2015

Kingdom Of Saudi Arabia
Ministry Of Higher Education
King Saud University
College Of Engineering

جامعة الملك سعود
King Saud University

Industrial Engineering Department

Academic programs








Preface

Industrial Engineering (IE) is concerned with the design of production systems (manufacturing and services). The industrial engineer analyzes and specifies integrated components of people, machines, materials, production methods and facilities to create efficient and effective systems that produce goods and services beneficial to mankind. Industrial engineers are the bridge between institutional goals and operational performance. They are expected to exert leadership in workplace as well as to plan, analyze, design, and implement broad spectrum of systems that bring value to the organization. Industrial engineers identify opportunities for improving systems productivity, quality, operating costs, and optimum use of scarce resources.

The profession of industrial engineering is on a fast pace over the past few decades and is expected to progress in the future. Since IE is a distinguished discipline with significant training in using engineering methods and the planning and operation methods with intellectuality for creativity and innovation of production systems. Moreover, it provides a route to upper management in organizations.

The IE at KSU offers distinguished undergraduate and graduate (Higher Diploma, Master and Doctorate) programs which continuously updated to keep pace with national and international developments. These programs curricular are based on four areas of concentrations which are Manufacturing Systems Engineering, Industrial Operations Systems Engineering and Logistics, Human Factors Engineering, and Quality, Safety and Maintenance Systems Engineering.

IE graduates fit in diverse environment within manufacturing, services, and governmental sectors. Our graduates are working for companies such as AEC, SABIC, ARAMCO, SAMBA, SEC, STC, ALSALAM, and the list goes on.

Mohammed Saad Al-Kahtani, Ph.D.
Industrial Engineering Department Chairman

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Brief

The IE Program was established in 1983 as program in the mechanical engineering department. In 2002, a separate department for industrial engineering was established for the IE programs. Students' enrolment in the IE Program has developed, since its early start, from 15 student in 1983 to 100 students in 2012, due to the rapid development in various industrial fields in the KSA resulting high demand for industrial engineers. Currently the enrolment criteria is set to GPAs of 4 or more (on a scale of 5) according to the preset admission criteria by the C of Engineering, resulting high quality students in the program.
The IE Program was established to provide specialized engineer equipped with scientific and technological foundation and the necessary decision-making techniques, tools and skills to work effectively in related industrial engineering job functions in consulting, industry, government and academia in the field of production systems (manufacturing and services). The IE Program graduates participate effectively in country national growth and development of its economic plans by proper design, install, and operate production systems achieving high productivity, and quality at suitable prices.

IE Department graduates are employed in both government and private sectors of the Saudi businesses. Moreover, many of them have achieved highly ranked and leading positions, for example, in ministries (minister of housing and rector of youth affairs), in universities (vice rector of academic affairs in Prince Salman University, and assistant vice rector of academic affairs in KSU), deans at KSU (dean of postgraduate studies and dean of institute of advance manufacturing), chairman of Riyadh Valley Company, and board member of Almarai Company.

Knowledge, Abilities and Skills

The IE Program is distinguished in providing its graduates with diverse knowledge and cognitive skills required for successful functioning in production systems (manufacturing and services systems). This diversity strengthens graduates ability to:

1. Planning ability of production systems (Manufacturing and service): Possess the knowledge and skills of the industrial planning, modeling, analysis and decision making for achieving strategies and operations plans for production systems.

2. Design ability of production techniques for production systems (manufacturing and service): Possess the knowledge and skills to determine the appropriate production processes, equipment, tooling, and timing needed to design and to execute the production.

3. Design ability of production systems (manufacturing and services): Possess the knowledge and skills of design work stations, work areas, production

lines، handling systems, integrated manufacturing systems, and industrial facilities and specification.

4. The ability to design and develop products (commodity and service): Possess the knowledge and skills to identify customer requirements, product specifications, product components and functions, methods of improving and developing the product value, and prototyping of product modeling.

5. The ability to design and implement the working methods and human factors: possess the knowledge and skills of analysis and measurement of human effort (mental and muscular), the link between man and machine, analysis of the various work elements movements and calculate the standard times, and determine the worker performance rate the productivity.

6. Ability to estimate and analyze the industrial and engineering costs: Possess knowledge and skills to study the productive labor economics and determine the cost and the pricing of the product.

7. Ability to design and implement quality systems: Possess knowledge and skills to create quality control maps and how to use them in the diagnosis quality problems, to determine the acceptable samples in the quality, to identify the process capabilities, to apply quality management systems.

8. Ability to design and operate maintenance systems: Possess knowledge and skills to analyze the types of malfunctions and sequence of components in the system, to conduct engineering analysis of the amount and frequency of failures of the components of the system, to design of system reliability, to plan and schedule maintenance operations, and forecast and determine maintenance resources.

9. Ability to design and implement safety systems: Possess the knowledge and skills to analyze risks in the work environment, to find engineering solutions and selecting protection and hazards prevention equipment and systems, to determine the conditions and procedures of safety, and to develop safety plans.

Industrial Engineering Department Vision

The vision of the industrial engineering department is to be internationally recognized for leadership and excellence in teaching, research and cooperation with Saudi manufacturing and service industries.

Industrial Engineering Department Mission

The mission of the IED is to offer a broad spectrum of educational programs that are internationally recognized and consistent with global advances in the

discipline, and to provide a nurturing and resource-rich environment to conduct state-of-the-art research, and finally, to serve the community and profession through cooperation with local, regional and international organizations.

Values

The establishment and development of scientific and technical knowledge in the areas of Industrial Engineering is a national secretariat urged by sharia, because of the pivotal and leading role of the profession of Industrial Engineering in the society. This role of the design, analysis and operation of production systems (manufacturing and services) would raise the national economic level, which advances the nation to the ranks of developed countries.

