

Industrial Engineering Department

M.Sc. Study Plan

The Industrial Engineering Department offers the degree of Master of Science (M.Sc.). The M.Sc. degree is obtained after completion of the following requirements:

A. Thesis option (34 Credit Hours):

1) Compulsory Courses (16 Cr.)

- ◆ **IE 710: Design of Engineering Experiments** 3 Cr.
- ◆ **IE 740: Reliability and Quality Control** 3 Cr.
- ◆ **IE 750: Operations Research & Management** 3 Cr.
- ◆ **IE 760: Advanced Engineering Materials** 3 Cr.
- ◆ **IE 765: Advanced Manufacturing Processes** 3 Cr.
- ◆ **IE 790: Industrial Engineering Seminar** 1 Cr.

2) Elective Courses (9 Cr.): to be selected from Table 1.

After approval of the Industrial engineering department council, a student may study no more than 3 graduate-level credit hours from other departments at the University.

3) Master thesis (9 Cr.): to be finished within at least two semesters.

B. Comprehensive Exam (Non-thesis) Option (34 Credit Hours):

1) Compulsory Courses (22 Cr.)

- ◆ **IE 710: Design of Engineering Experiments** 3 Cr.
- ◆ **IE 740: Reliability and Quality Control** 3 Cr.
- ◆ **IE 745: Project Management** 3 Cr.
- ◆ **IE 750: Operations Research & Management** 3 Cr.
- ◆ **IE 760: Advanced Engineering Materials** 3 Cr.
- ◆ **IE 765: Advanced Manufacturing Processes** 3 Cr.
- ◆ **IE 770: Advanced Computer Aided Manufacturing** 3 Cr.
- ◆ **IE 790: Industrial Engineering Seminar** 1 Cr.

2) Elective Courses (12 Cr.): to be selected from Table 2.

After approval of the Industrial engineering department council, a student may study no more than 3 graduate-level credit hours from other departments at the University.

3) Passing IE798 Comprehensive Exam (0 Cr.):

Table 1

Course Number	Course Name	Credit Hours
IE 741	Quality Management in Pharmaceutical Industries	3
IE 742	Man-Machine Systems	3
IE 743	Industrial Biomechanics	3
IE 744	Industrial Hygiene and Environmental Biotechnology	3
IE 745	Project Management	3
IE 746	Materials Handling and Facilities Layout	3
IE 747	Lean and Agile Production Systems	3
IE 748	Industrial Marketing and Finance	3
IE 749	Hospital Management	3
IE 751	Decision & Risk Analysis	3
IE 752	Industrial Simulation	3
IE 753	Enterprise Resource Planning	3
IE 754	Manufacturing Strategies	3
IE 755	Computational Intelligence	3
IE 756	Maintainability & Maintenance Planning	3
IE 757	Product Realization	3
IE 759	Special Topics in Engineering Management	3
IE 761	Tribology	3
IE 762	Mechanical Behavior of Materials	3
IE 763	Non-metallic Materials Technology	3
IE 764	Materials Removal Processes	3
IE 766	Material Joining Processes	3
IE 767	Advanced Machine Tool Design	3
IE 768	Precision Manufacturing	3
IE 769	Advanced Mechanics of Materials	3
IE 770	Advanced Computer Aided Manufacturing	3
IE 771	Analysis of Materials Machining	3
IE 772	Advanced Design for Manufacturability	3
IE 773	Advanced Robotics Engineering	3
IE 774	Advanced Control Systems	3
IE 775	Multi-Variable Control Systems	3
IE 776	Geometric Modeling	3
IE 778	Finite Element Theory	3
IE 779	Special topics in manufacturing	3

