Mechanical Engineering

Course syllabus:

MEI 601 Manufacturing Processes

Pre-request GE 605, GE 610

Manufacturing Process selection: Material selection, basic consideration, dimensions and tolerances, availability, automation and labour costs. Principles of Metal Forming: Analysis of forming processes - stress/strain, strain rate and temperature effects, yield criteria, flow rules. Metal Forming Applications: rolling, forging, extrusion, deep drawing and bending. Relevant computer simulation techniques involving CAD and finite element analysis. Laser Processing: application of lasers in manufacturing processes (Machining, Welding, ..etc.), Computer Aided Modelling of Materials in Manufacture: Brief review of materials in manufacture. Casting, forging and powder metallurgy. Requirements for accurate computer models. Constitutive equations for materials processing.

MEI 602 Modern Metal Cutting

Pre-request GE 605, GE 610

Fundamentals of metal cutting, chip formation, estimation of cutting force, heat generation and temperatures in metal cutting, cutting tools: types, material, geometry, classification. Tool wear, tool life, optimization of cutting Conditions. Non-traditional Machining: EDM, ECM, EBM, USM, …

Laboratories Course work:

(1) Practical application of selected shapes of work-piEEPs in a lathe machine

(2) Practical application of spur and bevel gear making in a milling machine

(3) Demonstration cutting by an EDM machine

MEI 603 Welding and Casting Technology Pre-request GE 605, GE 610

Traditional welding processes, welding metallurgy, selection of welding processes, design of weld joints, weld defects, NDT testing of weld joints, application of TIG & MIG welding, plasma and electron beam welding, welding automation. Evolution of casting, casting metallurgy, process selection, economic and feasibility considerations, die casting, investment casting, centrifugal casting, casting defects, automation of casting processes.

MEI 604 Manufacturing Metrology

Pre-request GE 605, GE 610

Errors in measurement: Types of errors, compound errors, the effect of averaging results, graphical methods. Measurements by light waves: Nature of light, monochromatic rays, interferometer, laser metrology. Linear measurement: Slip and block gauges, , operation of measuring machines. Angular measurement: Sine bar, measurement of taper gauges, optical instruments for angular measurements. Surface metrology: Surface evolution – stylus method, numerical values for surface assessment, surface texture specimen, other methods of surface evolution, computer aided analysis, roundness assessment of work-piEEP and rotation accuracy of machine spindles, vibration assessment of machine systems; forced and self excited vibration. Machine tool metrology: Alignment tests, tests for squareness. Calibration of rotary tables, Gear measurements, Measurements of screw threads.

MEI 605 Application of CAD/CAM

Pre-request ME 602, ME 601

Computer Integrated Manufacturing (CIM) Models. Flexible manufacturing: equipment and systems. Computer Aided Design (CAD): The role of computers in the design process, computer hardware, I/O devices, constructing geometric elements in CAD, transformation in two-dimensions (translation, rotation), transformations in three-dimensions, computer graphic aids, CAD modelling,

solid modelling, surface modelling, mathematical representation of Bezier surfaces, cell decomposition and boundary models, Boolean and sweep operations, interfaces for CAD/CAM. Computer Aided Manufacturing (CAM): Control structures for manufacturing systems, function oriented structures, hardware structures, software oriented structures, software systems for CAD, CAM and CAPP, programming NC equipment, part programming, group technology, examples of CAM applications in industry (computer aided machining), industrial robots, robot coordinate systems, robot applications.

MEI 609 Advanced Quality Engineering

Pre-request GE 605, GE 610

The concept of quality engineering. Methods for quality improvement. Methods for productivity improvement. Principles of Shewhart meaning of quality, Deming definition of quality, Taguchi principles of quality: control charts for variables, individuals, and attributes. Process capability analysis. Variation of assemblies. Monte Carlo simulation. Multi-variate situations.

Computer based workshops. Design of quality control systems in manufacturing. Use of advanced statistical process controls, sampling inspection techniques, process capability, and other statistical tools. vendor sourcing and control tools, methods for establishing specifications and tolerances, quality function deployment, and other quality control techniques.

MEI 610 CNC Machining

Pre-request ME 602

Introduction to CNC: Evolution of NC, NC applications, CNC controllers, CNC fundamentals: Axis and motion nomenclature, CNC turning fundamentals, CNC milling fundamentals. Programming concepts: CNC codes, programming sheets, preparing to programme, tool motion, canned cycles, tooling, setting cutting variables. CNC turning: G-codes, M-codes, examples of applications. CNC milling: G-codes, M-codes, milling examples. CNC – EDM machining.

