**Sustainability courses**

**College:** Engineering and Technology

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| **Department:** Sustainable Energy Engineering |
| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) |
| **12210441** | **Thermodynamics and Power Technology** | **3** | **environmental, cultural** |
| **12150310** | **Sustainable Energy Technology (1)**  | **3** | **social, environmental, cultural, economic** |
| **12150311** | **Sustainable Energy Technology (1) Lab.**  | **1** | **social, environmental, cultural, economic** |
| **12150410** | **Sustainable Energy Technology (2)**  | **3** | **social, environmental, cultural, economic** |
| **12150411** | **Sustainable Energy Technology (2) Lab.**  | **1** | **social, environmental, cultural, economic** |
| **12150420** | **Energy Audit, Management and Conservation**  | **3** | **social, environmental, cultural, economic** |
| **12150510** | **Computer Applications for Renewable Energy** | **3** | **social, environmental, cultural, economic** |
| **12150520** | **Energy Storage Systems** | **3** | **social, environmental, cultural, economic** |
| **12150430** | **Energy and Environmental Technology** | **3** | **social, environmental, cultural, economic** |
| **12110535** | **Power Plant Engineering** | **3** | **social, cultural, economic** |
| **12150530** | **Special Topics in Sustainable and Renewable Energy** | **3** | **social, environmental, cultural, economic** |
| **12150531** | **Smart-Grid Power Systems**  | **3** | **social, environmental, cultural, economic** |
| **12150540** | **Energy Policy** | **3** | **social, cultural, economic** |
| **12150541** | **Sustainability in Energy, Water and Food** | **3** | **social, cultural, economic** |
| **12150532** | **Alternative Fuel Sources**  | **3** | **social, environmental, cultural, economic** |
| **12150533** | **Sustainable Buildings and Systems** | **3** | **social, environmental, cultural, economic** |
| **12150534** | **Geothermal and Hydropower Systems** | **3** | **social, environmental, cultural, economic** |
| **12150535** | **Fuel Cell & Hydrogen Production Technology** | **3** | **social, environmental, cultural, economic** |
| **12150536** | **Bio-Energy Technology**  | **3** | **social, environmental, cultural, economic** |
| **12210591** | **Automotive Electronics and Electricity**  | **3** | **social, environmental, cultural, economic** |
| **12210549** | **Heating , Ventilation and Air Conditioning and Refrigeration (HVAC) Systems** | **3** | **social, environmental, cultural, economic** |
| **12110318** | **Electrical Power Systems (1)** | **3** | **social, economic** |
| **12110423** | **Electrical Power Systems (2)** | **3** | **social, economic** |