Table 2

Course Number	Course Name	Credit Hours
IE 741	Quality Management in Pharmaceutical Industries	3
IE 742	Man-Machine Systems	3
IE 743	Industrial Biomechanics	3
IE 744	Industrial Hygiene and Environmental Biotechnology	3
IE 746	Materials Handling and Facilities Layout	3
IE 747	Lean and Agile Production Systems	3
IE 748	Industrial Marketing and Finance	3
IE 749	Hospital Management	3
IE 751	Decision & Risk Analysis	3
IE 752	Industrial Simulation	3
IE 753	Enterprise Resource Planning	3
IE 754	Manufacturing Strategies	3
IE 755	Computational Intelligence	3
IE 756	Maintainability & Maintenance Planning	3
IE 757	Product Realization	3
IE 759	Special Topics in Engineering Management	3
IE 761	Tribology	3
IE 762	Mechanical Behavior of Materials	3
IE 763	Non-metallic Materials Technology	3
IE 764	Materials Removal Processes	3
IE 766	Material Joining Processes	3
IE 767	Advanced Machine Tool Design	3
IE 768	Precision Manufacturing	3
IE 769	Advanced Mechanics of Materials	3
IE 771	Analysis of Materials Machining	3
IE 772	Advanced Design for Manufacturability	3
IE 773	Advanced Robotics Engineering	3
IE 774	Advanced Control Systems	3
IE 775	Multi-Variable Control Systems	3
IE 776	Geometric Modeling	3
IE 778	Finite Element Theory	3
IE 779	Special topics in manufacturing	3

Graduate Courses In Industrial Engineering (Course Descriptions)

710 Design of Engineering Experiments: (3 Credit Hours)

This course aims to provide students with the details of the design of engineering experiments for manufacturing process analysis, human factors experimentation, and life testing. Topics include basic experimental design models, blocking, factorial experiments, nested designs, covariance analysis, response surface analysis, and estimation of effects.

740 Reliability and Quality Control: (3 Credit Hours)

Introduction to statistically based quality improvement methods useful in industrial settings. Study and application of statistical models and methods for defining, measuring and evaluating reliability of products, processes and services: life distributions, reliability functions, reliability configurations, reliability estimation, parametric reliability models, accelerated life testing, reliability improvement.

741 Quality Management in Pharmaceutical Industries: (3 Credit Hours)

Quality management systems in pharmaceutical industries (ISO, TQM, GMP). Statistical quality control and sampling methods applied to raw material, work-in-process, and finished products. Quality management systems are examined at Jordanian pharmaceutical industries.

742 Man-Machine Systems: (3 Credit Hours)

Analysis of integrated man-machine systems: physical and psychological effects of systems of deterministic and conditional responses of individuals and groups, and the resulting interaction between individuals, groups, and machine systems; also current research and development pertaining to man-machine systems.

743 Industrial Biomechanics: (3 Credit Hours)

Review of muscle, bone and joint structure and function. Kinematics and kinetic principles as applied to human movement. Analysis and application of human movements to ergonomics. The development and application of biomechanical models of physical work tasks, especially manual materials handling and hand-arm work activities.

744 Industrial Hygiene and Environmental Biotechnology: (3 Credit Hours)

Analysis of the effects of various environmental stressors on people at work, including their interference with performance and the development of acute and chronic health problems. Study of how numerous physical environmental agents such as heat, cold, noise, vibration, illumination, radiation, and gravity affect workers alone and in combination. Topics include measurement and evaluation.

745 Project Management: (3 Credit Hours)

Review of the various technical and managerial aspects of project management. Introduction to CPM and PERT. Specific topics include network development and analysis, precedence constraints, resource allocation, time-cost trade-off, heuristics, criticality index, computer applications, design and analysis of engineering projects, and optimization techniques for project scheduling.

746 Materials Handling and Facilities Layout: (3 Credit Hours)

Analysis of organized human activities (industrial and office operations). Recent methods are applied to optimize location and layout of facilities. Introduction to modern material handling systems, receiving, shipping, warehousing, expert systems in plant layout, logistics of motion of people and materials, flow analysis, plant layout, and material handling techniques.

747 Lean and Agile Production Systems: (3 Credit Hours)

Introduction of the fundamental concepts for production utilizing lean manufacturing principles and practices. Basic operations management models and tools used in designing, building and operating a manufacturing system that can be applied to any operations. Examine the Toyota Production System. The concept of agile manufacturing is introduced and examine its application at Ford. Mixing lean and agile systems to achieve responsiveness.

748 Industrial Marketing and Finance: (3 Credit Hours)

Consumer and industrial buyer behavior, Market segmentation, targeting and positioning. Marketing planning for industrial and consumer products. Marketing decision variables. Sales and demand forecasting. Introduction to accounting principles, financial reports. Techniques of financial analysis, Management of working capital. Nature and aspects of risk evaluation. Capital budgeting system. Profit planning and control. Short-term and long-term debt financing. Internal financing and dividend policy. Cost of capital and Capital structure.