Laboratories and course work:

- CNC demonstration software in turning
- CNC demonstration software in milling
- Practical application of CNC turning
- Practical application of CNC milling
- Practical application of CNC – EDM machining

MEI 611 Engineering Economics and Cost Accounting

Pre-request GE 605, GE 610

General concepts, tools of engineering economy, net present value for money, annual equivalent, rate of return, pay back period, methods of project evaluation, depreciation, replacement analysis, income tax, inflation, cost estimation, cost indexes, product pricing, BE analysis.

MEI 618 Engineering Management/Operations Research

Pre-request GE 605, GE 610

Fundamental concepts of mathematical systems theory and decision theory. Application of general systems approach for specification of requirements, analysis, design, implementation of industrial engineering, and information systems. Generalized techniques and applications common to industrial and mechanical engineers. Class project concerning analysis of large-scale systems problem utilizing operational research.

MEI 685/MEM 685 Composite Materials Technology

Pre-request MEM 680, MEM 695

Properties of laminates, properties of short fiber composites, processing thermosets, metal matrix composites and ceramic matrix composites, principles of processing polymer matrix composites, textile reinforced composite materials.

MEP 626 Advanced Thermodynamics

Pre-request GE 605, GE 610

Availability Analysis of Cycle, Mixtures and Solutions, Equilibrium of Multiphase-Multicomponent Systems, Chemical Availability, An Introduction

to Thermo-Economic Optimization, Kinetic Theory of Gases and Transport Phenomena, Statistical Thermodynamics, Applications of Statistical Thermodynamics.

MEP 627 Combustion Engineering

Pre-request MEP 630, MEP 628, MEP 626

Fuels, Combustion process, Adiabatic flame temperatures, Ignition and flammability of hydrocarbon fuels, Flames, Flame propagation, Flame stabilization, Applications of droplet evaporation, Applications of turbulent premixed flames.

MEP 628 Conduction Heat Transfer

Pre-request GE 605, GE 610

Principles of conduction. Analysis of one-dimensional and multidimensional steady and transient, phase change and moving heat source problems are examined. A comprehensive treatment of numerical and analytical methods for solving heat conduction problems is presented.

MEP 630 Convective Mass and Heat Transfer

Pre-request MEP 632, MEP 628

Principles of convection. Analysis of heat transfer for internal and external flows; laminar and turbulent boundary layer theories; forced and natural convection. Analysis using similarity transformations, integral solutions and numerical methods.

MEP 632 Fluid Dynamics

Pre-request GE 605, GE 610

Boundary layer phenomena, Fundamentals of incompressible flow, Kinematic and dynamic equations for compressible viscous flow, Incompressible flow cricriteria, viscous flow patterns and solution methods. Fundamentals of turbulence, including scaling, transport, and kinetic energy of turbulence; wakes, jets; wall-bounded flows; spectrum of turbulence. Dynamics of vorticity, inviscid flow; boundary layer theory and computational techniques. Dynamical equations, structure of time-averaged flows, two-equation and Reynolds stress closure models, Flow computation. Classical solution techniques for compressible laminar and turbulent boundary layers, computational methods for inviscid and viscous flows. Softwares (FLUENT)

MEP 634 Control Volume Method

Pre-request MEP 630

Formulation and implementation of control volume based on finite difference method for the solution of convection-diffusion problems. Discussion of different interpolating schemes such as Upwind Scheme; Exponential Scheme; Hybrid Scheme and Power-Law Scheme. Generalized formulation and flow field calculation.

MEP 635 Radiation Heat Transfer

Pre-request MEP 628

Introduction to thermal radiation; the electromagnetic spectrum; the black body; wave phenomena versus geometric optics; polarization; diffraction and refraction effects; emission; reflection; absorption, and transmission of

thermal radiation by surfaces; radiant interchange among surfaces; radiation through a participating medium; the Monte Carlo ray trace method.

MEP 637 Applied Finite Elements

Pre-request MEP 630

Formulation and computer implementation of finite elements models of typical equations of fluid flow, heat transfer, and solid mechanics, the problems considered include heat conduction and convection, torsion, ground water flow, electrostatic and magnetism, plane elasticity, flow of viscous incompressible fluid, and plane bending. Both theoretical development and computer program development are studied.

