (**2** LCT + **2** TUT + **1** LAB + **0** OTH) – SWL = **165** – ECTS = **6**

Prerequisite **CIV113**

Concrete materials: Cement (Manufacture, Chemical composition, Hydration of cement, Physical and mechanical properties, testing of cement, Common types of cement), Aggregates (Types, Physical, chemical and mechanical properties), Mixing water, Reinforcing steel (Types, Properties, Standard specifications), Admixtures (Chemical admixtures, Mineral admixtures, Air entrained admixtures). Properties of fresh concrete: Consistency, Workability, Cohesion, Segregation, Bleeding, air entraining. Properties of hardened concrete: (compressive, tensile, flexural, shear, and bond strengths). Concrete mix design methods.

CIV214 Concrete Technology (2)

3 Cr. Hrs. = (**2** LCT + **2** TUT + **1** LAB + **0** OTH) – SWL = **165** – ECTS = **6**

Prerequisite **CIV211**

Concrete manufacturing: (Approval of materials source, Storage, Batching and mixing, Transportation, Pouring, Compacting, Curing, Construction joints, Formwork). Ready mixed concrete: (Production methods, Inspection, Quality control measures). Statistical analysis to judge the concrete quality. Hot weather concreting: (Definition, Problems, Precautions). Concrete flooring: (Floor types, Materials properties, Construction joints, Surface finish and preparation). Volumetric changes of concrete: (Elasticity, Creep). Durability of concrete: (Carbonation, Corrosion process, Permeability. Non-destructive testing: (Rebound hammer, Ultrasonic, Pulse velocity, Core, Steel detection, Radiation). Special types of concrete: (High performance, Polymer, Fiber and Lightweight concrete).

CIV215 Foundation Design (1)

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite CIV213

Shallow foundations. Spread footings. Strip footings. Combined footings. Strap beam footings. Raft foundations. Deep foundations. Pile foundations. Caissons. Retaining structures. Sheet-piling walls. Supported deep excavations. Free and fixed earth support types. Anchors. Struts. Waling beams. Braced cofferdams.

CIV216 Computer Aided Structural Design

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction: Overview of F.E.M for Beam Element -Plates and Shells- Modeling of. D. Structures: (Beams - Frames - Trusses). Modeling of solid Slabs-One way, Two way and Hollow Blocks. Modeling of surfaces of revolution. Modeling of. D Frames (Steel and concrete). Modeling of foundations on elastic supports. Development of. D models for Retaining walls and Water tanks. Interface between F.E. programs and Auto- Cad program. Interface between F.E. programs and Column design programs. Sensitivity of structures to boundary conditions variation. A design project is an integral part of this course.

CIV218 Sustainability of Construction and Building Physics

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

The basic concepts of sustainability and sustainable construction, Development of international and local regulations in the area of sustainability, The different rating systems of construction sustainability. Causes and defects of climate change, the different techniques to approach energy-efficient and energy-saving constructions applying the concepts of building physics.

CIV219 Geology

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Earth composition. Major types of rocks and deposits. Soil and rock cycle. Minerals identification and classification. Clay minerals. Principles of structural geology: joints, faults, folds and landforms. Subsurface exploration: techniques and tests. Influence of geological origin on composition and structure of soils. Substance and mass properties of rock: compressibility, shear strength and permeability. Rock as a construction material. Weathering and engineering aspects of transported soils: alluvial, colluvial, glacial, coastal, aeolian, lacustrine and residual soils. Soil description and engineering classification.

CIV222 Fluid Mechanics for Civil Engineers

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

Introduction. Fluid continum. Fluid as a continuum. Fluid statics. Pressure. Pascals Law. Kinematics of fluid flow. Introduction. Types of Fluid Flow. Dynamics of fluid flow. Basic equn -Integration. Energy Equation (Conservation of energy). Dimensional Analysis and Hydraulic similitude. Dimensional Analysis. Pi Theorem.

CIV232 Soil Mechanics (1)

3 Cr. Hrs. = (*2* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite CIV112

Introduction to geotechnical engineering, earth crust, soil and rock,

minerals, soil formation. Index properties and classification of soils. Weight-volume relation- ships. Soil structures. Moisture-density relation- ships. Hydraulic soil properties and permeability. Principle of total and effective stresses. Stress distribution due to external loads and analysis of total settlements. Outline of theory of consolidation. Shear strength of soil.

CIV311 Finite Element Method

2 Cr. Hrs. = (*2* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite **MAT211**

Direct perturbation method in deriving stiffness matrix. Assemblage of stiffness matrices of discrete elements and minimum matrix band width. A-Method in deriving element shape functions. Different stress-strain relationships (. D, plane stress, and plane strain). Lagrangian method in deriving elements shape functions. Energy approach in deriving stiffness matrix. Application of energy method in deriving stiffness matrix for multi-node truss and beam element. Application of energy method in deriving stiffness matrix for Plane stress and plane strain element. Applications using computer software.

