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| **ESM801** | **Momentum, Heat and Mass Transfer** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Fundamental concepts and laws in momentum, heat and mass transfer. Boundary layer equations. Heat and mass diffusion. Analogy between momentum, heat and mass transfer. One-dimensional mass transfer. Mass transfer in laminar flaws and mass diffusion equation. Heat and mass transfer in psychometrics process. Conservation equations for mixtures. Heat, momentum and mass transfer equations in multiple dimensional.** |
| **ESM802** | **Analytical Methods of Engineering** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Derivative-integral concepts and their engineering applications. Engineering applications of partial derivatives, determining the maximum and minimum points of the functions with two variables mathematically and graphically. The least square method and curve assignment (regression). Multiple correlation, matrice calculations for engineers, solutions of high order linear differential equations.** |
| **ESM803** | **New and Renewable Energy Technology** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Significance of natural gas and nuclear energy, solar energy, wind energy, hydrolic energy, geothermal energy, wave energy, hydrogen energy, solar-hybrid power systems.** |
| **ESM805** | **Exergy Analysis of Energy Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Thermodynamic notions,1st and 2nd law of thermodynamics and analyses methods, thermodynamical modelling, entropy, 2nd law analyses of engineering systems, reversible work,irreversibility, 2nd law analysis of open and closed systems, exergy analyses, determination of exergy and environmental relation, exergy components, exergy balance, exergy formulation for closed system and control volume, chemical exergy, standard exergy definition, definition of exergy efficiency, usage of exergy analyses for thermodynamical enhancement, heat transfer and thermal design of systems and modelling importance, application of fluid mechanics and heat transfer at thermal system design and importance and also examples.** |
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| **ESM809** | **Energy Conservation and Efficiency** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Base and detailed energy control, data collection methods and instruments, determination of energy saving opportunities, energy and cost saving estimation, assessment of energy saving and preparing report. Energy efficiency at constructions and industry. Application of energy saving regulations.** |
| **ESM811** | **Energy Management Of Industry** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **The importance and the fundamentals of energy management in industry, related database and legal legislation; energy consumption analyses; energy efficient technologies in electrical, illumination, boiler, furnace, steam, pressurized air systems; insulation, waste heat recovery techniques; energy analysis and tracing, measurement devices and measurement techniques; economical analysis methods.** |
| **ESM813** | **Drying Technologies** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Drying theory, application of drying theory to dryers, examination of heat and mass transfer together, drying models, optimum dryer design.** |
| **ESM815** | **Fuel Cells and Electricity Production** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Hydrogen production, storage and transportation, overview of fuel cell systems, Alkaline fuel cell. molten carbonate fuel cells, work process and principles of solid oxide fuel cells and solid polymer fuel Cells, typical cell equipment, cell configurations, applications and economics, principles of fuel cell electrochemical, fuel cells temperatures. Adiabatic flame temperature. Criteria of chemical equilibrium, Equilibrium constants. Chemical kinetics: reaction rates, Arrhenius relation. Activation energy. Reactions of single-step, consecutive and chain. Droplet and spray combustion. Combustion systems, fuel atomization, the group combustion numbers. Fluid bed combustion. Coal combustion. Ignition, combustion environmental pollutant.** |
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| **ESM817** | **Measurement and Data Acquisition** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Introduction, Variables , Static and dynamic characteristics, Selection criteria, A/D, D/A, Amplification, data acquisition system, measurement methods and measurement instruments, Temperature sensor, Resistant strain gauges, Transducers, Digital transducers, Pressure, Force, Torque, Speed, density, viscosity, magnetic, moisture and humidity sensors, step motors, radiation and radioactive sensors, emission measurements. Thermovison, Optic sensors, Image system** |
| **ESM819** | **Rheology** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Introduction and basic concepts, physical properties of fluids, viscosity concept, classifying the rheological behaviour of fluids, Newtonian and non-Newtonian fluids, Types of viscometers and its application, shear stress-shear strain, lineer and non-lineer viscoelasticity, types of rheometers, laminar and turbulent pipe flow of non-Newtonian fluids, drawing rheological graphs.** |
| **ESM822** | **Design Of Solar Powered Systems** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Solar energy technologies, performance analyses about energy transformation systems, active and passive solar energy system applications, theoric basics used in energy systems design, project methods of solar energy systems, hybrid systems design where solar energy is used.** |
| **ESM823** | **Analogy and Model Theory** | **3** | **0** | **0** | **8** |
| **Purpose and Content** | **Dimensions and units, dimensional systems, dimension conversions, the principle of co-dimensionality. The structure of the physical equations. Transformations.Correlation of variables. Form of dimensionless relations. Different dimensions.Dimensional modeling. Repeated Variables method and Buckingam Pi Theorem, Examples.** |
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| **ESM896** | **PhD Qualification** | **0** | **1** | **0** | **26** |
| **Purpose and Content** | **The Thesis, related subjects and other current Subject** |
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| **ESM897** | **PhD Seminar** | **0** | **2** | **0** | **6** |
| **Purpose and Content** | **A comprehensive research and presentation about a subject assigned by student and supervisor.** |
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| **ESM899** | **PhD Thesis Research** | **0** | **1** | **0** | **26** |
| **Purpose and Content** | **Thesis topics and contemporary topics.** |
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| **LUEE801** | **Scientific Research Techniques and Scientific Ethics** | **3** | **0** | **3** | **8** |
| **Purpose and Content** | **Fundamental concepts and information about the science, the structure of scientific research, scientific methods and different ideas on these methods, data acquisition methods (quantitative and qualitative), registration, analysis, interpretation and reporting of datas.** |
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| **ESM8098D** | **Course Field of Specialization** | **4** | **0** | **0** | **4** |
| **Purpose and Content** | **The Thesis, related subjects and other current Subject** |
| **ESM8098T** | **Thesis Field of Specialization** | **4** | **0** | **0** | **4** |
| **Purpose and Content** | **The Thesis, related subjects and other current Subject** |