MEP 638 Refrigeration and HVAC System Design

Pre-request MEP 626, MEP 632, MEP 628

Analysis, design, performance prediction of vapor-compression and absorption refrigeration components and systems; applications to heat pumps and cryogenic. Computer analysis and design of air conditioning systems for commercial and industrial buildings, including component and equipment selection. Energy – efficient concepts and controls are emphasized.

MEP 641 Renewable Energy Systems

Pre-request MEP 626,MEP630

Solar radiation intensity and location; basic concepts of solar thermal process; collectors; applications for water heating; active and passive building heating and cooling; industrial processes. Wind energy

fundamentals. Aerodynamic theory of propellers and windmills. Optimal blade design and economics.

MEP 643 - Principles of Desalination

Pre-request MEP 630 MEP 626

Theory and methods of separation, topics include conventional and non-conventional desalination techniques. Detailed analysis and description of basic distillation and freezing processes, major components and systems, plant installation and factors in plant economics.

MEP 636 – Advanced Gas Dynamics

Pre-request MEP 632

Control volume analysis, conservation of mass, conservation of energy, pressure energy equation, sonic velocity, equations for perfect gas in terms of Mach number, varying area adiabatic flow, perfect gas with losses, nozzle operation, diffusers operation, normal shock waves, shocks in nozzles, oblique shock waves, oblique tables and charts, Prandtl Meyer flow, analysis of Prandtl Meyer flow, Fanno flow, reference state and fanno tables applications, friction shocking, Rayliegh flow applications, correlation with shocks, propulsion engines, thrust, power and efficiency

MEP 645 – Advanced Gas Turbine Cycles

Pre-request MEP 626

Brief review of power generation thermodynamics, reversibility and availability, basic gas turbine cycles, cycle efficiency with turbine cooling, full calculation of plant efficiency, wet gas turbine plants, the combined cycle gas

turbine (CCGT), Novell gas turbine cycles, the gas turbine as a cogeneration (combined heat and power) plant.

MEP 646 – Advanced Internal Combustion Engines

Pre-request MEP 626

Engine performance characteristics, performance indices; idealised thermodynamic cycles and the limits to ideal behaviour; thermo-fluid implications of maximising power output using high engine speeds. Maximising air/fuel charge, intake and exhaust system design, supercharging and turbocharging; fuel systems, combustion control and engine management systems.

MEP 647Advanced Acoustics

Advanced concepts in acoustics with emphasis on duct acoustics, transmission and radiation of sound, acoustics of mufflers, combustion instability and suppression of sound.

MEM 676 Design and Manufacturing

Pre-request GRE605, GRE610

Basic stress analysis, Materials inventory, computer tools for stress analysis, manufacturing principles, design methodology, computer in design, fundamental strategies and life cycle, analysis, quality function development, design for manufacture, systematic selection methods, material selection for aerospace applications, materials for marine applications, materials in civil engineering and construction, materials for automotive applications, Avoidance of failure.

MEM 678 Light Metals and Alloys

Pre-request MEM 680

Physical metallurgy principles, physical metallurgy of Al alloys, Al alloy systems, solidification processing of light alloys, high pressure gas atomization of light alloys, spray forming of light alloys, structure-property relationship in Al alloys, structure-property and applications of Al-Li alloys, Al MMCs (processing-microstructure), Al MMCs (properties), Development of Ti alloys, clean melting of Ti alloys, Mg alloys, development and uses of structural Magnesium alloys, Ti fiber reinforces MMCs, designing light alloys for non-equilibrium processing, fusion welding processes of light alloys, solid state welding of light alloys.

MEM 679 Surface Science and Engineering

Pre-request MEM 680, MEM 678

Fundamentals of thin film growth, adhesions and interfacial effect5s, ion implantation, carburizing and nitriding, methods of plasma surface treatment, CVD process in microelectronics, PVD techniques, coating selection and PVD applications, surface analytical techniques, high temperature surface engineering, advanced wear and corrosion resistance coatings, hot dip galvanizing of tin plates, electro and electro-less plating, mechanical testing of coatings, conversion coatings, fundamentals of paint, new developments in wear resistant coatings, bulk structural analysis, plasma polymerization methods, depth profiling and microscopy.

MEM 680 Introduction to Materials Engineering

Pre-request GME605, GME610

Crystal structure, defects, fundamental properties of materials, functional properties of materials, structural properties of materials, surfaces and interfaces, steels, light metals, structure and properties of ceramics, processing of ceramics, structural properties of polymers, processibility of polymers, composites, corrosion, selection.