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| **Department:** Sustainable Energy Engineering |
| **Course Descriptions** |
| course number | Course name | C.H | **Course Description** |
| **12210441** | **Thermodynamics and Power Technology** | **3** | Thermodynamics properties: temperature, pressure, entropy etc; Thermodynamic systems: isolated, open and closed systems; Thermodynamic processes: cyclic, reversible, non-reversible, adiabatic, isentropic, throttling, poly tropic processes etc. ; Processes of sublimation, vaporization, condensation and fusion; First and second law of thermodynamics; Energy balances on all major components in the system such as heat exchangers; Heat transfer analysis due to : conduction, convection and radiation ; Heat and power generation technologies, including those based on steam and gas turbine cycles, as well as combined steam and gas cycles. |
| **12150310** | **Sustainable Energy Technology (1)**  | **3** | Introduction to energy systems : conventional and renewable energy resources ; Solar Spectrum, Solar Time and angles, day length, angle of incidence on tilted surface; Sun path diagram; Shadow angle protractor; Solar Radiation ; Extraterrestrial Radiation; Effect of earth atmosphere; Estimation of solar radiation on horizontal and tilted surfaces; Measurement of solar radiation; Solar radiation calculations. Photovoltaic fundamentals; Solar Cell Physics; The Photovoltaic Effect, Dark and illumination characteristics; Figure of merits of solar cell; Efficiency limits; Variation of efficiency with band-gap and temperature; Efficiency measurements; High efficiency cells. Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Types of Solar cells. Solar Cell Fabrication Technology. Solar Photovoltaic System Design; Maximum tracking; Centralized and decentralized SPV systems; Stand alone, hybrid and, grid connected system. The Recent developments in Solar cells, Role of nano-technology in Solar cells. Wind speed analysis; Wind turbine energy, power, torque and speed characteristics. Solar heater systems: Design, amount of heat. |
| **12150311** | **Sustainable Energy Technology (1) Lab.**  | **1** | Solar radiation measurement ; Solar cell characteristics (V\_ I) ; Solar panel connections ; battery charging; PV standalone systems; Grid-connected PV systems; solar tracking systems; Solar stations (Installation, visiting); Solar heating systems |
| **12150410** | **Sustainable Energy Technology (2)**  | **3** | Global, regional and local wind systems; Wind energy conversion principles; Rotor characteristics; Maximum power coefficient; Tip speed ratio; Types and classification of different wind turbines. Power, torque and speed characteristics; Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Wind turbine design considerations; Wind Energy Applications: Wind pumps, wind generators. Hydro power principles; Geothermal energy fundamentals; Biomass Energy; Other technologies for Renewable Energy. Hybrid renewable energy systems. |
| **12150411** | **Sustainable Energy Technology (2) Lab.**  | **1** | Wind speed measurements; Wind turbine characteristics. Hydropower generation; Electrolysis; Fuel cell characteristics; Hybrid system connection; Biogas generation; Hybrid systems |
| **12150420** | **Energy Audit, Management and Conservation**  | **3** | Introduction to energy management ; Assessment of energy consumption ; Techniques for reducing energy consumption ; Energy recovery and management techniques of production and distribution systems ; Incentives and requirements for improving energy efficiency in the residential, commercial, transportation, and industrial sectors ; Methods for energy audit of the industrial and civil installations ;Energy Audit Instruments; Duties and responsibilities of energy auditors ;Energy conservation in boilers, steam turbines and industrial heating systems; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management ; Conservation in : electric motors , compressed air system , HVAC and refrigeration systems , pumps and pumping systems. |
| **12150510** | **Computer Applications for Renewable Energy** | **3** | Simulation software used to design renewable energy systems based on: PV stand alone or grid connected systems, wind systems, hybrid systems with and without diesel generators with and without storage system. Economical evaluation of the system to choose the optimal. |
| **12150520** | **Energy Storage Systems** | **3** | This course is intended to provide students an overview on energy storage schemes/devices with major focus on electrochemical storages including ionic batteries, fuel cells and super-capacitors. The course will cover operating principles, physics behind them, characterization methods and advantages/issues of each scheme. Analysis of thermal storage models; storage materials and heat transfer fluids; Thermal storage applications. |
| **12150430** | **Energy and Environmental Technology** | **3** | Energy production and consumption, with some national statistics; Energy resources, including fossil fuels and Renewable Energy resources; Extraction, conversion, and transmission technologies (e.g., engines, turbines, generators); Environmental impacts of fuel consumption; Some current national and international policies, climate change. Pollution due to thermal power station and their control. Pollution due to nuclear power generation, radioactive waste and its disposal. Effect of hydroelectric power stations on ecology and environment. Effect of Hydro-electric power stations on ecology and environment. Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, acid rain biological damage due to environmental degradation. Technology Assessment / Environmental Audit; Ecological Impact Assessment; Social Impact Assessment; Strategic Impact Assessment; Modeling in EIA and conclude with a Case Study. |
| **12110535** | **Power Plant Engineering** | **3** | Choice of power generation; Load & Load duration curves; Load factor; Diversity factor; Load deviation curve; Load management; Number and size of generating unit; Cost of electrical energy; Tariff-Power factor improvement ; Thermal power stations : types , elements , site selection , Instrumentation and control ; Gas turbine power plant ; Combined cycle power plant ; Principle of cogeneration ; Technical options for cogeneration, Classification of cogeneration systems, Factors influencing cogeneration choice ; Hydropower Plant : Classification, components, turbines- characteristics and their selection ; Nuclear power plant ; Diesel-electric Power Plant. |
| **12150530** | **Special Topics in Sustainable and Renewable Energy** | **3** | Recent topics in sustainable and renewable Energy covered by a visiting professor or a department faculty member |
| **12150531** | **Smart-Grid Power Systems**  | **3** | The course will provide students with a working knowledge of fundamentals, design, analysis and development of Smart Grid. The course offers an introduction to the basic concepts of power systems along with the inherent elements of computational intelligence, communication technology and decision support system. The automation and computational techniques needed to ensure that the Smart Grid guarantees adaptability and capability of handling new systems and components are discussed. The interoperability of different renewable energy sources are included to ensure that there will be minimum changes in the existing legacy system. Standards and requirements needed for designing new devices, systems and products for the Smart Grid are discussed. Power flow analysis and optimization schemes needed for the generation, transmission, distribution, demand response, and reconfiguration is explained in detail and simulation tools such as Matlab and Paladin are used. |
| **12150540** | **Energy Policy** | **3** | Government, corporate, and public perspectives on the analysis, formulation, implementation, and impacts of energy-related policies, regulations, and initiatives. Energy policy development, implementation, and assessment at multiple governmental and corporate scales are also of the topics that covered in this course. The course includes case studies from real-world energy problems and the corresponding actions. This is to provide the student with context for the drivers, frameworks, and assumptions of energy policy. Climate change and its relation with energy policy is one of the topics covered in this course. International agreements, national Legislation including the National Energy Policy Act, and statewide energy legislation will be reviewed in this course. |
| **12150541** | **Sustainability in Energy, Water and Food** | **3** | Interconnections between food, energy, and water with respect to sustainable development. Sustainable energy systems and energy security. Food security and sustainability assessments of food production systems and food consumption patterns. Analysis and discussion concepts of strong and weak sustainability to primary energy supply, agriculture, and water supply. Society development and policies (energy security and emission reductions) are discussed in terms of food, energy and water needs. Natural resources and their impact on energy, food, and water. Qualitative and quantitative indicators for sustainability. Energy, food, and water resources availability and how they can be localized and developed to achieve society needs. Infrastructure requirements and risks related with energy, food, and water. Technological and cultural drivers on energy, food, and water system. Energy efficiency technologies for sustainable agriculture and food processing. Energy in crop production systems. Sustainable energy options in agriculture. |
| **12150532** | **Alternative Fuel Sources**  | **3** | Hydrogen Production Methods: From fossil fuels, electrolysis, thermal decomposition, photochemical, photo catalytic, hybrid; Hydrogen Storage Methods: Metal hydrides, Metallic alloy hydrides, Carbon nano-tubes, Fuel cell basics : Definition, difference between batteries and fuel cells , performance characteristics of fuel cells, efficiency of fuel cell, fuel cell power plant , types of fuel cells . An introduction to hydrocarbon fuels - their availability and effect on environment: Gasoline and Diesel self-ignition characteristics, octane number, cetane number; Alternative fuels: Liquid and gaseous fuels, physico-chemical characteristics; Alternative Liquid Fuels. Fuel composition, Fuel Induction techniques. Biodiesel formulation techniques, application in diesel engines. Compressed Natural Gas components. Hydrogen combustion characteristics. Biogas, Producer gas and their characteristics. |
| **12150533** | **Sustainable Buildings and Systems** | **3** | The fundamentals of conventional energy sources used in buildings; renewable technology; policies and drivers that are leading to the more widespread uptake of low carbon building technologies; low carbon building codes, global policies and planning from the past, present and future. Integrated design: urban microclimate design, passive architectural interventions, active interventions. Low carbon buildings design and operation. |
| **12150534** | **Geothermal and Hydropower Systems** | **3** | Geothermal Systems: Geothermal Exploration Techniques, Drilling Techniques and Logging Methods, Reservoir Physics, Well Test Analysis, Monitoring & Forecasting, Direct and Indirect Use of Geothermal Resources, Visualization and Modeling Techniques, design, sizing, analysis and environmental impacts of geothermal systems (Geothermal Power Plants and its types and Heat pump systems. Hydropower systems: hydropower systems including pico, mini, small and large scale plants. General overview of types of hydropower plants, planning, assessment of hydropower resources, dam design, mechanical and electrical equipment, economic analysis of hydropower plant and the environmental impacts. |
| **12150535** | **Fuel Cell & Hydrogen Production Technology** | **3** | Overview of the various types of fuel cells followed by a detailed discussion of the proton-exchange membrane (PEM) fuel cell fundamentals: thermodynamic relations, kinetics, and overall design and performance characteristics of PEM fuel cells. Hydrogen production technology, hydrogen systems modeling, hydrogen applications, life-Cycle analysis methods, hydrogen production from hydrocarbons, hydrogen delivery and storage systems and safety. |
| **12150536** | **Bio-Energy Technology**  | **3** | Chemistry & Biochemistry of biomass, Biodiesel, Bio-Methane, Bio-Ethanol & Bio-Hydrogen, Bio-Energy Systems, Direct Biomass Combustion & Co-firing Technologies, Gasification & pyrolysis Technologies, Analysis and evaluation of the Biotechnologies and policies and future of Bio-fuels and Bio-Energy. |
| **12210591** | **Automotive Electronics and Electricity**  | **3** | This course covers electronic theory, wiring diagrams, test equipment, and diagnosis, repair, and replacement of electronics, lighting, gauges, horn, wiper, accessories, and body modules. Topics include networking and module communication, circuit construction, wiring diagrams, circuit testing, and troubleshooting, electronic systems including programmable logic controllers, computer-controlled systems such as ignition, steering and automotive power train on-board data networks, telematics, high voltage systems, navigation, collision avoidance systems and electronic accessories. Topics include interpretation of wiring schematics |
| **12210549** | **Heating , Ventilation and Air Conditioning and Refrigeration (HVAC) Systems** | **3** | The first part of the course will deal with the determination of heating and cooling loads and occupants comfort in order to properly size the HVAC systems of a building. Then the preparation of the energy balance of a building according to the technical standards will be dealt with. Finally, the various type of HVAC systems (all water, mixed air water and all air) will be presented and in the final part the fundamentals of HVAC design will be outlined. In parallel with the course lectures, the student will be required to prepare design work about a simple HVAC system (e.g. heating system for a residential building). |
| **12110318** | **Electrical Power Systems (1)** | **3** | Fundamentals of power systems generation, transmission, and distribution. Transformer principles, synchronous machines, transmission line parameters and calculations. Types of conductors, series resistance, series inductance of three-phase transmission lines and capacitances. Short, medium and long models of transmission lines. Power equations and calculation, series impedance of transmission lines capacitance of transmission lines, current and voltage relation on a transmission lines, system modeling, overhead line insulators, mechanics design of overhead lines, underground cables. |
| **12110423** | **Electrical Power Systems (2)** | **3** | Admittance model and network calculations, Y-bus build up and modification, power flow solutions: Gauss Seidel, Newton Raphason, fast decoupled method, power flow studies and analysis in design and operation and short circuit calculations. Simulation assignments are required. |