CIV312 Concrete Structures Design (2)

3 Cr. Hrs. = (*3* LCT + *0* TUT + *1* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **CIV113**

Design of reinforced concrete slabs: solid slabs, ribbed slabs, panelled beams slab, flat slabs (beamless slabs), stairs; Design of sections under eccentric forces; Characteristics of interaction curves and their application in design; Design and reinforcement details of concrete slender columns. Design of reinforced concrete frames. Types and details of joints in RC structures.

CIV318 Sustainability of Construction and Building Physics

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

The basic concepts of sustainability and sustainable construction, Development of international and local regulations in the area of sustainability, The different rating systems of construction sustainability. Causes and defects of climate change, the different techniques to approach energy-efficient and energy-saving constructions applying the concepts of building physics. Assessment and analysis techniques and the use of specifications as well as service life models for building materials, components and assemblies.

CIV321 Ground Improvement

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Geotechnical problems with soft and loose soils, Soil improvement techniques. Mechanical stabilization densification: Deep and shallow compaction, Techniques, Compaction equipment, In-situ soil parameters after densification. Preloading: Consolidation analysis, Preloading with and without drains. Design and construction of soil reinforcement: History of soil reinforcement, Reinforcing materials, Physical and mechanical properties, Utilization methods, Advantages and limitations, and construction techniques, Analysis and design of reinforced embankments constructed on soft soils, Analysis and design of reinforced earth walls. Grouting: types, properties, and techniques. Criterion for choosing suitable technique for soil improvement.

CIV331 Surveying (2)

3 Cr. Hrs. = (**2** LCT + **2** TUT + **2** LAB + **0** OTH) – SWL = **180** – ECTS = **6**

Prerequisite **CIV131**

Introduction to vertical control, different methods for height difference determination, ordinary levelling, survey level and survey staff, Calculation of ordinary levelling, Precise level, Calculations of precise levelling, Indirect methods for height difference determination, Tachometry, Trigonometric levelling, Earth curvature and refraction and their effects on height differences, applications of levelling, longitudinal levelling, cross section levelling, grid levelling, contour lines, topographic maps, volume computations and earth work.

CIV391 Field Project

3 Cr. Hrs. = (**1** LCT + **0** TUT + **6** LAB + **0** OTH) – SWL = **195** – ECTS = **6**

Prerequisite **- - -**

The project is to be completed within the student's junior year. The student is requested to consider a simple engineering problem that is civil engineering related. The student should analyze the problem and find a systematic approach towards solving the problem. Practical work to achieve the goals are accomplished, the stages and results are analyzed. By the end the student is requested to submit a technical report and make an oral presentation to persuade the audience of his approach.

CIV415 Programming in Structural Analysis

3 Cr. Hrs. = (**3** LCT + **1** TUT + **0** LAB + **0** OTH) – SWL = **150** – ECTS = **6**

Prerequisite **- - -**

higher-level Theory of Structures. Emphasis is placed upon students gaining a real understanding of elementary plastic theory of structures with application for slab analysis and design; dynamics of structures; stability of structural elements and structural systems. The topics are linked to requirements of Australian Standards. The course also revises the most common software used in the workforce for Advanced Structural Analysis.

CIV431 Problematic Soil and Rock Mechanics

3 Cr. Hrs. = (**3** LCT + **1** TUT + **1** LAB + **0** OTH) – SWL = **165** – ECTS = **6**

Prerequisite **- - -**

Definition and Subject of the Discipline. Nature of the discipline and interdisciplinary connections. Discontinuity and granularity. Multicomponent structure. Mechanical Models of Rocks and Soils. Description of the models. The concepts of rheology of a continuum. The model of an elastic body. Linear rheological models. Piecewise linear models. Terzaghi's hydrodynamic model. Discrete model for rocks and soils. Shear resistance of soils. Properties of Rocks and Soils. Physical properties of rocks. Physical properties of soils. Rheological properties of rocks. Rheological parameters of soils. The properties of frozen soils. Viscoelasticity in Soil and Rock Mechanics. Distribution of stresses in the substratum. Deformations of the substratum and slopes. The in-situ state of a rock mass. Excavations in a rock stratum. Problems associated with drilling. Discrete models of rock strata. Groundwater Flow. Equations of groundwater movement. Two-dimensional groundwater flow problem. Some practical problems. Seepage in scarps and slopes. Drainage of the ground and excavations. Water flow in rock strata. Outline of the Theory of Consolidation of Porous Deformable Media. Brief outline of the history of the theory of consolidation. Quasi-stationary problems. Dynamic problems of the theory of consolidation. Thermo-consolidation. Plasticity and Limit States. Constitutive relations for elastic-plastic models of rocks and

soils. The limit state conditions. Limit analysis. Examples of application of approximate methods. The method of characteristics. Mechanics of the Clay Fraction. Data and assumption. Physical fundamentals. Clay particles and ground water. The primary structure of the clay-water fluid. Movements of a structure element. Action of isotropic pressure (consolidation). Action of the stress deviator. Rheological models of primary clay. Structural changes of clay-water fluid. The oriented clay-water fluid. Clayey soils. Creep in clayey soils.