MEM 685/MEI 685 Composite Materials Technology

Pre-request MEM 680, MEM 695

Properties of laminates, properties of short fibre composites, processing thermosets, metal matrix composites and ceramic matrix composites, principles of processing polymer matrix composites, textile reinforced composite materials.

MEM 686 Composite Mechanical Performance

Pre-requestMEM 685

Basic mechanics of reinforcement, laminate theory, fracture processes and toughness of composites, reinforcement and matrices, interfaces in composite materials, manufacturing processes, modelling of the processing of fibre composites, failure criteria, introduction to design, the effect of stress concentration, fatigue, structure and behaviour of woven composites, impact and environmental effects.

MEM 690 Ceramics Processing

Pre-request MEM 695

Ceramic microstructures, mechanical properties of ceramics, processing of engineering ceramics; powders as well and green bodies and densification, high performance refractories, finishing operations, inorganic glasses,

functional ceramics, non-oxide structural ceramics, applications of oxide ceramics, design with ceramics.

MEM 692 Advanced Polymeric Materials

Pre-request MEM 695

The amorphous state, the crystalline state, mechanical behaviour, thermo-plastics, thermo-sets, liquid crystal polymers, toughness and toughening mechanisms in polymers, plastics processing review, advanced processing techniques, blends and alloys, polymer matrix composites, adhesives and coatings, biodegradable polymers, photo active polymers, polymers in aerospace, microelectronics, automotive applications, recycling of polymers.

MEM 694 Fracture Mechanics

Pre-request MEM 680, MEM 695

On completion of the course the delegate should:

Basic stress analysis and mechanical properties, stress intensity factor and its use in fracture mechanics, fracture of ceramics, energetics approach to fracture, limitations of linear elastic fracture mechanics, Aspects of fracture of metals, elastic/ plastic fracture mechanics, fatigue, aspects of the fatigue of welded structures, application of fracture mechanics to polymers and composites.

MEM 695 Physical Metallurgy

Pre-request MEM 680

Binary phase diagrams and how to use them to predict microstructure, transformation diagrams and how to use them, characterization of

microstructure, diffusion, liquid-solid transformation, precipitation in solid state, pearlitic, bainitic and martensitic transformation, non-ferrous materials, ferrous materials, microstructure and processing, defects, cold work recover re-crystallization and grain growth, strengthening mechanisms.

MEM 699 M. Sc. Project

Pre-request Finish 33 units with GPA 3.0/4.0

The M. Sc. Project includes the research work conducted by the student as a partial fulfilment for the award of the M. Sc. Degree. The student is aided by a member of staff and should present at lest 2 seminars during the time period of preparing the research work.

GRE 601 Research Methods

Writing a proposal, the purposes of literature review, using library resources, working with others, Errors and uncertainty, collection and presentation of data, experimental design, communication of research findings, protecting and exploiting research.

GME 605 Engineering Mathematics

An introduction to the use of mathematical analysis techniques for the solution of engineering analysis problems and the simulation of engineering systems. Both continuous and discrete methods are covered. Initial and boundary value problems for ordinary and partial differential equations are treated.

GME 610 Numerical Methods

Advanced numerical methods for solving parabolic, elliptic, and hyperbolic partial differential equations; convergence and stability criteria; grid generation; special mesh systems and orthogonal coordinate systems; computer applications.

REE 615 (RD 640) Energy Planning and Environment

Concept of Energy System, World Energy Resource, Assessment of Word Energy Resources, World Energy Consumption/Demand, Future Energy Demand and Cliatic Protection, Environmental Impacts of the World Energy System, Economical Aspects of the Energy system, International and National Energy Policies for Renewable Energy Diffusion, Strategic Planning of Energy system.

REE 611 (RD 641) Solar Thermal Processes

Solar Ray Geometry: Solar-earth geometric relations, Apparent solar path diagram, Shadow determination. Solar Radiation: Solar extraterrestrial & terrestrial irradiation, Insolation on tilted surfaces. Solar Energy Collectors: Flat-plate solar energy collectors, Thermal analysis of flat-plate collectors, Concentrating collectors, Thermal analysis of concentrating collectors, Central rEEPiver-heliostat systems. Heating Processes: Service water heating, Space heating, Performance and design of heating systems using f-chart and utilizability methods, Cooling Processes: Vapour-compression

and absorption refrigeration systems, Solar operated absorption systems, Performance of solar absorption air-conditioning systems.