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| **Department:** Electrical Engineering **-** Renewable Energy track |
| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) |
| **12210441** | **Thermodynamics and Power Technology** | **3** | **environmental, cultural** |
| **12150310** | **Sustainable Energy Technology (1)**  | **3** | **social, environmental, cultural, economic** |
| **12150311** | **Sustainable Energy Technology (1) Lab.**  | **1** | **social, environmental, cultural, economic** |
| **12150410** | **Sustainable Energy Technology (2)**  | **3** | **social, environmental, cultural, economic** |
| **12150411** | **Sustainable Energy Technology (2) Lab.**  | **1** | **social, environmental, cultural, economic** |
| **12150420** | **Energy Audit, Management and Conservation**  | **3** | **social, environmental, cultural, economic** |
| **12150510** | **Computer Applications for Renewable Energy** | **3** | **social, environmental, cultural, economic** |
| **12150520** | **Energy Storage Systems** | **3** | **social, environmental, cultural, economic** |
| **12150430** | **Energy and Environmental Technology** | **3** | **social, environmental, cultural, economic** |
| **12110535** | **Power Plant Engineering** | **3** | **social, cultural, economic** |
| **12150530** | **Special Topics in Sustainable and Renewable Energy** | **3** | **social, environmental, cultural, economic** |
| **12150531** | **Smart-Grid Power Systems**  | **3** | **social, environmental, cultural, economic** |
| **12150540** | **Energy Policy** | **3** | **social, cultural, economic** |
| **12150532** | **Alternative Fuel Sources**  | **3** | **social, environmental, cultural, economic** |
| **12150533** | **Sustainable Buildings and Systems** | **3** | **social, environmental, cultural, economic** |
| **12110318** | **Electrical Power Systems (1)** | **3** | **social, economic** |
| **12110423** | **Electrical Power Systems (2)** | **3** | **social, economic** |

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| **Department:** Electrical Engineering **-** Renewable Energy track |
| **Course Descriptions** |
| course number | Course name | C.H | **Course Descriptions** |
| **12210441** | **Thermodynamics and Power Technology** | **3** | Thermodynamics properties: temperature, pressure, entropy etc; Thermodynamic systems: isolated, open and closed systems; Thermodynamic processes: cyclic, reversible, non-reversible, adiabatic, isentropic, throttling, poly tropic processes etc. ; Processes of sublimation, vaporization, condensation and fusion; First and second law of thermodynamics; Energy balances on all major components in the system such as heat exchangers; Heat transfer analysis due to : conduction, convection and radiation ; Heat and power generation technologies, including those based on steam and gas turbine cycles, as well as combined steam and gas cycles. |
| **12150310** | **Sustainable Energy Technology (1)**  | **3** | Introduction to energy systems: conventional and renewable energy resources; Solar Spectrum, Solar Time and angles, day length, angle of incidence on tilted surface; Sun path diagram; Shadow angle protractor; Solar Radiation; Extraterrestrial Radiation; Effect of earth atmosphere; Estimation of solar radiation on horizontal and tilted surfaces; Measurement of solar radiation; Solar radiation calculations. Photovoltaic fundamentals; Solar Cell Physics; The Photovoltaic Effect, Dark and illumination characteristics; Figure of merits of solar cell; Efficiency limits; Variation of efficiency with band-gap and temperature; Efficiency measurements; High efficiency cells. Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Types of Solar cells. Solar Cell Fabrication Technology. Solar Photovoltaic System Design; Maximum tracking; Centralized and decentralized SPV systems; Stand alone, hybrid and, grid connected system. The Recent developments in Solar cells, Role of nano-technology in Solar cells. Wind speed analysis; Wind turbine energy, power, torque and speed characteristics. Solar heater systems: Design, amount of heat. |
| **12150311** | **Sustainable Energy Technology (1) Lab.**  | **1** | Solar radiation measurement ; Solar cell characteristics (V\_ I) ; Solar panel connections ; battery charging; PV standalone systems; Grid-connected PV systems; solar tracking systems; Solar stations (Installation, visiting); Solar heating systems |
| **12150410** | **Sustainable Energy Technology (2)**  | **3** | Global, regional and local wind systems; Wind energy conversion principles; Rotor characteristics; Maximum power coefficient; Tip speed ratio; Types and classification of different wind turbines. Power, torque and speed characteristics; Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Wind turbine design considerations; Wind Energy Applications: Wind pumps, wind generators. Hydro power principles; Geothermal energy fundamentals; Biomass Energy; Other technologies for Renewable Energy. Hybrid renewable energy systems. |
| **12150411** | **Sustainable Energy Technology (2) Lab.**  | **1** | Wind speed measurements; Wind turbine characteristics. Hydropower generation; Electrolysis; Fuel cell characteristics; Hybrid system connection; Biogas generation; Hybrid systems |
| **12150420** | **Energy Audit, Management and Conservation**  | **3** | Introduction to energy management ; Assessment of energy consumption ; Techniques for reducing energy consumption ; Energy recovery and management techniques of production and distribution systems ; Incentives and requirements for improving energy efficiency in the residential, commercial, transportation, and industrial sectors ; Methods for energy audit of the industrial and civil installations ;Energy Audit Instruments; Duties and responsibilities of energy auditors ;Energy conservation in boilers, steam turbines and industrial heating systems; Cogeneration and waste heat recovery; Thermal insulation; Heat exchangers and heat pumps; Building Energy Management ; Conservation in : electric motors , compressed air system , HVAC and refrigeration systems , pumps and pumping systems. |
| **12150510** | **Computer Applications for Renewable Energy** | **3** | Simulation software used to design renewable energy systems based on: PV stand alone or grid connected systems, wind systems, hybrid systems with and without diesel generators with and without storage system. Economical evaluation of the system to choose the optimal. |
| **12150520** | **Energy Storage Systems** | **3** | This course is intended to provide students an overview on energy storage schemes/devices with major focus on electrochemical storages including ionic batteries, fuel cells and super-capacitors. The course will cover operating principles, physics behind them, characterization methods and advantages/issues of each scheme. Analysis of thermal storage models; storage materials and heat transfer fluids; Thermal storage applications. |
| **12150430** | **Energy and Environmental Technology** | **3** | Energy production and consumption, with some national statistics; Energy resources, including fossil fuels and Renewable Energy resources; Extraction, conversion, and transmission technologies (e.g., engines, turbines, generators); Environmental impacts of fuel consumption; Some current national and international policies, climate change. Pollution due to thermal power station and their control. Pollution due to nuclear power generation, radioactive waste and its disposal. Effect of hydroelectric power stations on ecology and environment. Effect of Hydro-electric power stations on ecology and environment. Primary and secondary pollution, air, thermal and water pollution, depletion of ozone layer, global warming, acid rain biological damage due to environmental degradation. Technology Assessment / Environmental Audit; Ecological Impact Assessment; Social Impact Assessment; Strategic Impact Assessment; Modeling in EIA and conclude with a Case Study. |
| **12110535** | **Power Plant Engineering** | **3** | Choice of power generation; Load & Load duration curves; Load factor; Diversity factor; Load deviation curve; Load management; Number and size of generating unit; Cost of electrical energy; Tariff-Power factor improvement ; Thermal power stations : types , elements , site selection , Instrumentation and control ; Gas turbine power plant ; Combined cycle power plant ; Principle of cogeneration ; Technical options for cogeneration, Classification of cogeneration systems, Factors influencing cogeneration choice ; Hydropower Plant : Classification, components, turbines- characteristics and their selection ; Nuclear power plant ; Diesel-electric Power Plant. |
| **12150530** | **Special Topics in Sustainable and Renewable Energy** | **3** | The course will provide students with a working knowledge of fundamentals, design, analysis and development of Smart Grid. The course offers an introduction to the basic concepts of power systems along with the inherent elements of computational intelligence, communication technology and decision support system. The automation and computational techniques needed to ensure that the Smart Grid guarantees adaptability and capability of handling new systems and components are discussed. The interoperability of different renewable energy sources are included to ensure that there will be minimum changes in the existing legacy system. Standards and requirements needed for designing new devices, systems and products for the Smart Grid are discussed. Power flow analysis and optimization schemes needed for the generation, transmission, distribution, demand response, and reconfiguration is explained in detail and simulation tools such as Mat lab and Paladin are used. |
| **12150531** | **Smart-Grid Power Systems**  | **3** | Government, corporate, and public perspectives on the analysis, formulation, implementation, and impacts of energy-related policies, regulations, and initiatives. Energy policy development, implementation, and assessment at multiple governmental and corporate scales are also of the topics that covered in this course. The course includes case studies from real-world energy problems and the corresponding actions. This is to provide the student with context for the drivers, frameworks, and assumptions of energy policy. Climate change and its relation with energy policy is one of the topics covered in this course. International agreements, national Legislation including the National Energy Policy Act, and statewide energy legislation will be reviewed in this course. |
| **12150540** | **Energy Policy** | **3** | Recent topics in sustainable and renewable Energy covered by a visiting professor or a department faculty member |
| **12150532** | **Alternative Fuel Sources**  | **3** | Hydrogen Production Methods: From fossil fuels, electrolysis, thermal decomposition, photochemical, photo catalytic, hybrid; Hydrogen Storage Methods: Metal hydrides, Metallic alloy hydrides, Carbon nano-tubes, Fuel cell basics : Definition, difference between batteries and fuel cells , performance characteristics of fuel cells, efficiency of fuel cell, fuel cell power plant , types of fuel cells . An introduction to hydrocarbon fuels - their availability and effect on environment: Gasoline and Diesel self-ignition characteristics, octane number, certain number; Alternative fuels: Liquid and gaseous fuels, physic-chemical characteristics; Alternative Liquid Fuels. Fuel composition, Fuel Induction techniques. Biodiesel formulation techniques, application in diesel engines. Compressed Natural Gas components. Hydrogen combustion characteristics. Biogas, Producer gas and their characteristics. |
| **12150533** | **Sustainable Buildings and Systems** | **3** | The fundamentals of conventional energy sources used in buildings; renewable technology; policies and drivers that are leading to the more widespread uptake of low carbon building technologies; low carbon building codes, global policies and planning from the past, present and future. Integrated design: urban microclimate design, passive architectural interventions, active interventions. Low carbon buildings design and operation. |
| **12110318** | **Electrical Power Systems (1)** | **3** | Fundamentals of power systems generation, transmission, and distribution. Transformer principles, synchronous machines, transmission line parameters and calculations. Types of conductors, series resistance, series inductance of three-phase transmission lines and capacitances. Short, medium and long models of transmission lines. Power equations and calculation, series impedance of transmission lines capacitance of transmission lines, current and voltage relation on a transmission lines, system modeling, overhead line insulators, mechanics design of overhead lines, underground cables. |
| **12110423** | **Electrical Power Systems (2)** | **3** | Admittance model and network calculations, Y-bus build up and modification, power flow solutions: Gauss Seidel, Newton Raphson, fast decoupled method, power flow studies and analysis in design and operation and short circuit calculations. Simulation assignments are required. |