749 Hospital Management: (3 Credit Hours)

Survey of management engineering roles in the delivery of health care. Review of functional relationships present in health care delivery systems. Application of industrial engineering tools to solve health care delivery problems focused on cost reduction, process redesign, facility design, quality improvement, and systems integration.

750 Operations Research & Management: (3 Credit Hours)

This course aims to provide students with the ability to use advanced mathematical models in management decisions. Topics include formulation of descriptive and optimization models for deterministic and probabilistic systems, linear and nonlinear programming, Optimization search engines, transportation and network models as decision tools and sensitivity analysis applications to advertising, product mix, manpower and production scheduling, budgeting and facility location.

751 Decision & Risk Analysis: (3 Credit Hours)

This course will focus on complex decisions often made in production and business systems under certainty, risk, and uncertainty. Several interrelated tools will be used including influence diagrams, Analytical Hierarchy Process (AHP), decision trees, and multi-attribute utility theory.

752 Industrial Simulation: (3 Credit Hours)

This course emphasizes the creation and analysis of Discrete Event Simulation models of production and business systems to provide students with the ability and experience for input analysis, model building, output analysis with applications in using specialized simulation software tools that are useful for evaluating the impact of new systems or improving existing systems.

753 Enterprise Resource Planning: (3 Credit Hours)

This course aims to provide students with a deep understanding of Enterprise Integration. The course will focus on the contribution of Process Management, Knowledge Management, and Enterprise Resource Planning (ERP) technologies to Enterprise Integration from Logistics and Supply Chain Management (SCM) to Customer Relationship Management (CRM).

754 Manufacturing Strategies: (3 Credit Hours)

This course aims to provide students with a conceptual and practical understanding of different aspects of Manufacturing Strategy and an ability to integrate these aspects into an organization's corporate strategy. Topics include developing the manufacturing strategy, focused-manufacturing, and integrating the business strategy.

755 Computational Intelligence: (3 Credit Hours)

This course aims to provide students with state-of-the-art Computational Intelligence (CI) techniques utilized for manufacturing systems design and operation. The focus is on Artificial Intelligence (AI) tools such as Knowledge Based Systems (KBS), Neural Networks, Data Mining, and Group Technology.

756 Maintainability & Maintenance Planning: (3 Credit Hours)

This course aims to provide students with detailed introduction and state-of-the-art techniques to the important aspects of Engineering Maintainability. Topics include Maintainability Engineering, Maintainability Design, Evaluating Maintainability, Maintenance Planning, and Maintainability & Reliability.

757 Product Realization: (3 Credit Hours)

Global realization in the global marketplace, consumer behavior, enterprise model, definition of quality, the value of future product, foundations of total quality management (TQM), managing TQM using strategic quality deployment, parameter and tolerance design, costs, statistical quality control, and innovation.

759 Special Topics in Engineering Management: (3 Credit Hours)

Different topics in engineering management are suggested. The contents of these topics must be approved by the department council.

760 Advanced Engineering Materials: (3 Credit Hours)

Structure, chemical, physical and mechanical properties, manufacturing considerations, steel products, heat treatment of steels, carbon and alloy steels, tool steels, stainless steels, cast iron, cast steel, copper and its alloys, aluminum and its alloys, nickel, zinc, titanium, magnesium and some non-metallic materials.

761 Tribology: (3 Credit Hours)

Friction in metals, friction in plastics and ceramics, reducing friction, measuring friction, wear, wear of plastics and ceramics, measuring wear, lubrication, metal working fluids, solid lubricant, lubricant selection.

762 Mechanical Behavior of Materials: (3 Credit Hours)

Crystalline and non-crystalline solids, structural defects, plastic deformation of single crystals, plastic deformation of polycrystalline materials, dislocation theory, strengthening mechanisms, mechanical behavior of materials in service.