REE 612 (RD 642) Photovoltaic Solar Cells

The course focuses on the physical principles, technology, and design of efficient semiconductor photovoltaic. Course goals equip students with the concepts and analytical skills to understand efficiency limitations, to assess the viability of various solar and thermo-photovoltaic technologies, and to introduce the physics required for understanding photovoltaic energy conversion. The course will focus on three primary aspects of photovoltaic energy conversion, (i) the transfer and conversion of solar (i.e. thermal) radiation to electronic energy, (ii) the theory and design of the semiconductor photovoltaic cell and (iii) photovoltaic systems and applications.

REE 617 (RD 643) Thermo-economic Optimization of Energy Systems

Energy Analysis: Definitions, Introduction to energy costing. Vapour and gas power cycles. Exergo-Economics. Economic Analysis of Thermal Systems: Estimation of total capital investment, Principles of economic evaluation, Annuities, Cost escalation, Levelization. Design Optimization: Optimization of the collector area, Optimization of the storage capacity, Optimization of the heat exchanger area. Economic of Wind Energy Systems: Energy delivery factor,

Capital costs, Economic concepts, Revenue requirements, Value of wind generated electricity, Hidden costs and non-economic factors in industrialized countries, Economic and non-economic factors in developing countries.

REE 616 (RD 644) Energy Storage

This course treats engineering materials and systems employed in conventional and unconventional direct energy conversion and energy storage.

REE 613 (RD 645) Wind Energy

Wind Speed and Energy Distributions: Speed and power relations, Power extracted from the wind, Rotor swept area, Air density, Wind speed distribution, Wind speed prediction, Wind resource maps. Propeller-Type Converters: Theory of non-interacting stream-tubes, Model behaviour of power output and matching to load, Non-uniform wind velocity, Restoration of wind profile in wake, and implications for turbine arrays. Wind Power System: System components, Turbine rating, Electrical load matching, Variable-speed operation, System design features, Maximum power operation, System control requirements, Environmental aspects, Wind farm sizing.

REE 618 (RD 646) Hydrogen Energy Systems

The goal of the course is to introduce students to concepts and tools for analyzing the hydrogen economy. As presently envisioned, hydrogen would be used as an alternative energy carrier to displace a significant proportion of petroleum use for transportation and provide electricity for stationary applications. A multidisciplinary set of tools is required to fully understand the large technical, societal and economic efforts and impacts associated with a shift to the hydrogen

economy. This course will introduce these tools via a series of lectures on various topics including hydrogen production, storage, transportation and utilization.

REE 614 (RD 648) Passive Solar Heating and Cooling

Passive Solar Systems: Direct gain, Indirect gain. Design Patterns: Building location, Building shape and orientation, Location of indoor spaces, Protected entrance, Window location, Overhang shading, Choosing the system, Appropriate materials. Direct Gain: Solar windows, Collectors and skylights, Performance and design of direct gain systems, Masonry heat storage, Interior water wall. Thermal Storage Wall Systems: Performance and design of absorber storage (Trombe) wall systems, Wall details, Convection loops. Attached Greenhouse Systems: Sizing the greenhouse, Greenhouse connection. Roof Pond Systems: Sizing the roof pond, Roof pond details.

REE 619 (RD 649) Fuel Cells

Survey course is to introduce fuel cell technology. The emphasis will be on the electrochemistry, the polymer materials science of PEM systems, and the various methods of generating power directly from a fuel and an oxidant. The course will cover the science and engineering aspects of fuel cells. The system effects of the stack will be introduced so as to provide a complete picture of the technology. Elements addressed will range from thermo-chemistry, electro chemistry, polymer science, and electrochemical engineering. Development of an understanding of the proton exchange membrane fuel cell will be the primary objective. The student is expected to

have a broad understanding of the technical needs, challenges, and opportunities after completing this course.

WDE 621 (RD 617) Seawater Thermal Desalination

Fundamentals: Heat transfer surface and performance ratio, Boiling point elevation, Pressure drop losses, Hydrostatic head effects, Flash range. Multi-stage Flash Distillation: The submerged coil evaporator, Multi-stage flash principles, Stage number effect, Flash plant layout and components. Multiple Effect Distillation: VTE multiple effect distillation, Analysis of multiple effect distillation, Fluted tubes, Horizontal tube evaporator, Multiple-effect plant layout and opera-tion. Other Methods of Distillation: Vapour compression distillation, Vapour reheat distillation, Freezing methods. Combined Power and Water Production: Combination plants, Cost allocation

WDE 622 (RD 618) Membrane Désaliénation (Reverse Osmoses)

Conceptual Design. Free Energy Requirement. Thermodynamic Relations: Distribution between solution and membranes, Chemical potential differences across membranes. Transport Relations and Mechanism of Salt Rejection: Mechanism of salt rejection, Transport equations and phenomenological analysis. Membranes: Cellulose acetate and other carbohydrate based membranes, Other neutral membranes, Ion-exchange membranes. Concentration Polarization: Batch cell without stirring, Laminar flow, Turbulent flow, Experimental tests, Pumping work. Development and Applications: Configuration and hyper-filtration systems, Field tests and applications, Some remarks on economics.