IE Department Goals and Objectives

Goal (1): Empower industrial engineering graduate with technical, social, and professional capabilities enabling them to work in the competitive global engineering environment.

Objective 1: Equipping the students with the appropriate knowledge, skills, and tools to design, operate and analyze industrial production systems.

Objective 2: Impeding in industrial engineering graduate besides leadership and long-life learning behaviors, the understanding of industrial engineering profession, ethics, and responsibilities.

Goal (2): Promote industrial engineering graduate competency through distinguished educational support.

Objective 3: Maintaining high quality faculty members, teaching assistants, technicians, and laboratories.

Objective 4: Promoting continuous engagement of industrial engineering students in community and industry.

Goal (3): Promote the industrial engineering profession.

Objective 5: Strengthen the relation with government, public and private sectors by organizing conferences and symposia, delivering short courses and seminars, promoting consultancy, and providing professional laboratory services.

Objective 6: Professional development and research work by encouraging scientific publishing and active participation in professional conferences and meetings.

Faculty Members

	Faculty Name	Rank	Major area	University	E-mail
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Admission Requirements & Regulations for the B.Sc. Programs

Admission of Students who have finished the Preparatory-Year of Science Colleges

- Students are accepted by merit according to the following rule:
  0.25x Mark of Achievement test + 0.25 x Mark of Capabilities test + 5 x cumulative GPA of preparatory year + points of the course Math140 + points of the course Math150
  It should be noted that the Capabilities Test administrated by the National Center for Assessment in Higher Education is similar to the General Aptitude Test (GAT) or to the SAT.
- The college accepts 400 students for the first semester and 50 students for the second semester. The general rule of the college is to reach the target value of the student to faculty ratio of 20 recommended by the Ministry of Education (AFFAQ 2029).

Student and Course Transfer

Internal Student Transfer

- Student from Science Colleges of KSU must have a minimum cumulative Grade Point Average (GPA) of 4.0 out of 5.0.
- Student from KSU Health Colleges must have a minimum cumulative Grade Point Average (GPA) of 4.0 out of 5.0, and they should have completed successfully or obtained an equivalence of the preparatory-year for the science colleges.
- The cumulative GPA is calculated after a student completes at least 12 hours after the preparatory year (not including courses of the university requirements: Islamic culture and Arabic language).
- If the college intake capacity is exceeded, the Dean of the College of Engineering may accept no more than fifty students satisfying the transfer criteria.
- Acceptance of students is done by merit when all the conditions are satisfied.
- Transfer from Humanitarian colleges is not accepted.

External Student Transfer

- The student must have a minimum cumulative GPA of 4.25 out of 5.0 or its equivalent from an accredited college of engineering.
- The student must have a minimum score of 80% in mathematic courses studied in his college.
- The student must have successfully completed at least 30 credit hours of his college requirements after the preparatory year (The equivalence of the preparatory year completed by the student is done according to the University regulations. If the student did not study a preparatory year in his college, the University has the right to ask the student to study the KSU preparatory year for science colleges or whatever the University sees suitable after carrying out all the equivalences for the student).

Once these conditions are satisfied the student is considered as a visiting student and is allowed to register at least 12 credit hours according to his study plan in his previous college and in coordination with the KSU college-of-engineering. The 12 credit hours should not include courses of Islamic culture and Arabic language. The student must also obtain a GPA in the semester of at least 4.5 out of 5.

Students Allocation to College Departments

- During their first year at the college after the preparatory year, students must attend introductory orientation-presentations offered by the college departments so as to get acquainted with the nature of the different engineering disciplines.
- After successfully passing 28 hours during the first year at the college, a student submits electronically a request to the Deanship of Admission & Registration, prioritizing his preference of the different disciplines.
- Each department is given a number of students in accordance to its capacity and arrangement with the department and college.
- The priority of acceptance for admission in a department is given to those applicants with the highest GPA.

Students Transfer from other Departments of the College

- Students from another department of the college must have a cumulative Grade Point Average (GPA) higher than the lowest GPA admitted to the department.
- A prescribed form must be filled-in by the student for final approval by the college students affairs unit
- The priority of acceptance is given to the students with the higher grades, on the basis of available seats in each department.

Credit Transfer

It is permissible for the students to transfer credits of courses studied in a reputable engineering college if the courses are equivalent to those offered by the college departments. Approval of the department is perquisite for the transfer acceptance. Transferred credits are not included in the GPA but a grade of at least C should be scored to pass courses.

Practical Training

- A student is allowed to register for the practical training after successfully completes 110 hours, through the student portal (e-educate). No other courses are allowed for him during the practical training period.
- Local companies are contacted by Vice Dean for academic affairs to enquire about the possibilities of training the department students and the number of students that can be accepted.
- Replies from companies are kept in the electronic system of the college.
- All available training opportunities are sent to the department, and announced by the department for students.
- Student fill-in a form for the practical training and submit it to the department practical-training committee showing his choice of companies.
- Vice Dean officially contacts the companies and secures the placement of students.

- Student must get the training for the period is 10 weeks and submit weekly reports to the convener of the department committee for practical training.
- Company reports a confidential assessment of the student performance to the department.
- Department allocates the grade of the training as pass or fail based on the company evaluation and weekly reports.

Although the practical training is non-credited, it is required to satisfy the undergraduate degrees requirements.