- 763 Non-metallic Materials technology: (3 Credit Hours)**
Types of non-metallic materials and their basic structures, properties of non-metallic materials, applications of non-metallic materials, methods of manufacturing non-metallic materials.
- 764 Materials Removal Processes: (3 Credit Hours)**
Geometry of cutting Tools, principle of metal machining, mechanics of multi-point tools, theory machinability, cutting tool materials, cutting fluids, fundamentals of machine tools, transfer machines.
- 765 Advanced Manufacturing Processes: (3 Credit Hours)**
Solidification processes, particulate processing, metal forming and sheet metalworking, metal removal processes, property enhancing and surface processing operations, joining and assembly processes.
- 766 Material Joining Processes: (3 Credit Hours)**
Gas, arc, and resistance welding and cutting processes, solid state and other weld processes, the metallurgy of welding, welding design and processes selection, testing welded joints, brazing, soldering, adhesive bonding and mechanical joining processes.
- 767 Advanced Machine Tool Design: (3 Credit Hours)**
Machine tool structure and components (slides, bearings, encoders, controllers, spindles, motors, fixtures, accessories). Static and dynamic error measurement methods and compensation techniques. Modal analysis testing and chatter prevention. New technologies and trends in machine tools (parallel kinematics machines, high-velocity machining, multi-spindle machining, dry machining).
- 768 Precision Manufacturing: (3 Credit Hours)**
Emphasis on design and performance of precision machining for manufacturing. Topics include machine tool elements and structure, sources of errors (thermal, static and dynamic, process related) precision machining processes and process models (such as diamond turning) . Sensors for process monitoring and control, metrology, actuators, machine design case studies.
- 769 Advanced Mechanics of Materials: (3 Credit Hours)**
One, two, and three dimensional stresses and strains at a point; theories of elastic strength; effect of loading on the member; torsion of noncircular sections; curved beams; unsymmetrical bending.
- 770 Advanced Computer Aided Manufacturing: (3 Credit Hours)**
The application of computer technology in manufacturing systems; includes the use of computers for direct numeric control of machine tools, adaptive control and optimization, and integrated manufacturing systems, including applications of industrial robots.
- 771 Analysis of Materials Machining: (3 Credit Hours)**
An analytical approach to the mechanics and physics of various machining process; covers the basic phenomena underlying process characteristics, such as wear, plastic flow, surface integrity, friction, and economics.

772 Advanced Design for Manufacturability: (3 Credit Hours)

The design process; interaction of materials, processes, and design; economic considerations; design considerations for machining, casting, forging, extrusion, forming, powder metallurgy, designing with plastics, design for assembly, projects and case studies.

773 Advanced Robotics Engineering: (3 Credit Hours)

Underlying theories of robotics systems; implications for engineering design. Kinematics, and dynamic of robotic arms. Special emphasis on control issues for robotics such as hybrid and multivariable control theories.

774 Advanced Control Systems: (3 Credit Hours)

Advanced techniques for analysis of electrical, mechanical and electromechanical systems. State space function concepts are emphasized with methods for determining state equations. Stability, observability, controllability, and control of control systems.

775 Multi-Variable Control Systems: (3 Credit Hours)

Analysis and synthesis techniques for multi-input multi-output (MIMO) control systems. Basic issues with multivariable control system design; norms of signals and systems; model reduction; state feedback control and optimization; output feedback control; low order controller design.

776 Geometric Modeling: (3 Credit Hours)

Computer-based representations of the shape and spatially dependent attributes of real or conceived physical objects. Techniques and concepts needed to couple the digital computer with the techniques of the geometric modeling and graphics display for analysis and viewing.

778 Finite Element Theory: (3 Credit Hours)

Theory of finite element methods and applications; review of matrix algebra and basic theorem of elasticity. Direct formulation of plane truss element and variational formulation of plane stress/strain, axisymmetric solids, flexural beam, and flat plate elements. Element analysis and isoparametric formulation. Applications to problems of stability vibrations, thermal stress analysis, and fluid mechanics. Computer programming techniques.

779 Special topics in manufacturing: (3 Credit Hours)

Different suggested topics in design and manufacturing. The contents of these suggested topics must be approved by the department council.

790 Industrial Engineering Seminar: (1 Credit Hour)

Topics presented by invited lecturers from industry, educational institutes, and department faculty. IE graduate students present some topics.

798 Comprehensive Examination: (0 Credit Hours)

This exam is taken after the completion of 34 credit hours.

799A Thesis Research: (9 Credit Hours)

799B Thesis Research: (6 Credit Hours)

799C Thesis Research: (3 Credit Hours)

799D Thesis Research: (0 Credit Hours)