WDE 623 (RD 619) Corrosion and Materials Selection for Desalination Plant

Fundamental properties of materials, functional properties of materials, structural properties of materials, surfaces and interfaces, steels, light metals, structural properties of polymers, processibility of polymers, composites, corrosion, material selection.

WDE 624 (RD 620) Scale Formation and Fouling Phenomena and their Control in Desalination Plants

The purpose of the course is to provide theoretical and practical knowledge on membrane fouling in RO technology. Particulate, inorganic, bio-fouling and organic fouling are dealt with in detail, including pre-treatment options. Scaling and fouling control; Information technology and optimization in desalination;

Distillate post-treatment and quality control. Fouling is the common name for all types of deposits blocking the membrane surface. Four types of foulants will be dealt with in this course:

* Chemical foulants, which cause scaling
* Physical foulants, which are related to deposition of particle,
* Biological foulants which can form bio-fouling
* Organic foulants, which can interact with the membrane.

Techniques for scale prevention based on the use of anti-scalants will be included in the course. Anti-scalants consist of polymeric substances that are able to inhibit scale formation at low dosages. The conditions imposed by economic limitations can also be considered (depending on the instructor). Basic information on the action of anti-scalants is scarce and the rational use of anti-scalants is restricted by the lack of adequate technical

information. Elucidation of nucleation and scale precipitation phenomena in the presence of

anti-scalants is a pressing research need for better scale control and desalination cost reduction.

REE 697 or WDE 697 (RD 697) Special Topics

Study selected subjects related to renewable energy and/or water desalination with emphasis placed on rEEPnt developments in the field: permission of department is required.

REE 699 or WDE 699 (RD 699) M. Sc. Project

After completing all course work (or at least 24 Credits), each student commences with a thesis project on which he/she typically works over a period of 6-8 months (maybe longer depending on the student's activity). Provided that a thesis project deals with a clearly defined topic from the domain of sustainable energy engineering (or water desalination), and under the condition that competent guidance/supervision is available to the student throughout the thesis project period, the project may be carried out either in the Academy for Graduate Studies or in a Research Center or in an industrial environment. However, if the

MEI 697, MEP 697, MEM 69, REE 697 or WDE 697 (RD 697) Special Topics

Study selected subjects related to renewable energy and/or water desalination with emphasis placed on rEEPnt developments in the field: permission of department is required.

MEI 697, MEP 697, MEM 69, REE 699 or WDE 699 (RD 699) M. Sc. Project

After completing all course work (or at least 24 Credits), each student commences with a thesis project on which he/she typically works over a period of 6-8 months (maybe longer depending on the student's activity). Provided that a thesis project deals with a clearly defined topic from the domain of sustainable energy engineering (or water desalination), and under the condition that competent guidance/supervision is available to the student throughout the thesis project period, the project may be carried out either in the Academy for Graduate Studies or in a Research Center or in an industrial environment. However, if the Thesis project is to be carried out outside the Academy for Graduate Studies, special agrEEPent and written permission from the department and the School of Engineering and Applied Sciences must be obtained.

In general students are encouraged to identify and/or define relevant projects on their own, and to seek environments in which these can be carried out successfully. If possible, the department will advertise thesis project proposals.

The thesis project is conducted under the guidance of an advisor from within the program, with the assistance of local/external advisors. Students are

expected to keep their advisors regularly updated on the progress of their project work, and need to submit progress reports at different stages of their work.

The purpose of thesis projects is for the students to elaborate sustainable solutions to specific energy engineering problems, preferably relevant to the conditions and requirements in the local economy.

Upon completion of their thesis projects, students are expected to formally present the results of their efforts within the framework of a seminar and respond to comments/questions put forward by a committee consisting of their thesis advisors and invited referees. These presentations must be carried out within the premises of the Academy.

Upon successful completion and presentation/defence of their project work, students are awarded by the Academy of Graduate Studies the *Degree of Master of Science in Industrial Engineering, Thermal Power, Material Engineering, Alternative Energy, or in Water Desalination.*