CIV441 Cost Estimation and Project Control

2 Cr. Hrs. = (*2* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Prestressed concrete concepts. Prestressing losses. Statically determinate prestressed structures. Design of end anchorage zone. Limit state of flexure and shear. Statically indeterminate prestressed structures. Bridge loading and load combinations. Bridge planning and systems. Design of concrete box-girder bridges. Basics of precast concrete.

CIV442 Management of Project Resources

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Introduction to project procurement management, project resources management; critical project resources, material management: planning& control; Procurement& acquisition costs; resources management information systems; inventory analysis, inventory factors. Resources allocation and leveling.

CIV443 Insulation Works

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

traditional, state-of-the-art and possible future thermal building insulation materials, with respect to properties, requirements and possibilities. Basic thermal transport properties are treated, including solid state, gas, radiation and convection conductance. The advantages and disadvantages of the miscellaneous building insulation materials and solutions are discussed. Examples of insulation materials are mineral wool, expanded polystyrene, extruded polystyrene, polyurethane, vacuum insulation panels, gas insulation panels, aerogels, and future possibilities like vacuum insulation materials, Nano insulation materials and dynamic insulation materials. Various properties, requirements and possibilities are compared and studied. Among these are thermal conductivity, perforation vulnerability, building site adaptability and cuttability, mechanical strength, fire protection, fume emission during fire, robustness, climate ageing durability, resistance towards freezing/thawing cycles, water resistance, costs and environmental impact.

CIV454 Sustainable Development

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

Cracking limit state; Design of Water tanks: design of sections, elevated, ground and underground tanks, circular and rectangular tanks, calculation of internal forces. Design and reinforcement details of corbels and deep beams. Lateral resistance of buildings: earthquake and wind. Design and detailing of shear walls and RC cores. Introduction of Prestressed concrete structures.

CIV455 Control of Industrial Pollution

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

Causes of deterioration of concrete structures – Evaluation of concrete structures – Repair and strengthening materials (types, selection and testing) – Bond between repair and strengthening materials and substrate concrete – Different repair and strengthening techniques – Protection and maintenance of concrete structures – Repair and strengthening of different concrete elements (footing – column – beam – slab …. etc.) – Structural analysis of repair and strengthening – Design of repair and strengthening – Case studies.

CIV461 Risk and Safety Management

3 Cr. Hrs. = (*3* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Introduction to project risk management, Introduction to advanced concept of the systematic process of identifying, analyzing, and responding to risk and safety management of construction projects. Risk management during construction project life, risk analysis, risk evaluation, risk assessment, risk prevention in construction projects, Safety and health considerations on construction project, safety regulations and safety management. Environmental Risk Assessment Methodology, Environmental Impact Assessment Environmental Health Risk Assessment. National and International regulations.

CIV462 Legal and Contracts Issues in Construction Projects

2 Cr. Hrs. = (*2* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

-Methods of contractors' selection, tender types. Construction contracts basics and definitions. Types of construction contracts; cost-based contracts and Price given in advance contracts. Legal Aspects of Construction Projects "Egyptian Law", Legal Aspects of Construction Projects "FIDIC". Construction Claims; Definition & Classification, Generation and Procedure of Claims, Claim categories. Dispute resolution techniques; Mediation, Conciliation, Adjudication, Arbitration, Litigation … etc.

CIV491 Graduation Project 1

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite *- - -*

Identification of a real-life problem related to the program in general and the concentration in specific, Setting the overall objectives of the project and specific objectives of Project (Collecting data from the field, market and/or literature, proposing engineering solutions, developing conceptual ideas/designs, conducting preliminary analyses, comparing different ideas based on technical aspects, Selection of the solution approach.

CIV492 Graduation Project 2

3 Cr. Hrs. = (***1*** LCT + ***0*** TUT + ***6*** LAB + ***0*** OTH) – SWL = ***195*** – ECTS = ***6***

Prerequisite **- - -**

This graduation project may be seen as a continuation of the first part (CIV 491: Graduation Project) of a major topic, or it might be a new subject that the student is considering proving his competence in materials engineering practice.

Department of Chemical Engineering

CHG231 Separation Processes

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **CHG132**

Fundamentals of vapour-liquid equilibrium, Flash distillation, Continuous distillation and the McCabe-Thiele construction, including consideration of (the feed line, the reflux ratio, non-ideal systems), Batch distillation, Plate distillation column design, Absorption and stripping of dilute mixture in plate columns, Liquid-liquid extraction, • Fundamentals of interfacial mass transfer, Absorption and stripping of dilute mixture in packed columns, Design of packed columns.

CHG232 Chemistry of Petrochemical Processes

4 Cr. Hrs. = (*3* LCT + *2* TUT + *1* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **CHE221**

fundamental topics of mass/mole balances, thermodynamics, chemical kinetics, and transport phenomena in quantitative fashion through the use of advanced mathematical concepts.

