



جامعة مؤتة/كلية الهندسة
قسم الهندسة الميكانيكية

**Mutah University/Faculty of Engineering
Mechanical Engineering Department**

الخطة الدراسية لبرنامج الماجستير
في الهندسة الميكانيكية

**A Masters Program Proposal
in Mechanical Engineering**

2014

List of Courses for the Suggested Degree

Table 1: List of Compulsory Courses (15 credit hours) for Thesis Branch (no prerequisite for all compulsory courses)

: جدول رقم (1) المواد الإجبارية (15) ساعة حدا أدنى معتمدة لمسار الرسالة:-

الرقم	رقم المادة	اسم المادة	الساعات المعتمدة
1	04027001	رياضيات هندسية متقدمة Advanced Engineering Mathematics	3 نظري
2	04027002	تحليل عددي متقدم Advanced Numerical Analysis	3 نظري
3	0402750	منهجية البحث Research methodology	3 نظري
4	04027101	تحليل اجهادات Stress Analysis	3 نظري/ عملي
5	04027201	علوم المائع – الحرارية Thermo – fluid sciences	3 نظري/ عملي
6	04027004	ندوة Seminar	0 عملي

Table 2: List of Elective Courses (9 credit hours) for Thesis Branch (no prerequisite for all Elective courses)

: جدول رقم (2) المواد الاختيارية (9) ساعة أحد أقصى معتمدة لمسار الرسالة (على ان يتم

الاختيار بالتنسيق مع المشرف على الرسالة وبموافقة مجلس القسم):-

الرقم	رقم المادة	اسم المادة	الساعات المعتمدة
1	04027102	ترايبولوجي متقدم Advanced Tribology	3 نظري/ عملي
2	04027103	ميكانيكا الكسر Fracture Mechanics	3 نظري/ عملي
3	04027104	تحكم آلي متقدم Advanced Automatic Control	3 نظري/ عملي
4	04027105	نظريات الاحتكاك واللبليان المتقدمة Advanced Friction and Wear Theories	3 نظري/ عملي
5	04027106	اهتزازات ميكانيكية متقدمة Advanced Mechanical Vibrations	3 نظري/ عملي
6	04027107	نظرية المرونة واللدنة Theory of Elasticity and plasticity	3 نظري/ عملي
7	04027108	تصميم المحامل تحت الأحمال الديناميكية Bearings Design Under Dynamic Loadings	3 نظري/ عملي
8	04027109	مواضيع تخصصية في التصميم و الميكانيكا التطبيقية Special Topics in Design and Applied Mechanics	3 نظري/ عملي
9	04027202	أنظمة الطاقة المتجددة Renewable energy systems	3 نظري/ عملي
10	04027203	ديناميكا حرارية متقدمة Advanced Thermodynamics	3 نظري/ عملي
11	04027204	انتقال الكتلة و الحرارة المتقدم	3 نظري/ عملي

عملي		Advanced Heat and Mass Transfer		
نظري/ عملي	3	ميكانيكا المائع المتقدم Advanced Fluid Mechanics	04027205	12
نظري/ عملي	3	الطاقة الشمسية المتقدمة Advanced Solar Energy	04027206	13
نظري/ عملي	3	أنظمة تكييف الهواء Air Conditioning Systems	04027207	14
نظري/ عملي	3	الوقود والاحتراق Fuels and Combustion	04027208	15
نظري/ عملي	3	تصميم الأنظمة الحرارية المتقدمة Advanced Thermal System Design	04027209	16
نظري/ عملي	3	انتقال الحرارة و ديناميكا المائع الحسابي Computational fluid Dynamics and Heat Transfer	04027210	17
نظري/ عملي	3	ديناميكا الغاز Gas Dynamics	04027211	18
نظري/ عملي	3	مواضيع تخصصية في القدرة الحرارية و الطاقة Special Topics in Thermal power and Energy	04027212	19
نظري/ عملي	3	المواد المركبة والسيراميك Composite and Ceramic Materials	04027301	20
نظري/ عملي	3	الفحوصات اللا إتلافية Non-Destructive Tests (NDT)	04027302	21

1- تفاصيل الرسالة (Thesis):-

0402776 Thesis (3 Credit hours)
0402777 Thesis (6 Credit hours)
0402778 Thesis (9 Credit hours)

0402776 رسالة (3 ساعات معتمدة)
0402777 رسالة (6 ساعات معتمدة)
0402778 رسالة (9 ساعات معتمدة)

وصف المواد

0402701 Advanced Engineering Mathematics

Review of ordinary differential equations, vectors and vector calculus, matrices, partial differential equations, calculus of variations, complex analysis.

0402702 Advanced Numerical Analysis

Complex roots of polynomials, approximations of functions, systems of ordinary differential equations, eigenvalue/eigenvector problems, optimization, partial differential equations.

0402704 Seminar

Individual study in advanced areas of mechanical engineering under the supervision of faculty member, a written report and a presentation of the results of the study are required.