**Department: communication engineering and technology**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) | **Type of the course** |
| 12130302 | Signals and Systems | 3 | (environmental, economic) | Mandatory |
| 12130303 | Probability and Random Variables | 3 | (social, economic) | Mandatory |
| 12130406 | Digital Communications | 3 | (environmental, economic) | Mandatory |
| 12130306 | Analog Communications | 3 | (environmental, economic) | Mandatory |
| 12130408 | Microwaves Engineering | 3 | (environmental, economic) | Mandatory |
| 12130412 | Mobile Communications | 3 | (environmental, economic, social ) | Mandatory |
| 12130414 | Communication Electronics Mobile Communications | 3 | (environmental, economic, social)  | Mandatory |
| 12130415 | Optical Fiber Systems | 3 | (environmental, economic) | Mandatory |
| 12130517 | Wireless Communication Networks | 3 | (environmental, economic) | Mandatory |
| 12130525 | Electromagnetic Waves And Acoustics | 3 | (environmental, economic) | Mandatory |
| 12130411 | Communication Networks | 3 | (environmental, economic, social ) | Mandatory |
| 12130522 | Optical Communication systems | 3 | (environmental, economic) | Mandatory |
| 12130524 | Radar Communication Systems | 3 | (social, economic) | Elective  |
| 12130526 | Passive and Active Filters | 3 | (environmental, economic) | Mandatory |
| 12130527 | Digital Signal Processing | 3 | (environmental, economic) | Elective |
| 12130528 | Communications Security | 3 | (social)  | Elective |
| 12130529 | Multimedia Communications Technology | 3 | (environmental, economic) | Elective |
| 12130530 | Broadband Access Technologies | 3 | (environmental, economic) | Elective |
| 12130531 | Data Communications | 3 | (environmental, economic) | Elective |
| 12130532 | Modern Communication Systems | 3 | (environmental, economic) | Elective |
| 12130533 | Advanced Digital communications | 3 | (environmental, economic) | Mandatory  |
| 12130521 | Satellite Communications | 3 | (environmental, economic, social)  | Elective |
| 12130409 | Antenna and Wave Propagation | 3 | (environmental, economic) | Mandatory |
| 12130523 | Information Theory and Coding | 3 | (economic) | Elective  |

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| **Credit Hours:3** | **Course Name: Signals and Systems** | **Course N: 12130302** |
| **Representation of signals and systems, Basic continuous and discrete time signals, Continuous and discrete time systems, Memory, causality, stability, inevitability, linearity, and time invariance. LTI systems, impulse response, Time domain analysis of CT systems convolution integral, Fourier series analysis of CT signals. Fourier transform analysis of CT signals , Properties of Fourier transform , Fourier transform of periodic signals , Frequency response , Energy and power spectral densities, Hilbert transform.** |

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| **Credit Hours:3** | **Course Name: Probability and Random Variables** | **Course N: 12130303** |
| **Axiomatic definition of probability spaces, combinational methods, conditional probability, product spaces, random variables, distribution and density functions, multivariate distributions, conditional distributions and densities, independent RVs, functions of RVs, expected values, moments and characteristic functions, joint and marginal distributions, generating functions.** |

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| **Credit Hours:3** | **Course Name: Digital Communications** | **Course N: 12130406** |
| **Pulse code modulation sampling process, pulse amplitude modulation, time- division multiplexing, quantization, line codes, baseband pulse transmission, digital passband transmission, Inter-symbol interference, Noise in digital communications.** |
| **Credit Hours:3** | **Course Name: Analog Communications** | **Course N: 12130306** |
| **Amplitude and angle modulation techniques, Amplitude modulation, double side band, single side band, vestigial side band, quadrature amplitude modulation. Frequency modulation, phase modulation, phase locked loops. Super heterodyne receivers, frequency division multiplexing. Television. Noise in CW systems** |

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| **Credit Hours:3** | **Course Name: Microwaves Engineering**  | **Course N: 12130408** |
| **TEM mode transmission lines, field and distributed circuit analysis, frequency and time domain analysis, wave guiding structures. Rectangular and circular waveguides. Impedance transformations and matching techniques. S-matrix, Z- matrix, Y-matrix, ABCD-matrix, Signal flow graph of N-port networks, passive reciprocal and nonreciprocal devices. Electromagnetic resonators, microwave filters. Microstripline structures and coupled lines.** |

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| **Credit Hours:3** | **Course Name: Mobile Communications** | **Course N: 12130412** |
| **Introduction to Wireless Communication Systems. Modern Wireless Communication Systems. The Cellular Concept, System Design Fundamentals. Mobile Radio Propagation: Large-Scale Techniques for Mobile Radio.** |
| **Equalization, Diversity, and Channel Coding. Speech Coding. Multiple Access Techniques for Wireless Communications. Wireless Networking. Wireless Systems and Standards** |

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| **Credit Hours:3** | **Course Name: Communication Electronics Mobile Communications** | **Course N: 12130414** |
| **Introduction to electronic communications ,tuned circuits, Filters, Amplitude modulators and demodulators, FM circuits, Frequency modulators and demodulators circuits, phase modulators, frequency demodulators ,radio transmitters, communication receivers ,telecommunication systems, TV-signals, TV-receivers.** |

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| **Credit Hours:3** | **Course Name: Optical Fiber Systems** | **Course N: 12130415** |
| **Optics review: lenses, NA. Light-wave fundamentals: EM waves, dispersion, polarization, cavities, reflection at boundaries, critical angle. Integrated optic waveguides: Dielectric slab and modes, coupling, integrated optic components. Optic fibers waveguides: SI, GRIN. Light sources: LED, LD, optical amplifiers. Light decoders: photo detectors, multipliers. Couplers and connectors.** |