CHG251 Chemical Products Design and Development

3 Cr. Hrs. = (*3* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

Chemical Products. What are chemical products – examples: ball point pen ink, incandescent light bulb. Key importance of physical properties. Physical property categories checklist. Physical Properties. Molecular size and shape. Dispersive forces, polarity, hydrogen bonding. Property estimation. Gases, liquids, solids. Crystal growth and shapes. Multiphase systems – foams, emulsions, suspensions. Designing Volumetric Behavior. Density, volume, thermal expansion, compressibility, volume change on phase change. Effect of temperature, pressure and concentration. Ideal gas law – compressed air propellant for shaving cream can bag-on-valve. Volume change during shipping – temperature in the back of a truck. Stokes' law – stable multiphase products from equal densities, high viscosity or small radii. Compressibility of liquids – hydraulic fluids, Pascal's law. Poiseuille's equation – fluid movement. Volume change upon freezing and melting – bursting pipes. Thermal expansion of solids in contact with each other. Designing Thermal Behavior. Heat capacity – effect of temperature. Absorptivity and emissivity – temperature of the Earth. Heat of vaporization – cooling of an aerosol can. Insulation – thermal conductivity of multiphase systems. Heat transfer – cold packaging, heat transfer fluids. Combustion – fuels. Heat perception – counter irritants. Designing Phase Equilibrium Behavior. Phase diagram – solid, liquid, vapor, supercritical. Water activity – microbial activity. Vapor-liquid equilibria – shaving cream propellants, azeotropes. Solid-liquid equilibria – freezing point depressants. Solubility parameter model. Solvent selection. Evaporation and drying – hand sanitizer, fragrance fixatives. Designing Rheological Behavior. Viscosity – flow of fluids. Non-Newtonian behavior – shear thinning, shear thickening. Power law fluids – anti-icing fluids. Thickeners – polymers, gums. Stokes' law again – skin feel. Squeeze flow – fluids between solid surfaces, lubricants. Effect of temperature – viscosity index improvers. Designing Interfacial Behavior. Surface tension – pure liquids and mixtures. Creating surfaces – bubbles, drops, nucleation. Young's equation – contact angles, wetting and spreading. Zisman plots – critical surface tension for

wetting. Kelvin equation – phase behavior and curved surfaces. Ostwald Ripening – activity, pressure and concentration. Capillary rise – ink on paper. Interfacial tension – behavior of detergents. Surfactants – molecular structure, general behavior. Critical micelle concentration – effectiveness, efficiency. HLB – surfactant selection. Packing parameter – structure formation. Designing Sensory Behavior. Taste – bittering agents, flavoring chemicals. Smell – odor threshold, perfume notes, odorants. Sound – speed of sound, Hertzian impact. Perception – human sight, human touch. Human strength - grip, finger. Designing Optical Behavior. Electromagnetic spectrum – visible light, colors. Light and chemicals – reflection, refraction, transmission, absorption. Invisible light – optical brighteners, infrared reflective coatings. Ultraviolet – skin protection, chemical reactions. Chromophores – electronic transitions. Effect of pH – indicators. Colorants – pigments, dyes. Inks, paints, cosmetics. Sources – carmine. William Henry Perkin. Designing for Environmental, Health and Safety. Toxicity – concentration not chemical, LD50, LC50. Dose-response curves. Degradation in the environment – branching, biodegradability rules. ThOD – theoretical oxygen demand. Flammability – combustion, flash points, mixtures. Flame retardant additives. Designing for Reactivity. Reactivity – with oxygen, light, water. Autooxidation – free radical formation. Preservatives – antimicrobials, free radical scavengers. Corrosion – chemical reactions, electrochemistry. Corrosion inhibitors. Designing for Mechanical Behavior. Applied forces – compression, tension, torsion. Deformation – stress, strain, modulus. Stress-strain curves – strength, yield, fracture. Metals, plastics, elastomers, glasses. Reinforcements – glass fibers, carbon fibers. Composite materials. Designing for Electromagnetic Behavior. Electricity – flow of electrons. Conductors, insulators, semiconductors. Conductivity – metals, polymers. Flow of ions – batteries.

CHG271 Applied Chemistry

3 Cr. Hrs. = (***3*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite ***- - -***

Physical chemistry: Gases, Liquids, Solids. Thermochemistry, Thermodynamics, Solutions, Ionic equilibrium, Electrochemistry. Applied chemistry: Corrosion of metals, Alloys, Water chemistry and treatment, Chemistry of cements, Chemistry of polymers, Fuels and Combustion, Environmental pollution and its control.

CHG352 Environment and Safety Management/P

2 Cr. Hrs. = (***2*** LCT + ***0*** TUT + ***0*** LAB + ***0*** OTH) – SWL = ***90*** – ECTS = ***4***

Prerequisite ***- - -***

Understand in detail about Environment, Health & Safety (EHS) Management. Explain the Objectives of Environment, Health & Safety Management. Describe the Types of EHS Management Plan. Explain about the Elements of EHS Management. Explain the Types of EHS Inspections. Describe the Strategies for EHS Management. Explain in detail about the EHS Management Process. Explain Ways of Effective EHS Program.

CHG353 Fuel Processing

3 Cr. Hrs. = (***3*** LCT + ***0*** TUT + ***2*** LAB + ***0*** OTH) – SWL = ***165*** – ECTS = ***6***

Prerequisite ***- - -***

equipment and processes primarily focused on the handling of fuel and its associated liquids. Main topics covered include fundamentals, fuel characterization, phase behavior, vapor-liquid equilibrium, basic thermodynamics, and water-hydrocarbon behavior, as well as all the key equipment to process fuel.