Academic Programs

The Department of Industrial Engineering offers distinguished undergraduate and graduate (Higher Diploma, Master and doctorate) programs which continuously updated to keep pace with national and international developments. These programs curricular are based on four areas of specializations which are:

Manufacturing Systems Engineering: this area is concerned with the design and the analysis of production processes and manufacturing system. It includes many types of sciences {such as: manufacturing technology; factory design; automation of process and system using computers; computer aided design and manufacture; manufacturing system design and operation}.

Industrial Operations Systems Engineering and Logistics: this area is concerned with studying and analyzing industrial operations, engineering supply chains and planning, controlling and monitoring industrial production. It includes many types of sciences {such as: operations research; Production planning and control; designing and analyzing supply chains; manufacturing cost analysis}.

Human Factors Engineering: this area is concerned with design and analysis of work and its time according to the required human factors in order to achieve the best production levels. It includes many types of sciences {such as: human factors analysis; time and motion study}.

Quality, Safety and Maintenance Systems Engineering: this area is concerned with design and analysis of quality, safety and maintenance systems that are necessary for different production organizations. It includes many types of sciences {such as: maintenance engineering; quality engineering; occupational safety engineering}.

Offered Degrees

1. Bachelor of Science in Industrial Engineering.
2. Higher Diploma in Occupational Safety Engineering.
3. Master of Science in Industrial Engineering.
4. Doctorate of Philosophy in Industrial Engineering.

Bachelor of Science in Industrial Engineering

Introduction

The undergraduate program in Industrial engineering has been designed to offer high quality, up-to-date and internationally recognized education program. It is prepared to contain scientific and technological foundations, integrated knowledge, and skills of the applied sciences, engineering sciences, and industrial engineering sciences. It is, also, prepared to contain the necessary decision-making techniques and tools. This equips the students with the capability to perform their work effectively. Also, it gives the student the flexibility to pursue careers in variety of manufacturing and service organizations and work in related job functions in consulting, industry (manufacturing and services), government and academia.

The undergraduate program in Industrial engineering is based on the knowledge and skills of four main areas of specialization (manufacturing systems engineering, industrial operations systems engineering, logistics and human factors engineering and quality, safety and maintenance systems engineering). All the areas are integrated in a program that provides the students with the necessary principles, tools and skills of Industrial Engineering profession that in turns gives the flexibility to pursue careers in variety of manufacturing and service organizations.

Program Educational Objectives (PEOs)

Objective 1: Graduates will be able to identify, define and implement effective solutions to real cases in the manufacturing and service systems by applying industrial engineering sciences and tools, contemporary knowledge and cutting-edge technologies.

Objective 2: Graduates will be able to update their professional skills continuously to design integrated production systems of people, machines, information, energy, materials and financial resources.

Objective 3: Graduates will be able to communicate and work effectively and ethically as individuals and as team members.

Objective 4: Graduates will be able to assume leadership roles in their profession and communities.

Program Outcomes

Knowledge

1.1 Recall mathematics and basic sciences [a1]
1.2 Gain engineering sciences [a2]
1.3 Recognize the impact of engineering solutions in a global, economic, environmental and societal context. [h]
1.4 Outline the knowledge of contemporary issues [j]

Cognitive Skills

2.1 Conduct experiments and analyze data [b]
2.2 Design, develop, implement and improve a process, a component or an integrated system under realistic constraints. [c]
2.3 Identify, formulate and solve engineering problems [e]
2.4 Use the techniques, skills and modern engineering tools necessary in engineering practice. [k]

Interpersonal Skills & Responsibility

3.1 Participate in a multidisciplinary team [d]
3.2 Demonstrate professional and ethical responsibility [f]

Communication, Information Technology, and Numerical Skills

4.1 Communicate effectively [g]
4.2 Engage in life-long learning [i]

SUMMARY OF B.S. DEGREE REQUIREMENTS IN INDUSTRIAL ENGINEERING

Requirements	Cr. Hr.	Description
Preparatory year	**31**	English (16), Math (5), Humanities (6), IT (3), ENT (1)
University	**12**	Islamic (8) and Arabic (4) Studies
College	**51**	Compulsory (41), Complementary 10)
Department	**70**	Core (65), Projects (4), Practical Training (1)
Total	**164**	

RECOMMENDED SEMESTER SCHEDULE - INDUSTRIAL ENGINEERING PROGRAM

Level 1				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
MATH 140	Introductory mathematics	2(2,1,0)		
ENGL 140	English language – 1 -	8(20,0, 0)		
CT 140	IT skills	3(0,0,6)		
MC 140	Communication skills	2(2,1,0)		
Total		**15**		

Level 2				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
MATH 150	Differential Calculus	3(3,1,0)		
ENGL 150	English language -2 -	8(20,0,0)		
CI 140	Learning, thinking & research	3(3,1,0)		
CHS 150	Health & fitness	1(1,1,0)		
ENT 101	Entrepreneurship	1(1,0 ,0)		
Total		**16**		

Level 3				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
CHEM 101	General Chemistry (1)	4(3,0,2)		
PHYS 103	General Physics (1)	4(3,0,2)		

Level 4				
Course Code	**Course Title**	**Cr. Hr. (X,Y,L)**	**Pre-requisite**	**CO-requisite**
PHYS 104	General Physics (2)	4(3,0,2)		
MATH 203	Differential and Integral Calculus	3(3,2,0)	*MATH 106 MATH 107*	

MATH 106	Integral Calculus	3(3,2,0)	*MATH 150*	
MATH 107	Vectors & Matrices	3(3,2,0)	*MATH 150*	
ENGL 107	Technical Writing	3(2,1,0)		
Total		**17**		

GE 104	Basics of Engineering Drawing	3(1,0,4)		
ENGL 108	Communication Skills for Engineers	3(3,1,0)		
ARAB 101	Language Skills	2(2,0,0)		
IC ***	Elective Islamic Course	2(2,0,0)		
Total		**17**		

