STUDY PLAN

MASTER IN MECHANICAL ENGINEERING

(Thesis Track)

Plan Number			2012	T

I. GENERAL RULES CONDITIONS:

1. This plan conforms to the regulations of the general frame of the programs in graduate studies.
2. Areas of specialty for admission to the Master's program:
   - Holders of the Bachelor's degree in:
     a- Mechanical Engineering
     b- Industrial Engineering
     c- Civil Engineering.
     d- Chemical Engineering
     e- Mechatronics Engineering
     f- Agricultural Machines Engineering

II. SPECIAL CONDITIONS: All other specialization other Mechanical Engineering must be evaluated by Graduate Studies Committee for Admission or not, with a possibility to add extra undergraduate courses.

III. THE STUDY PLAN: Studying (33) Credit Hours as follows:

1. Obligatory Courses: (15 Credit Hours)

Course No.	Course Title	Credit hrs.	Theory	Prac.	Pre-request
0934702	Numerical Analysis	3	3	-	-
0934703	Advanced Engineering Measurements	3	3	-	-
0944706	Finite Element Method	3	3	-	-
0904708	Engineering Mathematics	3	3	-	-
0904709	Research Methodology	3	3	-	-

2. Elective Courses: Studying (9) Credit hours from the following:

Course No.	Course Title	Credit hrs.	Theory	Prac.	Pre-request
0904710	Advanced Vibration	3	3	-	-
0944711	Advanced Solid Mechanics	3	3	-	-
0944716	Advanced Control	3	3	-	-
0904717	Advanced Combustion	3	3	-	-
0944722	Advanced Heat Transfer	3	3	-	-
0944724	Advanced Fluid Mechanics	3	3	-	-
0904730	Special Topics in Mechanical Engineering	3	3	-	-

3. Thesis: 9 Credit hours (0904799)

Master's Course Description

0934702 Numerical Analysis **(3 Cr)**

Accuracy and stability of ODE solutions: One step-methods (Heun's Method, Predictor-Corrector) Adaptive step size control. Boundary and eigen value problem. Conversion of boundary value to initial value problem. Accuracy and stability of PDE solutions: Elliptic, Parabolic and Hyperbolic equations with applications. Finite Element Method: 1-D and multidimensional unconstrained problems. Constrained optimization. Integration equations: Simpson's integration and Newton-Cotes open and closed integration.

0934703 Advanced Engineering Measurements **(3 Cr)**

Introduction. The design of successful experiments, general concepts and dynamics. Random signal analysis. Flow measurements using pressure tubes. Flow visualization. Heat transfer instrumentation. Introduction to thermal anemometry. Laser Doppler anemometry. Particle sizing using optical methods. Computer methods, data reconstruction and flow visualization. Strain gages. Stress measurements using photoelasticity. Vibration measuring techniques. Digitization & Sampling, A/D and D/A converters. Design of computer interface cards.

0944706 Finite Element Method **(3 Cr)**

Introduction: General concepts, and definitions, Physical systems, (Natural phenomena) methods for solution. Formulation of differential equations governing the physical system, and the corresponding boundary conditions. Division (discretization) of analysis region into finite elements: Techniques for discretization. Efficient mesh, mesh refinement. FE-Equations (FE Properties) Trial solution, Trial functions: polynomials, Shape functions. Methods for developing FE-equations. Assembly of FE equations, Global equations system, Imposing the BCs, Programming and solutions Verification of the solution, Accuracy and convergence . Implementation of computer programs : High order FE, Isoparametric FE Applications.

0904708 Engineering Mathematics **(3 Cr)**

ODE's: Linear ODE's Variation of parameters, Power Series Method. PDE's: Separation of Variables, Orthogonal Functions and the general expansion Problem, Bessel Function's and Legender Polynomials, Fourier Series, Integral and Transforms, Laplace Transform. Vector Calculus: differentiation, integration, vector operators, Limits (multivariable), integral theories.

0904709 Research Methodology **(3 Cr)**

In this course, the student learns how to conduct a scientific research, starting from developing the research idea up to writing and presenting a technical report. The course starts by attending a number of lectures given by faculty and invited speakers where models of researches and case studies in advanced fields of mechanical engineering are presented. Meanwhile, students undertake limited researches of their own under the supervision of faculty staff members to learn how to define the problem; how to make literature review, searching through various resources such as the Engineering Index and Internet. Methods of Solution: Analytical, Numerical and Experimental methods. Report writing: Introduction; Analysis; Description of the experiment; Experimental procedure; Results; Discussion Conclusions; Recommendations; References; Abstract. At least one report/ paper will be prepared and presented by the student in front of colleagues and staff.

0904710 Advanced Vibration (3 Cr)

Response of SDOF oscillator to deterministic signals. Complex and real Fourier series. Convolution integrals. Equations of motions of MDOF vibration systems. Lagrange's equations, influence coefficients. Solutions of equations of motion of MDOF systems: eigenvalues and eigenvectors. Vibration of one dimensional continuous system: strings, bars and beams. Wave equation. Separation of variables methods. Introduction to nonlinear vibration. Discretization methods: Rayleyh-Ritz and finite element methods. Introduction to nonlinear vibrations of SOF oscillators. Jump phenomenon, sub and superharmonic responses. Mathieu's equation and stability analysis. Introduction to geometric methods. Phase plane plots and limit cycles.

0944711 Advanced Solid Mechanics (3 Cr)

This course introduces students to advanced topics in strength of materials. It covers the following subjects: Tensors, Theory of elasticity in 3D, plane stress and plane strain problems, bending of unsymmetrical sections, torsion of non-circular sections, bending and torsion of thin-walled sections, thin plates and stress concentration.

0944716 Advanced Control (3 Cr)

Linear systems: state space representation, stability analysis, pole placement, LQR, LQG. Adaptive Control: introduction to Robust Control: introduction to H-infinity techniques in control design.

0904717 Advanced Combustion (3 Cr)

Fundamental concepts of combustion including: Stoichiometry, Chemical kinetics, Conservation laws for reacting flow. Theories of flames and detonation waves. Also the course covers solid fuel combustion, simulation of IC engines. Environmental pollution.

0944722 Advanced Heat Transfer (3 Cr)

Steady, multidimensional conduction. Fin problem solutions using Beset and other functions. Unsteady multidimensional conduction. Forced convection including internal flow and heat transfer between parallel plates; entrance length. External flows over wedges and bodies of revolution. Free and mixed convection. Radiant heat transfer; heat transfer between surfaces in absorbing media. Mass transfer; Diffusion in stationary and laminar flow systems, mass transfer in turbulent flow.

0944724 Advanced Fluid Mechanics (3 Cr)

Introductory concepts. Hydrostatics. Kinematics of fluid motion. Conservation of mass. Introduction to inviscid flow. Momentum theorems. Introduction to viscous flow. The Navies - Stokes equation. Similitude, scaling, dimensional Analysis and modeling . Inertial free flows at low Reynolds number. Boundary layers. Turbulence. vorticity, circulation. Potential flows.

0904730 Special Topics in Mechanical Engineering (3 Cr)

This course is delivered according to the availability of staff members in light of the advent of new specializations in the fields of thermal sciences and applied mechanics. The student is not allowed to take this course more than once, even if the subjects are different.