CHG357 Advanced Reaction Engineering

3 Cr. Hrs. = (*3* LCT + *0* TUT + *2* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

chemical kinetics and transport phenomena, review of elements of reaction kinetics, rate processes in heterogeneous reacting systems, design of fluid-fluid and fluid-solid reactors, scale-up and stability of chemical reactors and residence time analysis of heterogeneous chemical reactors.

CHG370 Environmental Chemistry

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite CHE221

Teaching and Learning Methods.

CHG371 Renewable Energy Resources Interfacing

2 Cr. Hrs. = (*2* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *135* – ECTS = *4*

Prerequisite - - -

society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, and hydro.

CHG391 Industrial Project

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite - - -

The project is to be completed within the student's junior year. The student is requested to consider a simple engineering problem that is materials engineering related. The student should analyze the problem and find a systematic approach towards solving the problem. Practical work to achieve the goals are accomplished, the stages and results are analyzed. By the end the student is requested to submit a technical report and make an oral presentation to persuade the audience of his approach.

CHG421 Reservoir Simulation

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite - - -

"Buckley Leverett displacement. One dimensional water oil displacement. Model components, types, and modern gridding methods. Two dimensional displacement. Grid orientation and refinement. Routine and special core analysis. Single phase up-scaling of geo-cellular model parameters".

CHG422 Petroleum Economics

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

"Cash Flow Components and Economic Indicators. Upstream Petroleum Economics. Midstream and Downstream Petroleum Economics. Managing and Mitigating Uncertainty and Risk. Sensitivities, Simulations and Decision Analysis. Valuing Petroleum Assets, Portfolios and Companies.

CHG454 Project Planning and Management

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Recommended processes, tools and techniques, oil and gas project management case studies, class exercises, team working, production of business case and project plan, video, presentation and rapid response assessment based on a situational analysis.

CHG455 Instrumentation and Process Control

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

application, hardware, installation, and performance of process measurement instrumentation and control valves.

CHG456 Material Synthesis and Characterization

3 Cr. Hrs. = (*3* LCT + *1* TUT + *1* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

Introduction to feedback control systems. Characteristics of closed loop systems. Advantages and disadvantages of feedback. Obtainment of transfer functions along with illustrative examples. Block diagram reduction. Signal flow graphs. Sensitivity to parameter variation. Performance of control systems. Standard test signals. Time response of first and second order systems and response specs. Identifications of systems from time response. Static error analysis. Classical controllers P, PI, PD, PID. Routh - Method for stability analysis. Root locus. Frequency response. Identifications of systems from frequency response. Design of PID controllers and compensators. State space representation in canonical forms. State feedback gain matrix design method. Observability and controllability analysis.

CHG457 Petroleum Refinery Engineering

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite *- - -*

Oil Refineryis concerned with the study of crude oil refining, natural separation methods, distillation, absorption, cracking, coking, waxes, improvement, fuel, lubricants, flow sheets, plant design, and economics.

CHG458 Principles of Enhanced Oil Recovery

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite *- - -*

fundamentals of miscible, chemical and thermal oil recovery methods. Enhanced Oil Recovery (EOR) projects are usually handled by multidisciplinary teams. This course targets technical staff not involved in detailed engineering design and non-technical staff involved in the legal, financial and decision-making aspects of EOR projects.

CHG474 Biomass

3 Cr. Hrs. = (*2* LCT + *2* TUT + *2* LAB + *0* OTH) – SWL = *180* – ECTS = *6*

Prerequisite *- - -*

Biomass fiber morphology, cellulose, hemicellulose and lignin chemistry and their chemical analyses. It also covers biomass pretreatment/fractionation, enzymatic hydrolysis of lignocellulose and biochemical conversion of hydrolysate to ethanol or butanol.

CHG491 Graduation Project 1

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **- - -**

Under supervision, the student should approach his graduation project within his Senior year. The purpose of this graduation project is to provide students with an opportunity to engage in an activity that will allow them to demonstrate their ability to apply the knowledge and skills they have gained throughout their years in the educational system. The project is designed to ensure that students are able to apply, analyses, synthesize, and evaluate information and to communicate significant knowledge and understanding. Problems/ topics to be considered should be materials engineering oriented, in any of the related disciplines offered by the faculty.

CHG492 Graduation Project 2

3 Cr. Hrs. = (*1* LCT + *0* TUT + *6* LAB + *0* OTH) – SWL = *195* – ECTS = *6*

Prerequisite **CHG491**

This graduation project may be seen as a continuation of the first part (MEC 491: Graduation Project) of a major topic, or it might be a new subject that the student is considering proving his competence in materials engineering practice.