Level 5

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisite	CO-requisite
IC ***	Elective Islamic Course	2(2,0,0)		
MATH 244	Linear Algebra	3(3,2,0)	MATH 107 MATH 106	
GE 211	Computer programming with C++	3(2,0,2)		
STAT 324	Engineering Probability and Statistics	3(2,2,0)		
IE 222	Industrial Operations Analysis (1)	3(3,1,1)	MATH107	
IE 251	Manufacturing Materials	3(2,2,2)	PHYS104, CHEM101	
Total		**17**		

Level 6

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisite	CO-requisite
GE 201	Statics	3(3,1,0)	*MATH 106 MATH 107*	
MATH 204	Differential equation	3(3,2,0)	MATH203	
IE 214	Industrial operation Management (1)	3(3,2,0)	STAT324	
IE 252	Manufacturing processes (1)	3(3,2,1)	IE251, GE104	
IE 352	Manufacturing processes (2)	4(4,2,1)	IE251, GE104,	IE252
Total		**16**		

Level 7

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisite	CO-requisite
IC ***	Elective Islamic course	2(2,0,0)		
ARAB103	Expository Writing	2(2,0,0)		
GE 302	Industry and Environment	2(2,1,0)	PHYS104, CHEM101, MATH107	
GE 403	Engineering Economy	2(2,1,0)		
IE 322	Industrial Operations Analysis (2)	3(3,1,1)	IE222, GE211	
IE 333	Design & analysis of Experiment	3(3,1,1)	STAT324	
IE 341	Human Factors Engineering	3(2,1,2)		IE333
Total		**17**		

Level 8

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisite	CO-requisite
GE 404	Engineering project Management	2(2,1,0)		
IE 314	Industrial operation Management (2)	3(3,2,0)	IE214	
IE 337	Automatic Control Systems	3(3,1,1)	MATH204, GE 211	
IE 339	Quality Engineering	3(3,1,1)	STAT324	
IE 342	Work Analysis & Design	3(2,1,2)	IE352	
IE 360	CAD/CAM	3(2,1,2)	IE352	
Total		**17**		

Level 9

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisite	CO-requisite
IE 301	Product Design & innovation	2(2,1,1)	IE333, IE339, IE360	
IE 405	Manufacturing Economy	3(3,1,0)	IE342	
IE 420	Industrial System Simulation	3(2,1,2)	IE322	
IE 438	Engineering Reliability & Maintenance	3(3,1,1)	IE314	
IE 449	Safety Engineering	3(3,1,1)	IE341	
IE 496	Graduation Project - 1	2(1,1,2)	Complete 129 C.H. and passing courses in levels 1-7.	
Total		**16**		

Level 10

Course Code	Course Title	Cr. Hr. (X,Y,L)	Pre-requisite	CO-requisite
IC ***	Ethics of the Profession	2(2,0,0)		
IE 450	Industrial Facility Design	3(3,1,1)	IE342	
IE 461	Computer Integrated manufacturing	3(2,1,2)	IE360	
IE 462	Industrial Information Systems	2(2,1,1)	IE314	
IE 469	Manufacturing Systems	3(3,1,1)	IE438	IE461
IE 497	Graduation Project -2	2(0,1,4)	IE 496	
IE 999	Practical Training	1 (NP)	Completion of 110 credit hrs.	
Total		**16**		

IE Course Description

IE 214: Industrial Operations Management -1- *3(3,2,0)*
Introduction to operation management and productivity; Forecasting methods and analysis; Capacity planning; Inventory management; Material requirement planning.
Pre-requisite: STAT 324

IE 222: Industrial Operations Analysis -1- *3(3,1,1)*
Introduction to mathematical programming and optimization; Characteristics of linear programs; Modeling of various industrial programs as linear programs; Graphical solutions; Introduction to the theory of simplex methods; Big M method, Unbounded and infeasible solutions; Sensitivity analysis and introduction to the duality theory; Transportation and assignment problems and solution techniques; Shortest path, Minimum spanning tree, and maximum flow problems; Goal Programming.
Pre-requisite: MATH 107

IE 251: Manufacturing Materials *3(2,2,2)*
Engineering materials properties testing and processing parameters; Material compositions and structures; Iron and steel production; Aluminum production; Plastic production; Ceramic production; introduction to Nano materials; Material selection.
Pre-requisite: PHYS 104, CHEM 101

IE 252: Manufacturing processes -1- *3(3,2,1)*
Engineering materials processing parameters that influence design considerations, product quality and production costs; Definition of stress, strain and mechanical properties of materials applied to metal forming processes; sheet metal forming, processes (deep drawing, stretch shearing and bending) ; bulk forming processes (forging, rolling , extrusion and wire drawing); basic casting techniques; Welding processes.
Pre-requisite: IE 251, GE 104

IE 301: Product Design and Innovation *2(2,1,1)*
Introduction to manage innovation; Idea generation: Product specification and quality; Standardization of product; Product structure and components; Implementing prototype metrologies; Manufacturing product prototyping project.
Pre-requisite: IE 333, IE 339, IE360

IE 314: Industrial Operations Management -2- *3(3,2,0)*
Aggregate planning; machine scheduling; line balancing; JIT and lean operations; Supply chain management; Decision making methods.
Pre-requisite: IE 214

IE 322: Industrial Operations Analysis -2- *3(3,1,1)*
Deterministic dynamic programming; Forward and backward procedures; Integer programming; Branch and Bound methods; Nonlinear programming; Single and multi-variable unconstrained optimization; KKT conditions and quadratic programming; Markov chains; Queuing Theory.
Pre-requisite: IE 222, GE 211