0402711 Stress Analysis

Triaxial stress systems. Complex strain (strain transformation) and the elastic constants. Thick cylinders. Theories of elastic failure. Unsymmetrical bending. Struts. Torsion of non-circular and thin-walled sections. Rings. Rotating discs and cylinders subjected to thermal gradients. Circular plates and diaphragms. Experimental stress analysis.

0402712 Advanced Tribology

Review concepts of friction , wear and lubrication . Surface characterization . Contacts mechanics . Mechanisms of interaction between solids and Tribology behavior of materials . Physical and chemical properties of lubricants . Lubrication regimes . boundary and mixed lubrication .Theories and applications of hydrodynamic and hydrostatic bearings(application of Reynolds equation-steady state conditions), journal , thrust and stepped bearings. Air(or gas) bearings . Magnetic bearings. Elasto-hydrodynamic lubrication . solid lubrication(dry and self-lubricated bearings). Rolling elements bearings lubrication .

0402713 Fracture Mechanics

Review of basic concepts. Elements of fracture mechanics (Griffith crack theory, stress analysis of cracks, fracture toughness, etc.). Transition temperature approach to fracture control. Micro-structural aspects of fracture toughness. Environment-assisted cracking. Cyclic stress and strain fatigue and fatigue crack propagation. Analyses of engineering failures. Creep failure.

0402714 Advanced Automatic Control

Review of basic concepts, design of feedback control systems, state-space control systems, optimal control , robust control , digital control, nonlinear control, fuzzy control.

0402715 Advanced Friction and Wear Theories

Historical review of friction and wear studies. Theories of friction: Roughness theory, ploughing theory, adhesive theory and composite theory .Experimental finding of friction. Surface energy of contact and friction. Friction of non-metals. Wear mechanisms : Adhesive wear, abrasive wear, fatigue wear, erosive wear, corrosive wear and fretting wear. Wear coefficient : Archard model and Robinwize model . Wear in practice . Wear under different contact conditions.

0402716 Advanced Mechanical Vibrations

Review to basics, system response to various forcing inputs, multi-degrees of freedom systems, rotor dynamics, continuous systems, modal testing, nonlinear systems, random vibrations.

0402717 Theory of Elasticity and Plasticity

Elastic stress analysis and design for strength. Strains beyond the elastic limit. Introduction to advanced elasticity theory. Inelastic bending of beams. Curved bars bending. Torsion of inelastic circular bars. Torsion of solid noncircular members. Torsion of thin-walled tubular members. Yield and fracture criteria. Inelastic deflection of beams. Design of columns. Classical energy methods. Elastic analysis of systems. Plastic limit analysis. Non-linear elasticity. Deformation strain energy. Slip line theory. Temperature effect on elastic-plastic behavior. Finite Elements applications: Algorithms for formulating and solving the governing equations for stress problems with specified loading and boundary conditions using the three basic types of relationships (kinematics, kinetic, and constitutive) and to apply the differential approach and integral approach for the solution procedure.

0402718 Bearings Design under Dynamically Loadings

Reynolds equation for dynamically loaded bearings .Dynamically loaded journal bearings. Graphical methods of solution of dynamically loaded bearings problems . squeeze films lubrications: Parallel surface bearings, stepped parallel surfaces bearings, plane inclined slider bearings, partially circular plates and rings, conical seats , sphere near a plane and sphere in spherical seat. Lubrication of piston-rings. Short bearing theory. Design of liquid film bearings. Design of air bearings for high speed and stability.

0402719 Special Topics in Design and Applied Mechanics

This course is offered as a structural course after departmental council approval. The course consists of assigned reading and special problems or research in special areas, either theoretical, experimental or design in applied mechanics areas.

0402721 Thermo- Fluid Sciences

Review of the fundamentals of thermodynamics, fluid mechanics and heat transfer. Energy and laws of thermodynamics, integral and differential formulation of the conservation laws of fluid mechanics, conductive, convective and radiative heat transfer. Applications to thermal systems engineering.

0402722 Renewable Energy System

The environmental impact of energy use, Features of renewable energy, wind power, tidal power, wave power, biomass, solar energy, thermal design methods and conversion to mechanical energy, thermal design.

0402723 Advanced Thermodynamics

The laws of thermodynamics, general conditions for equilibrium and stability, thermodynamic potentials, phase transition and critical phenomena, principles of irreversible thermodynamics, chemical equilibrium of real gases and gas mixtures, recent developments in thermodynamics and related areas.

0402724 Advanced Heat and Mass Transfer

Conductive, convective and radiative energy transport, multidimensional steady and transient heat conduction, heat conduction with phase change, forced and free convection, Radiation from gases and vapors, mass diffusion and conservation laws for multi-component fluids, constitutive equations.

0402725 Advanced Fluid Mechanics

kinematics and dynamics of fluid flow, integral and differential formulations of the conservation laws, the Navier-Stokes equations, viscous and inviscid flows, vorticity and circulation, dimensional analysis and similarity.