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| **Credit Hours:3** | **Course Name: Wireless Communication Networks** | **Course N: 12130517** |
| **Diversity, capacity, space division multiple access, selection combining, maximal ratio combining, equal gain combining, square law combining, MIMO antenna systems, MIMO capacity, channel matrix,STC-MIMO, orthogonal space time block codes, transmitter and receiver structure, noise performance, smart antennas, BLAST and turbo-BLAST systems, wireless architectures.** |

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| **Credit Hours:3** | **Course Name: Electromagnetic Waves And Acoustics** | **Course N: 12130525** |
| **Plane Wave equations and their solutions, wave in material media, Dielectric and conductors Polarization, reflection and transmission of waves, Propagation of EM waves, space ground waves, wave propagation in the troposphere and ionosphere. Acoustics, acoustical wave equation, plane and spherical acoustical waves, sound power and loudness, reflection, transmission and absorption of sound, Environmental acoustics, noise control. Electro-acoustics, sound systems, acoustic transducers,** |

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| **Credit Hours:3** | **Course Name: Communication Networks** | **Course N: 12130411** |
| **Data line devices, modems, DSL, ADSL, network architecture, physical layers, interface specifications, common configurations, data link layers, frame design configurations, data link error control, data link protocols, LANs, WLANs, Ethernets, carrier sense multiple access.** |

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| **Credit Hours:3** | **Course Name: Optical Communication systems** | **Course N: 12130522** |
| **Overview of optical fiber communication, optical fiber power launching and coupling, LED modulation and circuits, LD modulation and circuits, analog modulation formats, digital modulation formats, optic heterodyne receivers, thermal and shot noise, SNR, CNR, error rates, modal noise, amplifier noise, Laser noise, jitter noise, receiver circuit design, analog system design, digital system design** |

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| **Credit Hours:3** | **Course Name: Radar Communication Systems** | **Course N: 12130524** |
| **Introduction to radar, radar equation, MTI and pulse Doppler radar, tracking radar, detection of signal in noise, information from radar signal, radar clutter, propagation of radar waves, radar antenna, radar transmitter and receiver** |

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| **Credit Hours:3** | **Course Name: Passive and Active Filters** | **Course N: 12130526** |
| **Filters, review of CT signals and systems. Concept of filtering. Butterworth, Chebyshev, elliptic, filters, etc. Frequency transformations. Phase and loss equalizers. Synthesis of passive filter networks. Active filters. Switched capacitor. Implementation of filters in different technologies used in communication systems** |

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| **Credit Hours:3** | **Course Name: Digital Signal Processing** | **Course N: 12130527** |
| **Discrete convolution, Fourier transform analysis of discrete time signals and systems, DTFT, DFT and FFT. Z-transform analysis of discrete time signals and systems, implementation of discrete time systems, FIR systems, IIR systems, design of IIR filters from analog filters** |

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| **Credit Hours:3** | **Course Name: Communications Security** | **Course N: 12130528** |
| **Remote Access technologies including VPN, RADIUS, TACAS+, L2TP, and SSH. Web, e-mail, and instant messaging vulnerabilities such as Spam, hoaxes, and packet sniffing. Directory and file transfer technologies. Wireless considerations such as WEP and WAP. IEEE 802.1x standard, virtual private network (VPN), Point to Point Protocol (PPP) and Point to Point Tunneling Protocol (PPTP), Instant Messaging (IM), vulnerabilities of Instant Messaging (IM), directory services ,IEEE 802.11 standards, Wired Equivalent Privacy (WEP), wireless vulnerabilities.** |

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| **Credit Hours:3** | **Course Name: Multimedia Communications Technology** | **Course N: 12130529** |
| **Statistical Analysis of Multimedia Signals, Linear Systems and Transforms, Pre- and Post-processing, Perceptual Properties of Vision and Hearing, Features of Multimedia Signals, Signal and Parameter Estimation, Feature Transforms and Classification, Signal Decomposition, Quantization and Coding, Still Image Coding, Video Coding, Audio Coding, Transmission and Storage, Signal Composition, Rendering and Presentation, Multimedia Representation Standards.** |

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| **Credit Hours:3** | **Course Name: Broadband Access Technologies** | **Course N: 12130530** |
| **Introduction and legacy networks, Broadband access networks, Demand for broadband, Broadband access technologies, Services, Status of global broadband markets, Penetration and growth, Business model, Convergence and bundling of services, Future broadband, Basic communication system, Channel coding, Modulation, Spectrum efficiency , Contention ratio, Digital subscriber lines, Copper access networks, Asynchronous Digital Subscriber Line (ADSL), DSL network architecture and network elements, Deployment strategies, Local Loop Unbundling (LLU), xDSL in a multiservice 21st Century Network, Power line broadband, Fiber optic systems, Fixed Wireless Access (FWA), Satellite broadband access, High altitude platforms, Wireless access networks (PAN, LAN, WAN, MAN), WiMAX, Introduction to 3G, Background and Standardization of 3G, History of 3G and 3G standards, Drivers for 3G- Spectrum, services, bearers, UMTS, HSDPA, LTE, IMT- Advanced, Femto cells, Power control, Handover, Admission control, Load control (congestion control), Interference management** |

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| **Credit Hours:3** | **Course Name: Data Communications** | **Course N: 12130531** |
| **Model of data communication systems, data transmission, modes of data transmission, digital signal encoding, bipolar line codes: AMI, HDB3, B8ZS, transmission channel, data compression, transmission media, transmission line characteristics, linear distortion, crosstalk, metallic transmission media, optical fibers, radio media, equalization, telephone networks, transport network, SDH, long distance networks, signal impairments, ISDN, digital point-to-point links, voice channel bandwidth. error control, error detection, forward error detection** |
| **Credit Hours:3** | **Course Name: Modern Communication Systems** | **Course N: 12130532** |
| **Analog and digital communication systems, ADC, digital transmission via carrier modulation, channel capacity and coding, digital transmission through band- limited channels. All the above systems modeled in Mat lab,** |

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| **Credit Hours:3** | **Course Name: Advanced Digital communications** | **Course N: 12130533** |
| **Representation of Digitally Modulated Signals, Memory less Modulation Methods, Signaling Schemes with Memory, Power Spectrum of Digitally Modulated Signals, Waveform and Vector Channel Models, Waveform and Vector AWGN Channels, Optimal Detection and Error Probability for Band- Limited Signaling, Optimal Detection and Error Probability for Power-Limited Signaling, Optimal Detection in Presence of Uncertainty, A Comparison of Digital Signaling Methods, Detection of Signaling Schemes with Memory, Optimum Receiver for CPM Signals, Performance Analysis for Wire line and Radio Communication Systems, Carrier Phase Estimation, Symbol Timing Estimation, Joint Estimation of Carrier Phase and Symbol Timing, Performance Characteristics of ML Estimators** |

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| **Credit Hours:3** | **Course Name: Satellite Communications** | **Course N: 12130521** |
| **current and Future Trends, Detailed Link Budget Considerations, Transmitters, Propagation and Rain, Receivers, LNAs, Figure of Merit, Total System Performance, Spectrum Sharing, Additional Noise Issues, Interference and Coordination, MSS Issues, Telemetry and Tracking, Power Limitations, Reliability Types of Satellite Communications Systems, Basic Link Budgets, Antennas, Propagation, Noise, C/N, Orbital Mechanics, Constellations, RF and Licensing Issues, Spectrum Allocations, Modulation, Multiplexing, Multiple Access,** |

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| **Credit Hours:3** | **Course Name: Antenna and Wave Propagation** | **Course N: 12130409** |
| **Antenna parameters, linear antennas, influence of earth on antenna radiation pattern and impedance, radiation from dipole antenna, loop antenna, aperture antennas, antenna arrays and the general array formula. receiving antenna theory, elements of ground waves, tropospheric and ionosphere propagation** |