IE 333: Design and Analysis of Experiments *3(3,1,1)*
Introduction to design of experiments and its applications in industry; Hypothesis testing; Analysis of variance; Residual analysis; Block design; Randomized complete and incomplete designs; Two and multi factor factorial design; Introduction to response surface methodology.
Pre-requisite: STAT 324

IE 337: Automatic Control Systems *3(3,1,1)*
Process control fundamentals; Control theory principles; Modeling analogy; Digital control using programmable logic controller and computer.
Pre-requisite: Math 204, GE 211

IE 339: Quality Engineering *3(3,1,1)*
An understanding of the basic concepts of quality; An appreciation of the functions served by a quality management system; the ability to design quality into products so as to satisfy both internal and external customer; The study of frequency distributions and probability models in quality control; Preparation and use various control charts; Construction of different sampling plans; Quality improvement Methods and analysis of quality costs; Application of computer in the above areas.
Pre-requisite: STAT 324

IE 341: Human Factors Engineering *3(2,1,2)*
Introduction to human factors; Human-Machine Systems; Information theory; Human Capabilities, environmental and thermal factors; Display and control Design, Hand Tools and Devices, Workplace Design, Physical Work and Manual Materials Handling and Speech Communications.
Co-requisites: IE 333

IE 342: Work Analysis and Design *3(2,1,2)*
Introduction to work analysis and design; Methods engineering: Study of the basic work measurement techniques; Applications and limitations of the stop-watch time study, pre-determined motion time systems.
Pre-requisite: IE 352

IE 352: Manufacturing Processes -2- *4(4,2,1)*
Machine tool elements; Cutting mechanics, Material removal operations; Tool materials , geometry and assembly techniques optimization of cutting variables for machining operations; Non-traditional machining; Process design and planning.
Pre-requisite: IE 251, GE 104;
Co-requisite: IE 252

IE 360: CAD/CAM *3 (2,1,2)*
Introduction to CAD/CAM; CAD software; Geometric modeling and its approaches; Geometric transformations; Geometric projections; Model data exchange; Finite element modelling; Introduction of numerical control; Numerical control part programming; Group technology.
Pre-requisite: IE 352

IE 405: Manufacturing Economics *3(3,1,0)*
Introduction to manufacturing economics; Labor cost analysis; Materials cost analysis; Overhead cost calculations; Operation cost estimating, product cost estimating, and product pricing.
Pre-requisite: IE 342

IE 420: Industrial Systems Simulation *3(2,1,2)*
Introduction to the concept of simulation including modeling and simulation languages; appropriate inputs to a simulation model, and random number generation; Analysis of the output from a simulation model; Validation of the simulation model.
Pre-requisite: IE 322

IE 438: Engineering Reliability and Maintenance *3(3,1,1)*
Introduction to the concept of reliability; Failure distributions; Reliability characteristics; Estimation of system reliability both for the independent and dependent cases; Maintenance workload analysis and calculations; Capacity planning of maintenance resources; Maintenance works scheduling; Maintenance audit and the measurement of maintenance works performance; Computerized maintenance management systems (CMMS).
Pre-requisite: IE 314

IE 449: Safety Engineering *3(3,1,1)*
Introduction to regulations and standards; Industrial hazard avoidance concepts and techniques; Plant safety applications; Management and its safety responsibilities; Analytical trees and fault tree analysis; Risk assessment; Emergency planning.
Pre-requisite: IE 341

IE 450: Industrial Facility Design *3(3,1,1)*
Facility design stages of Industrial factory Product, process and material handling analysis; Area allocation and space analysis; Flow analysis; Plant layout and plan; Computerized facility layout and allocations.
Pre-requisite: IE 342

IE 461: Computer Integrated Manufacturing *3(2,1,2)*
Computer aided process planning; Industrial robots application and programming; Automated material handling; ASRS Identification technology; Manufacturing cell and cellular manufacturing systems; Flexible manufacturing systems and flow line systems technology and Implementation ; Enterprise integration and ERP.
Pre-requisite: IE 360

IE 462: Industrial Information Systems *2(2,1,1)*
Analysis, design and implementation of industrial information systems with special focus placed on manufacturing systems and environments; Information systems development life cycle, information systems requirements determination; Data modeling; Structured analysis and functional architecture design ; Object-oriented analysis and design; E-business and web-based database.
Pre-requisite: IE 314

IE 469: Manufacturing Systems *3(3,1,1)*

Definition and classification of manufacturing systems; Manufacturing automation fundamentals ; Manufacturing strategies (lean manufacturing, agile manufacturing and Application of KBS in manufacturing) ; performance of manufacturing system; Modeling of manufacturing systems; High volume manufacturing systems design and analysis; Flexible manufacturing performance analysis; automated inspection analyses .
Pre-requisite: IE 438;
Co-requisite: IE 461

IE 496: project -1- *2 (1,1,2)*
Senior student select a project applying learned tools and knowledge to understand the process and elements of a large, interdisciplinary engineering project design through experience. The course is carried out by: Choosing the topic; Establishing the project; reviewing background; Preparing for/or preliminary conducting of the experiments; Collecting the field data and developing the mathematical model if applicable; Writing the first two chapters along with any preliminary findings.
Pre-requisite: passing levels 1 to 7 and 129 Cr. Hr.

IE 497: project -2- *2 (0,1,4)*
This course is continuation of part I of the project and the following tasks are carried out: Running and finalizing the experimental program or the mathematical/computer model; Analyzing the results and findings and drawing the conclusions; Writing the complete project report; Presenting and defending the project.
Pre-requisite: IE 496

IE 999: Practical Training
The student should gain an industrial training in the field at any governmental and or private industry for sixty days.
Pre-requisite: 110 Cr. Hr.