Department of Architecture Engineering

ARC010 Introduction to History of Art and Architecture

2 Cr. Hrs. = (*2* LCT + *0* TUT + *0* LAB + *0* OTH) – SWL = *90* – ECTS = *4*

Prerequisite - - -

The course is an introduction to art and Architecture from Pre-Historical periods to the modern times in the East and the West. It explains how art and architecture have developed through different cultures, religious beliefs, aesthetic values, and behavioral patterns. Overview of world art and architecture - Ancient Egyptian history of art and architecture - Greek and Roman history of art and architecture - Early Christian history of art and architecture in the West - Romanesque and Gothic history of art and architecture- Renaissance and Baroque history of art and architecture - Byzantine- Coptic history of art and architecture - Islamic history of art and architecture - 20th century history of art and architecture - Modern Art - Modern architecture - Modern Egyptian history of art and architect.

ARC111 Visual Perception, Art and Design

3 Cr. Hrs. = (*1* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite - - -

This course introduces the students to the fundamentals of Architectural Design as well as the scope and vocabulary of architecture. Also, the course presents the career range of architects and the role of the architect in the community. It aims to prepare students with all the basic knowledge & skills they need to be able to deal with the design process. The course introduces the generic issues that influence and shape architectural design, and aims at developing the skills to address them. The studio focuses on such elements as tectonics, design method and representation, human scale, space, form and light, function, place and time.

ARC121 Architectural Studio 1

4 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

This course introduces the students to the fundamentals of Architectural Design as well as the scope and vocabulary of architecture. Also, the course presents the career range of architects and the role of the architect in the community. It aims to prepare students with all the basic knowledge & skills they need to be able to deal with the design process. The course introduces the generic issues that influence and shape architectural design, and aims at developing the skills to address them. The studio focuses on such elements as tectonics, design method and representation, human scale, space, form and light, function, place and time.

ARC131 History and Theory of Ancient Architecture

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite SPD 111

The course focuses on studying the factors and features for Mesopotamian Architecture, Ancient Egyptian Architecture, Greek Architecture - Roman Architecture – Lessons Learned from History (Programming of Building Types – building Systems and Techniques-

Design Elements and Geometry). The course works both chronologically as a history of phases and styles, and methodologically, examining the contextual issues that give each period a distinctive architecture. Students will learn to understand and make critical judgments on buildings and be ready for more specialized studies in the history of architecture.

ARC132 History and Theory of Medieval Architecture

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **ARC142**

Early Christian, Byzantine, Romanesque, Gothic, Renaissance, Baroque, Rococo, and till the Industrial Revolution. As well as identify, analyze, compare and judge the formulation and preprogramming of building types, various architectural elements and styles, building material and constructions techniques, vernacular aspects embodied and associated arts. Special emphasis is put on Coptic (Egyptian) Architecture.

ARC141 Introduction to Building Systems

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite **- - -**

Environment and human needs. Construction methods: Masonry, Concrete, Timber, Steel, building elements: walls, openings, floors, roofs. Introduction to Climate-responsive design, Lighting, Acoustics and Ventilation.

ARC212 Interior Design and Modern Art

3 Cr. Hrs. = (*1* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite **- - -**

This course is meant to direct the students throughout the process of design starting from deriving the concept and reaching to fully developed multi-layered design allowing students understand the different aspects incorporated with the design process covering Utilitarian, Structural, Socio-cultural, Environmental and Economic aspects. Also, the course aims to train the students to effectively use various illustration media to express their work and express themselves including manual, digital, and mixed media as well as the written word.

ARC222 Architectural Studio 2

4 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **- - -**

This course is meant to direct the students throughout the process of design starting from deriving the concept and reaching to fully developed multi-layered design allowing students understand the different aspects incorporated with the design process covering Utilitarian, Structural, Socio-cultural, Environmental and Economic aspects. Also, the course aims to train the students to effectively use various illustration media to express their work and express themselves including manual, digital, and mixed media as well as the written word.

ARC223 Architectural Studio 3

4 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite **- - -**

This course focuses on the ways in which the nature of the structural system, method of construction and building materials affect and inform the process of design and the final form. By means of experimental physical models, students should be able to select building materials and methods of appropriate physical/formal characteristics to create an iconic building. This course encourages to develop a project with a comprehensive approach to programmatic organization, energy load

considerations, building material assemblies, exterior envelope and structure systems.

ARC233 History of Islamic Architecture

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Critical review of literature of Islamic architecture and analyzes its historical and theoretical frameworks. Challenges the tacit assumptions and biases of standard studies of Islamic architecture and addresses historiographic and critical questions concerning how knowledge of a field is defined, produced and reproduced.

ARC234 Theory and Criticism of Modern and Contemporary Architecture

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite ARC244

Re-interpreting Historical Traditions- The Modern Movement and Anti-Ornament- New Responses to Site- New Technique, Materials and Visions- Organic Design Approaches- The Purpose of Manifestos- The Responsibility for Housing- Industry and Commerce- Modernism Outside of Europe- Critique of Modernism - The Rise of Post-modern Theory 1969–1979 - Pluralism of Thought – the 1980s- Millennial Excursions - 1990s and beyond the new millennium.