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| **Credit Hours:3** | **Course Name: Information Theory and Coding** | **Course N: 12130523** |
| **Entropy, Joint Entropy, Conditional Entropy Relative Entropy, and Mutual InformationEntropy, Fan’s Inequality ,Markov Chains, Entropy Rate, Channel capacity, Differential Entropy, Gaussian Channel, Encoding a Source Alphabet, Some Particular Codes, The ASCII Code, Radix r Codes, Error-Detecting Codes, Simple Parity Checks, White Noise, Retransmission of Message, Simple Burst Error-Detecting Codes, Weighted Codes, ISBN Book Numbers, Error-Correcting Codes, Rectangular Codes, Triangular, Cubic, and n-Dimensional Codes, Hamming Error-Correcting Codes, Huffman Codes, Instantaneous Codes, Block Codes Miscellaneous Codes** |

**Department: Acoustics engineering**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) | **Type of the course** |
| 12160406 | Medical Acoustics Devices  | 3 | environmental | Mandatory  |
| 12160405 | Building Soundproofing | 3 | Environmental, economic , social  | Mandatory |
| 12160411 | Recordings and Mixing Engineering  | 3 | Environmental, economic  | Mandatory |
| 12160407 | Audio Systems | 3 | Environmental, economic  | Mandatory |
| 12160404 | Environmental Noise Measurements  | 3 | Environmental, economic  | Mandatory |
| 12160406 | Medical Acoustics Devices  | 3 | Environmental, economic  | Mandatory |
| 12160502 | Wireless Techniques | 3 | Environmental, social  | Mandatory |
| 12160511 | Studio Techniques | 3 | environmental | Mandatory |
| 12160401 | Acoustic Signal Processing  | 3 | environmental | Mandatory |
| 12160410 | Echo acoustics | 3 | Environmental, economic  | Mandatory |
| 12160402 | Electroacoustic | 3 | Environmental, economic  | Mandatory |
| 12160409 | Acoustic Waves Propagation  | 3 | Environmental, economic  | Mandatory |
| 12160312 |  Measurement Analysis and Assessments  | 3 | Environmental, social, economic  | Mandatory |
| 12160521 | Speech and Musical Acoustics  | 3 | Environmental, social, economic  | Elective  |
| 12160522 | Computer Simulation for Acoustics  | 3 | economic  | Elective |
| 12160523 | Transducers design  | 3 | Environmental, economic  | Elective |
| 12160524 | Psychoacoustics | 3 | Environmental, social, economic  | Elective |
| 12160525 | Noise Control  | 3 | Environmental, social, economic  | Elective |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160406** | **Medical Acoustics Devices**  | **3** |
| **The course is aiming at the design, development and marketing devices employing acoustic technologies including auditory and ultrasonic that are used for diagnostic and therapeutic medical applications** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160405** | **building soundproofing:** | **3** |
| **Sound insulation Absorption and reverberation time sources of external noise (rain noise, traffic, etc.); sources of noise within buildings (heating, ventilation and air-conditioning noise sources; fans; Absorption of seats, audience, variable absorption. Scattering and diffusion. Absorption materials Measurement of impulse responses; determination of room acoustic parameters. Sound source characteristics (musical instruments, speech, singing; sound power, directivity). Prediction methods (image sources, ray tracing, beam/cone tracing, finite differences, modal methods, physical scale modelling).** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160411** | **Recordings and Mixing engineering**  | **3** |
| **Mixing engineering enables practical and theoretical knowledge of the tools used in music production. During the course, an independent mix of an entertainment track is carried out. As part of the recordings, sound productions of classical and popular music are made using modern microphone techniques in a recording studio.**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160407** | **Audio Systems**  | **3** |
| **This course will introduce you to a broad range of audio systems including microphones, transmission, digital audio and loudspeakers. You will learn how to make sound effects for a computer game.**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160404** | **Environmental Noise Measurements**  | **1** |
| **This course discusses the measurement of environmental sound using appropriate sound measuring instrumentation. The course develops the ability to describe and explain the main provisions of current environmental noise legislation, and to interpret the requirements in order to carry out reliable measurements and apply acoustic theory to decisions about when, how and where to measure environmental sound.** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160406** | **Medical Acoustics Devices**  | **3** |
| **The course is aiming at the design, development and marketing devices employing acoustic technologies including auditory and ultrasonic that are used for diagnostic and therapeutic medical applications** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160502** | **Wireless techniques**  | **3** |
| **Basic concepts of wireless systems. Wireless local area networks. Radio and television. Antennas.**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160511** | **studio techniques**  | **3** |
| **Topics covered include studio signal flow, microphone selection and placement, use of outboard and software-based effects processors, overdubbing, creating composite audio tracks, and mixing. Digital signal processing**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160401** | **Acoustic signal processing**  | **3** |
| **This course gives a thorough grounding in the techniques and applications of digital technology in the acquisition, processing, storage and transmission of acoustic signals.** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160410** | **Ecoacoustics**  | **1** |
| **Tasks of eco-acoustics. The role of sound in the environment. Sound as a landscape value** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160402** | **Electroacoustic**  | **3** |
| **Electroacoustic combines elements of acoustics and electronics, dealing with the conversion of acoustic waves into electric current and vice versa using electroacoustic transducers.** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160409** | **Acoustic Waves Propagation**  | **3** |
|  **This course introduces acoustics by using the concept of impedance. The course starts with vibrations and waves, demonstrating how vibration can be envisaged as a kind of wave, mathematically and physically. They are realized by one-dimensional examples, which provide mathematically simplest but clear enough physical insights. Then the part 1 ends with explaining waves on a flat surface of discontinuity, demonstrating how propagation characteristics of waves** |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160312** | **Measurement Analysis and Assessments**  | **3** |
| **This course presents the scientific principles underlying acoustic measurement techniques, and techniques of standardized acoustic measurements, while considering the uncertainty introduced by the measurement process. The students are required to gain the skills to perform appropriate analysis of measured data, and communicate findings effectively to a specialist audience.** |

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| **12160521** | **Speech and Musical Acoustics**  | **3** |
| **This course presents an introduction to speech production and modeling, speech analysis and synthesis. The application of speech technology in modern communication devices. The concepts of human perception of sound and its application in a musical context.**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160522** | **Computer Simulation for Acoustics**  | **3** |
| **The course introduces the fundamental principles of computer simulation techniques including: geometric room acoustics, finite element method, and boundary element method using specialized computer simulation software. The student is required to show the ability of practical problem-solving using computer modeling of acoustical systems and assess the field of application, accuracy and limitations of the computer simulation methods.**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160523** | **Transducers design**  | **3** |
| **The course discusses the Loudspeakers and Microphones design principles. The analysis of the design of electro-dynamic and distributed mode loudspeaker systems, including the interaction of the electrical, mechanical and acoustical properties and to determine sensitivity, frequency response and directionality. Also, the course includes the study of two-port networks methods and the method of analogues. Practical issues such as radiation efficiency and non-pistonic vibration will be considered also the analysis of vented, transmission line and band-pass systems**  |
| **Course number** | **Course Name** | **Credit hour** |
| **12160524** | **Psychoacoustics**  | **3** |
| **This course provides an understanding of how the auditory system allows humans to perceive different attributes of the surrounding acoustic environment, and to develop a detailed understanding of how low-level percepts such as pitch arise from the physiology of the ear. Also, the course links the acoustic attributes to emotional response that drives good subjective experiment design.**  |

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| **Course number** | **Course Name** | **Credit hour** |
| **12160525** | **Noise Control**  | **3** |
| **Mixing engineering enables practical and theoretical knowledge of the tools used in music production. During This course provides the knowledge and understanding of noise control design processes and methodologies. Furthermore, the course provides the fundamentals necessary for appropriate selection of noise control options for realistic environmental and industrial noise scenarios, and to justify their selections. In addition, the course gives a thorough understanding of current best practice in noise control, and how to apply appropriate acoustical analysis to assess limitations and/or adapt them for application in unfamiliar situations.**  |