Higher Diploma in Occupational Safety Engineering

This program was designed to improve the skills of professionals in the field of occupational safety and health. This diploma offers the theoretical and practical skills necessary to develop those professionals' capabilities of protecting lives and property from damage by accidents. In addition, it provides the skills necessary for curbing hazards and accidents, improving quality and efficiency and minimizing loss due to accidents and injuries.

Program Objective and Outcomes

The objective of the higher diploma program in occupational safety engineering is to provide private and public sectors with qualified engineers capable of handling their responsibilities and duties in the field of occupational health and safety. Achieving this objective will elevate the performance level of doing their duties and enhancing the role of occupational health and safety in the workplace. In particular, the program aims at developing the following skills and capabilities among the diploma students:

1. Preparing safety systems strategies.
2. Analyzing risk in the workplace and designing effective safety programs to deal with hazards.
3. Preparing plans to execute safety programs.
4. Operating safety programs.
5. Reviewing safety programs and monitoring their effectiveness.
6. Evaluating safety programs by comparing their results with applicable safety standards in Saudi Arabia.
7. Mastering the ways of improving awareness of safety importance in the workplace.
8. Mastering the methods to spread occupational safety culture.
9. Evaluating and auditing safety system programs in different types of workplaces.

Program Study Plan

First Semester

Course Code & No.	Course Title	Credit Hours
SFE 501	Safety in Workplaces	3
SFE 505	Safety Systems and Risk Management	3
SFE 531	Safety in Petroleum and Natural Gas Operations	3
SFE 541	Safety in Chemical Industries	3
Total		12

Second Semester

Course Code & No.	Course Title	Credit Hours
SFE 511	Safety in Mechanical Systems	3
SFE 521	Safety in Electrical Systems	3
SFE 551	Safety in Civil Engineering Projects	3
SFE 590	Seminar and Field Visits	_
SFE 598	Applied Research Project	3
Total		12

Course Description

SFE 501 Safety in the Workplace
Introduction; Maslow's Hierarchy of Needs; Physical Work load; Cognitive Work load; Leadership Skills; Job satisfaction; Team work; Human Error; Fatigue, Stress and Boredom; Principles of Job Design; Working Hours and Shift work; Safety Culture .

SFE 505 Safety Systems and Risk Management
Introduction; Risk Management (hazard identification, risk assessment, risk control and continuous monitoring); Job Safety Analysis (JSA); Hazardous Substances Management; Types and Management of Industrial Pollutants (air, noise, chemicals and toxic materials); Accident Investigation Techniques, Methods and Strategies; Dealing with Emergencies, Losses, Injuries and Diseases; Procedures Followed after Accidents; Fault Tree Analysis (FTA); Accident Cost Analysis; Instructions on How to Present Data and Prepare Reports; First Aid Techniques; Developing Emergency and Evacuation Plans.

SFE 511 Safety in Mechanical Systems
Introduction to workplace hazards (like machines, pressure, heat, cutting, welding, etc.); Effects of Hazards on Humans and Workplaces Hazard and Operability Study (HAZOP); Failure Mode and Effects Analysis (FMEA); Properties of Combustible and Explosive Materials; Sources of Fire and Explosives in the Workplace; Quantifying Fire Safety (Burning and ignition, Mechanism of Fire Spread and method of calculation); Safety in Material Handling; Machine Guarding; Safety in Performing Mechanical Operations; Design of Protective Devices.

SFE 521 Safety in Electrical Systems
Introduction to Safety in Electrical Systems; Fundamentals and Concepts of Safety in Electrical Systems; Step and Touch Potentials; Safety Aspects of Human Body; Electrical Safety Equipment; Safety Procedures and Methods; Grounding of Electrical Systems and Equipment; Lightning Protection; Fire Detection and Alarm Systems; Electrical Maintenance and Its Relationship to Safety; Regulatory and Legal Safety Requirements and Standards; Accident Prevention, Accident Investigation and Rescue, and First Aid; Medical Aspects of Electrical Accidents; Low-Voltage Safety Synopsis; Medium- and High-Voltage Safety Synopsis; Human Factors in Electrical Safety; Safety Management and Organizational Structure; Safety Training Methods and Systems; Case Studies.

SFE 531 Safety in Petroleum and Natural Gas Operations

General overview on the petroleum and natural gas industry from exploration to shipping; Safety issues in the exploration procedures; Safety issues in the oil and gas well drilling procedures; Safety issues in the oil and gas well completion procedures; Safety issues in the oil and gas production procedures; Safety issues in the oil and gas storage procedures; Safety issues in the oil and gas transportation procedures; Oil and gas operation wastes; Field chemicals storage and handling; Control of associated Hydrogen sulfide gas; Safety issues in the oil and gas laboratories and R&D centers; Fire hazards of oil and gas; API safety standards.

SFE 541 Safety in Chemical Industries
General introduction to safety issues in chemical plants; Classification and types of fuels; Physical and chemical properties of fuels; Combustion Engineering: chemistry and calculations; Ignition and flammability limits; Sources of fire in chemical plants; Classification of hazardous materials; Storage and handling of hazardous materials; Safety issues and regulations in chemical plants.