ARC235 History and Theory of City Planning

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Introduction to plumbing systems, hygienic facilities design, piping installations placing. Plan procedures, drawing, structure of water systems and interpretation. Plumbing fixtures, traps, sanitary draw-of taps and flushing devices. disposal of wastewaters from buildings, hydraulic as applied to plumbing, materials for drainage elements. Sanitary & storm water drainage systems. Backflow prevention, building sewers. Statutory and private water supplies, pressure boosting, pressure reducing. Protection of potable water supply, thermal insulations, equipment for fire-water supply, water service pipes. General principles of natural gas supplies, requirements for gas appliances placing. Gas installation for buildings, gas service pipes….

ARC242 Sanitary Installations

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Introduction to plumbing systems, hygienic facilities design, piping installations placing. Plan procedures, drawing, structure of water systems and interpretation. Plumbing fixtures, traps, sanitary draw-of taps and flushing devices. disposal of wastewaters from buildings, hydraulic as applied to plumbing, materials for drainage elements. Sanitary & storm water drainage systems. Backflow prevention, building sewers. Statutory and private water supplies, pressure boosting, pressure reducing. Protection of potable water supply, thermal insulations, equipment for fire-water supply, water service pipes. General principles of natural gas supplies, requirements for gas appliances placing. Gas installation for buildings, gas service pipes….

ARC271 Introduction to Urban Design

3 Cr. Hrs. = (*1* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ARC012

The course provides an overview of the design of urban areas. Students learn theories and principles of urban design and issues concerning

process and practices. the physical and social structure of cities, models of urban form analysis, city and urban design, contemporary theories of urban design, suburbs, and metropolitan areas, implementation strategies, urban problems, projects analyzing the evolution of urban place, factors of high-quality urban design and development.

ARC272 Landscape Architecture

3 Cr. Hrs. = (*1* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

Form and space generation in landscape architecture. Elements of Landscape Architecture. The integration of both the building and the environment through the theories and principles of landscape design. Students with an in-depth understanding of how the two disciplines can be combined to produce integrated sustainable solutions. This is followed by the theoretical and historical backgrounds of landscape studies, site analysis plant materials and landscape elements.

ARC325 Environmental Design Studio 1

3 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ARC216 - ARC274

This course is a practical application of the environmental design elements that the students studied in the Environmental Studies course. The development of architectural concept, character and language is of particular importance. Course material combined with an understanding of appropriate environmental systems is a must. Environmental awareness and sustainability are studied and addressed throughout the course and within given projects.

ARC326 Environmental Design Studio 2

3 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite ARC321

This course is a practical application of the environmental design elements that the students studied in the Environmental Studies course. The development of architectural concept, character and language is of particular importance. Course material combined with an understanding of appropriate environmental systems is a must. Environmental awareness and sustainability are studied and addressed throughout the course and within given projects.

ARC335 20Th Century Egyptian Architecture andArts

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite *- - -*

The course introduces students to the importance of culture and heritage in architectural design and development process. It develops students' analytical and descriptive skills in order to understand the meaning and significance of Human Heritage as a product of Culture and Civilization, with special reference to Egyptian Architectural Heritage.

ARC336 Architecture, Culture and Heritage

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

The course introduces students to the importance of culture and heritage in architectural design and development process. It develops students' analytical and descriptive skills in order to understand the meaning and significance of Human Heritage as a product of Culture and Civilization, with special reference to Egyptian Architectural Heritage.

ARC343 Working Drawing Studio 1

4 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

Lighting principles for different uses. Lighting fixtures and fixations, Moist air properties and conditioning processes. Air-conditioning systems. Indoor and outdoor design conditions (Indoor air quality, thermal, comfort, and weather data. Space air diffusion and duct design. Heat transmission in building structures. Solar radiation. Infiltration and ventilation. Cooling/heating load calculations. Building energy calculations.

ARC344 Working Drawing Studio 2

4 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite - - -

Lighting principles for different uses. Lighting fixtures and fixations, Moist air properties and conditioning processes. Air-conditioning systems. Indoor and outdoor design conditions (Indoor air quality, thermal, comfort, and weather data. Space air diffusion and duct design. Heat transmission in building structures. Solar radiation. Infiltration and ventilation. Cooling/heating load calculations. Building energy calculations.

ARC355 Illumination and Ventilation in Buildings

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Lighting principles for different uses. Lighting fixtures and fixations, Moist air properties and conditioning processes. Air-conditioning systems. Indoor and outdoor design conditions (Indoor air quality, thermal, comfort, and weather data. Space air diffusion and duct design. Heat transmission in building structures. Solar radiation. Infiltration and ventilation. Cooling/heating load calculations. Building energy calculations.

ARC356 Architectural Acoustics

2 Cr. Hrs. = (*1* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite - - -

Leadership strategies in the professional practice of architecture, how architecture fits among associated professionals and the opportunities for professional engagement relative to the encapsulated expertise of an architectural office. Key learning topics include the architect's skill set, non-traditional creative uses of the architect's skill set, the leading edge of traditional practice, virtual building technologies and their relationship to practice. Types of architecture firms. Design process management. Business management of architecture firms. Procurement of architectural services. Architects' administrative role. Architecture practice stakeholders. Building contracts and legal aspects. Building codes. Introduction to real-estate investment concepts. Applications on design projects.