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| **Department:** Engineeringof IndustrialAutomation  |
| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) |
| **12120203** | **Protection and control devices** | **3** | environmental, economic |
| **12120204** | **Protection and control devices lab** | **1** |  environmental, economic |
| **12120307** | **Printed Circuit Board Design** | **2** | social, economic |
| **12120309** | **Programmable logic controller- 1** | **3** | environmental, economic |
| **12120310** | **Programmable logic controller- 1 lab** | **1** | environmental, economic |
| **12120415** | **Programmable logic controller- 2** | **3** | environmental, economic |
| **12120416** | **Programmable logic controller- 2 lab** | **1** | environmental, economic |
| **12120528** | **Supervision systems** | **3** | social, environmental, economic |

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| Electrical Power System Concept; Basic System Protection Concepts; Protection Equipments: Circuit breakers, Fuses, Over Loads, ELCB; Protection of generators, Transformers, Transmission Lines, Bus-Bar Systems, Feeders.; Electromechanical (relay) control systems construction: Transducers, Contactors, Relays, Timers, Counters; Schematic diagrams (control + power); 3-ph system calculations and P.F improvement; Lighting and socket loads calculations. | **Protection and control devices** | **12120203** |
| Practice on control methods and devices, Relays, Contactors, Timers and Counters. Industrial applications for traditional control. Protection devices: Fuse, CB, ELCB, Overloads, Control Circuits, Industrial installation (case studies), Electrical boards (case studies).Practice on simulating protection and control devices using desktop applications. | **Protection and control devices lab** | **12120204** |
| Electrical Circuits Design, Electronics and Digital ICs, Simulation of Electrical/ Electronic Circuits. Interfacing ICs, Printed Circuit Board design, Manual Soldering. | **Printed Circuit Board Design** | **12120307** |
| Traditional Control Systems (Review); Logic Controllers; Programmable Logic Controllers: definition and applications; Digital Input/ Output; Installation of PLC Systems; Environment Considerations; Combinational Systems Implementation; Function Blocks, Instruction List , Ladder , and Sequential Functional Charts (SFC) Programming; Translation between programming languages; Analogue Expansion Modules. | **Programmable logic controller- 1** | **12120309** |
| Practice on traditional control systems, Direct control of starting and breaking for motors, Pistons control and industrial machines control; Practice on Programmable Logic Controllers using STL, Ladder and Grafcet languages. Practicing on programmable Timers, Counters, Drums and Shifting Registers. Introduction and applications on analog IO. | **Programmable logic controller- 1 lab** | **12120310** |
| Programming different industrial applications; Programming Interrupts ; Programming start, stop, restart modes ; Emergency and Defaults ; Closed loop control ; PID blocks ; Design of an industrial automated system ; Available software for PLC networking ; Setup controller link network from PLC ; Setup an Ethernet network from PLC ; Overview of various networks the PLC can offer ; Setup routing tables ; Data links used to pass information from PLC to IP address of the PC and program over the network; SCADA Systems | **Programmable logic controller- 2** | **12120415** |
| Programming PLC to control different industrial simulators in the lab : Manipulator , Sorter , Stocker , and Elevator ; Practice on using PLC to control Electro pneumatic systems : Connection inputs and outputs and programming ; Practice on programming using PLC : PWM functions , PID functions , Fast counters , Timers , Comparators : Installing appropriate software for PLC local area network communications ; Programming different applications using remote input/output by CANopen ; Programming different applications using local area network established between PLCs . Program a supervisory display to control and monitor PLC operation through network. | **Programmable logic controller- 2 lab** | **12120416** |
| Analysis , Diagnosis , Fault Finding and Repair of Electrical Systems and Equipment , Guided Planning Analysis , Design and Drafting Tasks , Supervision and Facilitation of Performance , Evaluate Performance of Motor Control Systems , PLC Systems Applications , SCADA Systems , Program and Verify Programmable Controller Systems , Apply Contracting and Estimating Procedures. | **Supervision systems** | **12120528** |

**Department: Automotive Engineering**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) |
| 12250506 | Vehicle Manufacturing Overview | 3 | Renewable materials used to construct vehicle systems including: structure, interior trim, batteries and tyres (economical and environmental sustainability) |

**Vehicle Manufacturing Overview:**

This course presents an overview of vehicle manufacturing from an OEM (original equipment manufacturer) perspective. The course covers topics such as supplier integration, flexible manufacturing, quality engineering methods and their applications to manufacturing. It also focuses on opportunities and challenges presented in automotive manufacturing in a global environment.

**Department: Building Engineering & Environment**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) | **Type of the course** | **Course description**  |
| 12310359 | Environmental Systems II- Thermal Systems | 3 | Environmental, Economic | Mandatory | Thermal comfort in buildings (Temperature, humidity, Ventilation and Odors), heat transfer by conduction convection and radiation in buildings, building envelope and insulation, Heat loss and heat gain in buildings, Introduction to Heating and cooling strategies, Underfloor heating system Design. |
| 12310461 | Passive Solar Systems Design | 3 | Environmental, Economic | Mandatory | Introduction to climate analysis (e.g., radiation, wind, temperature, and relative Humidity) and thermal comfort. Analysis of natural ventilation, daylighting and visual comfort. Energy use in building and PV solar panels design. |
| 12310462 | Water and Sanitation Systems | 3 | Environmental, Economic, Social | Mandatory | Water supply system design, sanitation system design, solid waste disposal and fire alarm and protection systems |
| 12310468 | Green Buildings | 3 | Environmental, Economic, Social | Mandatory | Students are introduced to the key principles of green building, including current standards and considerations for regional factors. They are also introduced to the five components of green building that include energy, water, sustainable sites, materials and resources, and indoor environmental quality. The hands-on audit provides students with an opportunity to gather basic information about their school building and grounds to prepare them to do more in-depth audits related to energy, water, and more |
| 12310579 | Restoration of Buildings | 3 | Cultural, Environmental | Elective |  to teach students the basic trades that are used to preserve and restore historic structures. Classroom education provides a foundation in preservation theory and history along with an in-depth technical analysis of why buildings and materials fail, and explores traditional and modern approaches used to stabilize and repair them |
| 12310580 | Water and Wastewater Treatment Technologies | 3 | Social, Environmental, Economic | Elective | This course is an overview of engineering approaches to protecting water quality with an emphasis on fundamental principles. Theory and conceptual design of systems for treating municipal wastewater and drinking water are discussed, as well as reactor theory, process kinetics, and models. Physical, chemical, and biological processes are presented, including sedimentation, filtration, biological treatment, disinfection, and sludge processing.  |
| 12310581 | Environmental Impact and Risk Assessment | 3 | Social, Environmental, Economic, Cultural | Elective | The process and techniques for assessing and managing the impacts on and risks to humans and the ecosystem associated with engineered facilities, processes and products. Both biophysical and social impacts are addressed. Topics include: environmental assessment processes; environmental legislation; techniques for assessing impacts; engineering risk analysis; health risk assessment; risk management and communication; social impact assessment; cumulative impacts; environmental management systems; the process of considering alternative methods for preventing and controlling impacts; and stakeholder involvement and public participation. Examples are drawn from various engineering activities and facilities such as energy production, chemical production, treatment plants, highways and landfills.  |
| 12310576 | Building Acoustics | 3 | Social, Environmental, Economic | Elective | This course aims at understanding the physical properties of sound, The ear and the perception of sound. Introduction to ancient building acoustics, building materials and sound, Sound reflection, absorption, transmission, Room acoustic design, Room acoustic calculation, Sound transmission in buildings, Noise control, Linked rooms, Introduction of architectural acoustics calculations and measurement techniques., and electrical acoustical systems |