SEF 551 Safety in Civil Engineering Projects
Causes of accidents and injuries in civil engineering projects; Types of accidents and injuries in civil engineering projects and their various effects; Measurement of contractor's performance in safety; The role of project personnel in achieving safety: (the owner, designer, safety manager, project manager, supervisor, laborers); The relation between safety and society: (Ministry of insurance, Labor Ministry, Insurance companies); Recent trends of safety management; Safety and professional health code of the Council of Gulf Countries; Technical and Administrative codes; Safety in water and sewerage processing plants; Solid and dangerous wastes sites; Fire extinguishing systems; Preparation of safety programs for civil engineering projects; Case study for preparation of safety program; Recommendations for improvement of project safety; Implementation of building codes related to minimizing earth tremor and earthquake effects at the design stage.

SEF 590 Seminar and Field Visits
The aim of the seminar is to expose the students to different safety systems in industrial and service organizations and to provide them with the necessary skills on how to report and present safety systems studies.

SEF 598 Applied Research Project
The student selects a project in which he applies knowledge, tools and skills learned and mastered during his study in the program. Co-requisite: passing SEF 590.

Master of Science Program in Industrial Engineering

The Master of Science Program in Industrial Engineering was launched in year 1407 H (1987 G). The program offers a Master of Science degree in Industrial Engineering. The curriculum for the program is designed to give the student greater breadth and depth of technical and practical industrial engineering knowledge. The program allows the student to specialize in one of the following three areas: Industrial Systems Engineering, Manufacturing Systems Engineering, and Human Systems Engineering. These are distinct areas, each tailored to specific IE career needs and characterized by both breadth and depth in its curriculum.

The student can get the Master of Science degree by taking one of the following two options:

Complete successfully 24 credit hours, in addition to, finishing a master thesis (IE 600) on a selected research topic (Thesis Option).

Complete successfully 39 credit hours, in addition to, finishing a graduation project (IE 599) on a selected research topic (Non-Thesis Option).

Program Objectives

The objective of the Master of Science Program in Industrial Engineering is to qualify students to be capable of handling engineering skills and duties in professional way. This will be achieved by doing the following:

- Improve students' skills by providing them with the latest advanced engineering technologies in the field of Industrial Engineering.
- Improve students' knowledge by expose them to the up to date engineering researches and theories in the field of Industrial Engineering.
- Enhance students' capabilities in the field of improving industrial systems and technical services.
- Activate all cooperative aspects and scientific research activities between the university and the government and private sectors in order to participate in improving the efficiency of these sectors.

Program Study Plan (Thesis Option)

First Semester

Course No.	Course Title	C.H.
IE 516	Manufacturing Planning and Control	3
IE 520	Engineering Experimental Design	3
IE 523	Engineering Optimization I	3
Total		9

Second Semester

Course No.	Course Title	C.H.
IE 530	Quality Engineering	3
IE 535	Computer Simulation	3
IE 550	Facilities Analysis and Design	3
Total		9

Third Semester (Industrial Systems Engineering)

Course No.	Course Title	C.H.

IE 515	Maintenance Engineering	3
IE 524	Engineering Optimization II	3
Total		6

Third Semester (Human Systems Engineering)

Course No.	Course Title	C.H.
IE 541	Industrial Safety Engineering I	3
IE 544	Human factors Engineering I	3
Total		6

Third Semester (Manufacturing Systems Engineering)

Course No.	Course Title	C.H.
IE 556	Design and Analysis of Manufacturing Systems	3
IE 557	Advanced Manufacturing Processes	3
Total		6
IE 600 M.Sc. Thesis		

Program Study Plan (Non-thesis Option)

First Semester

Course No.	Course Title	C.H.
IE 516	Manufacturing Planning and Control	3
IE 520	Engineering Experimental Design	3
IE 523	Engineering Optimization I	3
Total		9

Second Semester

Course No.	Course Title	C.H.
IE 530	Quality Engineering	3
IE 535	Computer Simulation	3
IE 550	Facilities Analysis and Design	3
Total		9

Third Semester

Course No.	Course Title	C.H.
IE 515	Maintenance Engineering	3
IE 524	Engineering Optimization II	3
IE 544	Human factors Engineering I	3
Total		9

(Industrial Systems Engineering)
Fourth Semester

Course No.	Course Title	C.H.
IE 517	Analysis of Production Systems	3
IE 518	Scheduling	3
IE 525	Stochastic Processes	3
Total		9

Fifth Semester

Course No.	Course Title	C.H.
IE 526	Reliability Engineering	3

IE 599	Research Project	3
Total		6

(Manufacturing Systems Engineering)
Fourth Semester

Course No.	Course Title	C.H.
IE 556	Design and Analysis of Manufacturing Systems	3
IE 557	Advanced Manufacturing Processes	3
IE 556	Design and Analysis of Manufacturing Systems	3
Total		9

Fifth Semester

Course No.	Course Title	C.H.
IE 559	Manufacturing Automation	3
IE 599	Research Project	3
Total		6

(Human Systems Engineering)
Fourth Semester

Course No.	Course Title	C.H.
IE 541	Industrial Safety Engineering I	3
IE 542	Industrial Safety Engineering II	3
IE 545	Human Factors Engineering II	3
Total		9

Fifth Semester

Course No.	Course Title	C.H.
IE 546	Engineering Work Design	3
IE 599	Research Project	3
Total		6
IE 600 M.Sc. Thesis		

Course Description

IE 515: Maintenance Engineering
Preventive maintenance, Predictive maintenance, Corrective maintenance, Advanced concepts (Reliability centered maintenance, Total productive Maintenance), Concepts of maintainability engineering, Design for maintainability, Availability, Decision models in maintenance management.

IE 516: Manufacturing Planning and Control
Material requirement planning, Enterprise resource planning, Just-in-time manufacturing, Optimized technology, and supply chain management.