ARC373 Urban Planning

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Leadership strategies in the professional practice of architecture, how architecture fits among associated professionals and the opportunities for professional engagement relative to the encapsulated expertise of an architectural office. Key learning topics include the architect's skill set, non-traditional creative uses of the architect's skill set, the leading edge of traditional practice, virtual building technologies and their relationship to practice. Types of architecture firms. Design process

management. Business management of architecture firms. Procurement of architectural services. Architects' administrative role. Architecture practice stakeholders. Building contracts and legal aspects. Building codes. Introduction to real-estate investment concepts. Applications on design projects.

ARC375 Community DevelopmentandParticipatory Design

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

Leadership strategies in the professional practice of architecture, how architecture fits among associated professionals and the opportunities for professional engagement relative to the encapsulated expertise of an architectural office. Key learning topics include the architect's skill set, non-traditional creative uses of the architect's skill set, the leading edge of traditional practice, virtual building technologies and their relationship to practice. Types of architecture firms. Design process management. Business management of architecture firms. Procurement of architectural services. Architects' administrative role. Architecture practice stakeholders. Building contracts and legal aspects. Building codes. Introduction to real-estate investment concepts. Applications on design projects.

ARC381 Professional Practice and Legislations

2 Cr. Hrs. = (*2* LCT + *1* TUT + *0* LAB + *0* OTH) – SWL = *105* – ECTS = *4*

Prerequisite ARC483

Leadership strategies in the professional practice of architecture, how architecture fits among associated professionals and the opportunities for professional engagement relative to the encapsulated expertise of an architectural office. Key learning topics include the architect's skill set, non-traditional creative uses of the architect's skill set, the leading edge of traditional practice, virtual building technologies and their relationship to practice. Types of architecture firms. Design process management. Business management of architecture firms. Procurement of architectural services. Architects' administrative role. Architecture practice stakeholders. Building contracts and legal aspects. Building codes. Introduction to real-estate investment concepts. Applications on design projects.

ARC382 Building Economics and Cost Benefit Analysis

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite - - -

This course is a practical application of the environmental and technological design elements that the students studied in the Environmental Studies and building technologies courses. The development of architectural concept, character and language is of particular importance. Course material combined with an understanding of appropriate environmental and technological systems. Environmental awareness and sustainability are studied and addressed throughout the course and within given projects. Smart systems applications in design.

ARC427 Environmental Design and Technology Studio

4 Cr. Hrs. = (*2* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *210* – ECTS = *8*

Prerequisite ARC322A - RC343

This course is a practical application of the environmental and technological design elements that the students studied in the Environmental Studies and building technologies courses. The development of architectural concept, character and language is of particular importance. Course material combined with an understanding of appropriate environmental and technological systems. Environmental

awareness and sustainability are studied and addressed throughout the course and within given projects. Smart systems applications in design.

ARC437 Documentation of Heritage Buildings

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Concepts, heritage and practices, analyzing historic buildings, public history meaning and value, community activism.

ARC438 Heritage Management

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Concepts, heritage and practices, analyzing historic buildings, public history meaning and value, community activism.

ARC439 Restoratio and Upgrading of Heritage Buildings

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC458 Feasibility Studies and Project Management

3 Cr. Hrs. = (*1* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC474 Housing

3 Cr. Hrs. = (*1* LCT + *4* TUT + *0* LAB + *0* OTH) – SWL = *165* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC476 Sustainable Urbanism

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC477 Urban Sociology

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC478 Sustainable Landscape

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC483 Real Estate Marketing

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

Strategic marketing planning, action planning, developing and promoting effective content marketing. Specific techniques of branding, testing, analytics and attribution.

ARC484 Advanced Building Systems

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

The studio content is a comprehensive one. It challenges the students' ability to produce comprehensive projects that demonstrates each student's capacity to make design decisions across the different scales of expertise gained throughout their five years of education.

ARC485 Applications of Gis

3 Cr. Hrs. = (*2* LCT + *2* TUT + *0* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite *- - -*

The studio content is a comprehensive one. It challenges the students' ability to produce comprehensive projects that demonstrates each student's capacity to make design decisions across the different scales of expertise gained throughout their five years of education.

ARC491 Graduation Project 1

3 Cr. Hrs. = (*1* LCT + *2* TUT + *3* LAB + *0* OTH) – SWL = *150* – ECTS = *6*

Prerequisite ARC391, ARC492

The studio content is a comprehensive one. It challenges the students' ability to produce comprehensive projects that demonstrates each student's capacity to make design decisions across the different scales of expertise gained throughout their five years of education.

ARC492 Graduation Project 2

4 Cr. Hrs. = (*2* LCT + *3* TUT + *3* LAB + *1* OTH) – SWL = *225* – ECTS = *8*

Prerequisite ARC484ARC494

All students undertake a major project as part of the program. The aim of the project is to provide the students, who work in groups, with an opportunity to implement the appropriate concepts and techniques to a particular design in the field of environmental architecture & building technology.