0402726 Advanced Solar Energy

Nature of solar radiation, availability and prediction of solar radiation, methods of collecting and storing solar energy, analysis and design of systems for heating and cooling by solar energy, flat plate and concentrating collectors, economics of solar energy.

0402727 Air Conditioning Systems

Fundamentals concepts and engineering data including psychometric and comfort conditions, cooling load calculations, transient load calculations, codes and standards for building energy management, air conditioning systems, cost estimates and economic analysis, types and selection of equipment used in the performance of air conditioning.

0402728 Fuels and Combustion

Fossil Fuels, synthetic fuels, review of thermodynamics of gases, chemical equilibrium of real gases and gas mixtures, combustion of common fuels, combustion and flames, chemistry and physics of combustion, chemical kinetics, reaction rates, diffusion flames, detonation phenomena, atomization and vaporization of liquid fuel sprays, spray combustion, formation and control of pollution in combustion.

0402729 Advanced Thermal System Design

studies Design of thermal power system components and system optimization, heat balance, options for improved cycle efficiencies, availability loss characteristics of energy systems, and availability conversion methods.

0402730 Computational Fluid Dynamics and Heat Transfer

Numerical simulation of fluid flow and heat transfer, discretization techniques for elliptic, parabolic, and hyperbolic equations, stability and accuracy, diffusion equation, linear convection equation, nonlinear convection dominated problems, numerical solution of the Navier-Stokes equations, grid generation.

0402731 Gas Dynamics

Thermodynamics and fluid dynamics of compressible fluid flows, one-dimensional isentropic flow in nozzles and diffusers, normal and oblique shock waves, compressible flow with friction and heat transfer, application to nozzles, shock tubes and propulsion devices, two-dimensional Prandtl-Meyer flow and method of characteristics, high temperature gases and equilibrium, non-equilibrium and frozen flows.

0402732 Special Topics in Thermal Power and Energy

This course is offered as a structural course after departmental council approval. The course consists of assigned reading and special problems or research in special areas, either theoretical, experimental or design in thermal power and energy areas.

0402733 Viscous Fluid Flow

Review of the fundamental laws of fluid dynamics, exact solutions of steady and unsteady viscous flow problems, creeping and stretching flows, laminar boundary layers, stability of laminar flows and transition to turbulence.

0402743 Composites and Ceramic Materials

This course provides a broad overview of engineering composites with a specialization towards fiber reinforced matrix materials. Emphasis is placed on composite constituents, interfaces, all aspects of composites manufacturing, processing and composite mechanics (geometric aspects, laminate theory, strength and fracture theory). Practical composites design, environmental aspects and specialized composites are also introduced, geared towards recent developments. Structures, properties, applications and processing of ceramic materials are included. This course also includes Assignments that give hands-on experience in laminate manufacturing, mechanical testing and knowledge of composite microstructures.

0402744 Non-Destructive Testing

. Introduction to testing, destructive versus NDT, classification of NDT techniques: part testing, volumetric (system) testing. Defects in parts and assemblies. Surface and subsurface defects.: Liquid penetrants: surface tension and capillarity, properties of cleaners, penetrants and developers, defect sizing Radiography: introduction to electromagnetic waves, nature of radiation, Alpha, Beta ,Gamma and x-ray, safety precautions in radiography, flow detection using radiography. Ultrasonic flow detection: sound as mechanical waves, nature and behavior of ultrasonic waves. Types of ultrasonic waves, ultrasonic wave generation (the piezoelectric effect) reflection and refraction of ultrasonic waves, ultrasonic transducers and equipment, application techniques, ultrasonic test blocks, distance amplitude curves (DAC). Eddy current flow detection: nature and properties of eddy currents, material response to magnetic fields, eddy current generation, eddy current probes, testing techniques. Magnetic particle flow detection: magnetization and magnetic fields, material response to magnetic field, application of magnetic field in flow detection.

Other related techniques such as leak testing, acoustic emission, ..ect

Limitations of the different NDT technique, Selection of the appropriate NDT technique

0402750 Research Methodology (3 credit hours)

In this course students learn how to carry out different stages of scientific research starting from the formulation of research idea and finishing by a write up and presentation of a technical report. The course is in the form of lectures taught by faculty and invited speakers in which various types of research and different case studies in the advanced fields of energy engineering will be presented. As a part of the course, students will undertake at least one small research projects under the supervision of faculty members to learn how to define the problem and complete the literature review using various resources including the Engineering Index Journal list and other relevant internet sources. Measurement systems and instruments, acquisition of thermo fluid dynamic parameters, elements of technical design and drawing, elements of mechanical manufacturing (manufacturing devices) will be introduced.

Additionally students will gain knowledge on how to use in their projects appropriate analytical and numerical solutions and experimental methods. The general structure of their project reports will indicatively include the following sections: Abstract, Introduction, Analysis, and Description of the experiment, Experimental procedure, Results, Discussion and Conclusions, Recommendations and, finally, References.

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