**Department: Civil Engineering & Sustainable Structures (Co-operative)**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) | **Type of the course** | **Course description** |
| 12410220 | Introduction to Sustainable Systems | 2 | Social, Environmental, Economic, Cultural | Mandatory | Introduces the importance and role of technological, social, and sustainable systems in the modern world. Provides a framework for the theory and practice of sustainable engineering. |
| 12410323 | Sustainable Energy Systems | 3 | Social, Environmental, Economic | Mandatory | This course will provide students with knowledge of energy demand and supply from local to national scales. Topics include energy demands throughout the economy, major energy technologies, how these technologies work, how they are evaluated quantitatively, their economics and their impacts on the environment. In addition, the ever changing context in which these technologies (and emerging technologies) are being implemented will be outlined. Systems approaches including life cycle assessment will be refined and applied to evaluate energy systems. A particular focus will be placed on analysis of energy alternatives within a carbon constrained economy. |
| 12410462 | Water Supply And Sanitation Systems | 3 | Social, Environmental, Economic | Mandatory | Processes and methods for design and operation of treatment systems for water and wastewater, drinking water distribution systems and waste water collection systems, including storm water. The components of distribution and collection systems, water needs, composition of wastewater, drinking water quality, disinfection, effluent water quality, quality and environmental hygiene, process theory for water and wastewater, and selected methods for treatment of drinking water and wastewater. Wastewater generation and collection by sewers. Design of sewer networks using software.  |
| 12410469 | Advanced Concepts & Integrated Approaches in Sustainability | 3 | Social, Environmental, Economic, Cultural | Mandatory | Integrates disciplinary contributions to sustainability, teaches advanced concepts in sustainability, and explores methods for identifying sustainability challenges and generating solutions. Focuses on diversity of sustainability research, and integrates specialized approaches in sustainability. Advanced concepts in sustainability, including systems-thinking, complexity, nonlinearity, cascading effects, coupled natural-human systems, governance, future thinking, unintended consequences, normative concerns, transformation, power, participation, and equity. |
| 12410444 | Sustainable Solid Waste Treatment & Management | 3 | Social, Environmental, Economic | Mandatory | This course will address the following topics: Strategy for Waste & Resource Management and Drivers for Change. Biological Treatment of Wastes. Landfill for Waste Management and Landfill leachate. Energy from Waste & Value Recovery from Waste. Producer Responsibility and Sustainable Products. Secondary Raw Materials and the Circular Economy. Current Waste Management Practice and the Change in Business Model for Waste Management in the Future. Advances in waste recycling and recovery technologies to deliver added-value products. Interface of waste and resource management and civil engineering in the context of sustainable waste management in global cities and developing countries. |
| 12410533 | Infrastructure for Sustainable & Smart Cities | 3 | Social, Environmental, Economic | Mandatory | Developing infrastructure for sustainable cities entails understanding the connection between urban morphology and physiology. This course uses a systems approach to analyzing anthropogenic material flow and other components of urban metabolism, linking them to the design of urban infrastructure. Elements of sustainable transportation, green buildings, urban climatology, urban vegetation, water systems and local energy supply are integrated in the design of sustainable urban neighborhoods. |
| 12410571 | Traffic Engineering and ITS | 3 | Social, Environmental, Economic | Mandatory | This course will cover subjects like: theory of Traffic flow, quality and capacity of traffic flow. Control of traffic signals and introduction to Intelligent transport systems, components and services, information related to traffic and driver, methods of collection, analysis and presentation of traffic data. Models of simulation of traffic data and analysis, driver support systems, cooperative systems and autonomous driving and privacy and Intelligent Transportation Systems (ITS). |
| 12410442 | Sustainable Ground Water Engineering | 3 | Social, Environmental, Economic | Elective | Characteristics of groundwater aquifers, groundwater flow in aquifers, groundwater flow to wells, pumping tests, hydrochemistry, introduction to groundwater modeling, groundwater pollution, sustainable groundwater resources management, investigations of groundwater, artificial recharge of groundwater, well design, intrinsic vulnerability. |
| 12310581 | Environmental Impact and Risk Assessment | 3 | Social, Environmental, Economic, Cultural | Elective | The process and techniques for assessing and managing the impacts on and risks to humans and the ecosystem associated with engineered facilities, processes and products. Both biophysical and social impacts are addressed. Topics include: environmental assessment processes; environmental legislation; techniques for assessing impacts; engineering risk analysis; health risk assessment; risk management and communication; social impact assessment; cumulative impacts; environmental management systems; the process of considering alternative methods for preventing and controlling impacts; and stakeholder involvement and public participation. Examples are drawn from various engineering activities and facilities such as energy production, chemical production, treatment plants, highways and landfills.  |
| 12310580 | Water and Wastewater Treatment Technologies | 3 | Social, Environmental, Economic | Elective | This course is an overview of engineering approaches to protecting water quality with an emphasis on fundamental principles. Theory and conceptual design of systems for treating municipal wastewater and drinking water are discussed, as well as reactor theory, process kinetics, and models. Physical, chemical, and biological processes are presented, including sedimentation, filtration, biological treatment, disinfection, and sludge processing.  |

**Department: Mechanical engineering**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) | **Type of the course** |
| **Mechatronics engineering** |
| 12210101 | Introduction to automotive engineering | 3 | Social | Elective |
| 12210325 | Technical writing | 2 | Social | Mandatory |
| 12210588 | Renewable energy | 3 | Environmental, Economic | Mandatory |
| **Mechanical engineering** |
| 12220553 | Energy conversion | 3 | Environmental, Economic, | Mandatory |
| 12220561 | Thermal load analysis | 3 | Environmental, Economic, | Elective |
| 12220565 | Hydronic heating systems | 3 | Environmental, Economic | Mandatory |
| 12220569 | Renewable cooling | 3 | Environmental, Economic, Cultural | Elective |
| 12220570 | Environmental impacts of HVAC systems | 3 | Environmental,  | Elective |
| 12220568 | Roof ventilation | 3 | Environmental,  | Elective |
| 12220533 | Sanitary | 3 | Environmental,  | Mandatory, Elective |
| **Safety and fire engineering** |
| 12230210 | Introduction to fire and safety | 3 | Environmental, Social | Mandatory |
| 12230405 | Safety engineering | 3 | Social, cultural | Mandatory |
| 1230412 | Health , safety and environment | 3 | Environmental, Social | Mandatory |
| 12230556 | Risk assessment | 3 | Social, economic | Mandatory |
| 12230560 | Pollution  | 3 | Environmental | Elective |
| 12230563 | Fire and explosive material detection | 3 | Environmental, social | Elective |
| 12230565 | Special topics in safety engineering | 3 | Social, economic | Elective |
| 12230590 | Engineering statistics | 3 | economic | Elective |

**Department: Architectural Engineering (Co-operative)**

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| course number | Course name | C.H | **Related to sustainability** (social, environmental, cultural, economic) | **Type of the course** | **Course description** |
| 12280303 | Environmental Control Systems I (Electrical and Lighting Systems for Building) | 3 | Environmental, Economic | Mandatory | This course introduces you to the design of electrical building services, i.e. electrical systems and installations that provide power, movement, communication, comfort and safety in modern buildings. Building services are designed by electrical engineers prior to the construction of new buildings, and before maintenance and upgrade work in existing buildings |
| 12280308 | Environmental Control System II (Sanitary and HVAC) | 3 | Environmental, Economic | Mandatory | Appreciation and understanding of the physical requirements of buildings and the sanitary and HVAC systems involved. The first component involves water supply and draining systems, fixtures, and private sewerage systems. The Second component involves the study of Heating, Ventilation and Air Conditioning (HVAC), central heating and cooling systems, distribution media, delivery devices, HVAC system characteristics; psychometric use applications; system and equipment selection; duct design and layout. Both components address applications in different building scales and types. Attention is given to energy and resource conservation techniques and computer applications. |
| 12280403 | Green Architecture | 3 | Environmental, Economic | Mandatory | Introduction to the various forces that shape the human environment with a particular focus on ecological determinants; Integration and internalization of environmental considerations aimed toward sustainable environments; Various issues are studied, including, successful use of open spaces, indoor environmental qualities, as well as economic derivatives and human health matters; Natural Elements (air, sun and water) are examined as they interact with human needs within buildings or building complexes. |