IE 517: Analysis of Production Systems
Deterministic inventory problems, Single period problem, Stochastic inventory problems (continuous and periodic), aggregate production planning, and production planning optimization models.

IE 518: Scheduling.
Introduction to scheduling problem, performance measures of scheduling, single machine scheduling, parallel machine scheduling, flow shop scheduling, job shop scheduling, and project scheduling.

IE 520: Engineering Experimental Design
Sampling and descriptive statistics, Parameter estimation, Tests of hypothesis on the means, variance, and portions, Testing for goodness of fit, Non-parametric tests, Experiments with single factor, Randomized blocks, Latin squares and incomplete block designs, Factorial and fractional factorial designs, Regression analysis, Taguchi's concepts and approach to parameter design, Response surface methodology.

IE 523: Engineering Optimization I
Modeling techniques for selected case studies, and linear and nonlinear programming applications in engineering, Duality and optimality conditions, Revised primal and dual simplex methods, Sensitivity analysis, Interior point methods, Convex sets and functions, Algorithms for unconstrained and constrained optimizations, application for large size applications.

IE 524: Engineering Optimization II
Modeling with integer variables, optimal solutions techniques such as enumeration and cutting plane methods, decomposition algorithms, branch and bound methods, dynamic programming, and heuristic methods (Simulated annealing, Tabu search, Genetic algorithms, Artificial neural networks) and computerized real applications.

IE 525: Stochastic Processes
Stochastic processes, Poisson processes, Birth and death processes, Non-homogeneous Poisson processes, Renewal theory, Queuing models, stochastic dynamic programming, Markovian decisions.

IE 526: Reliability Engineering
Coherent systems analysis, parametric life models, specialized models, Lifetime data analysis and reliability testing, Loads, Capacity and reliability, Parametric and non-parametric models, Model adequacy.

IE 530: Quality Engineering
Principles of modern quality control techniques, Automatic process control, Process analysis and improvement, Principles and rules of TQM, Quality assurance Audit Programs, and ISO certification.

IE 535: Computer Simulation
Concept of simulation modeling, selecting the appropriate input distribution, random number generation, simulation languages, output analysis, alternative comparison, variance reduction technique, models of complex systems.

IE 541: Industrial Safety Engineering I
National and international standards for preventing accidents in the workplace, design and implementation of loss prevention programs, recent developments in industrial system’s safety and risk analysis techniques, concepts and methods of occupational accident prevention, an introduction to risk management software.

IE 542: Industrial Safety Engineering II
Concepts of designing safety workplace environment. Safety principles in the design of equipment and protective equipment, fault-tree theory and application in industrial safety context, industrial safety regulations in various industries, methodology in safety inspection.

IE 544: Human Factor Engineering I
Design and evaluation of human/machine interface using microcomputer, human performance, visual displays, automated system monitoring, structure and biomechanics of bone, cartilage, skeletal muscles, dynamics and control of musclo-skeletal system models, workload and optimization process of physical and mental workload in industry, shift-work, modeling the relationship between human and machine.

IE 545: Human Factors Engineering II
Signal detection theory and applications, memory and attention, perception and optimization of verbal and non-verbal material, selection of action and reaction, optimizing mental workload and time-sharing in the workplace, continuous manual control.

IE 546: Engineering Work Design
Studying of work components and their limitations, workplace, machine and production tools design, analysis of work performance and its times, data-base design in work design.

IE 550: Facilities Analysis and Design
Analysis and design of material flow, Selection of facilities and equipment, Selection, Design and layout of facilities, Location analysis, Plant site selection, Discrete techniques and continuous techniques, Storage layout, Warehouse design and location, Material handling analysis, Handling system design and selection of handling equipment.

IE 556: Design and Analysis of Manufacturing Systems
Classification of manufacturing systems; High volume manufacturing systems; Flexible manufacturing systems; Assembly systems design and planning; Material handling systems; Automated storage/retrieval systems; Modeling manufacturing systems; Manufacturing management and strategies; Emerging trends in manufacturing systems engineering.

IE 557: Advanced Manufacturing Processes
Nontraditional machining and thermal cutting processes; Super finishing processes; Selection of manufacturing materials and processes; Joining and assembly processes; Design for manufacturing (processing and assembly); Product and production relationships.

IE 558: Computer Integrated Manufacturing
CIM strategy; CIM components, Concurrent engineering; GT and cellular systems; Robotic systems; Systems integration; Selection of CIM systems; Implementation of

CIM systems; Modeling CIM systems; Enterprise resource planning; Future trends in CIM.

IE 559: Manufacturing Automation
Factory automation strategies and methodologies; Flexible automations (Programmable logic controller); Programmable automation (Personal computer as controller); Actuators and sensors; Automation design and analysis; Machine cell automation design; Assembly automation.

IE 599: Research Project
The project aims to develop the student's capability in searching for the technical and engineering principles, and finding solution for an applied problem in one the Industrial Engineering specialized field. The student should become familiar with profession environment as graduate engineer in the society. He would write an engineering report describing the problem, solution methodology, results and conclusion.

IE 600: M.Sc. Thesis

Doctorate of Philosophy in Industrial Engineering

The Industrial Engineering (IE) Department has taken the initiative to offer an ambitious PhD program in order to complement the role of KSU in providing highly qualified human resources and distinguished researchers and innovators and in strongly contributing in finding solutions of the technical problems of the industrial society. The program is designed to give the student greater breadth and depth of technical and practical industrial engineering knowledge and skills that are necessary for developing a knowledge-based industry and solving effectively and efficiently the encountered problems that face the industrial revolution of the country.

Program Objectives and Outcomes

The objectives of the program are to:

- Prepare a new generation of distinguished faculty in the light of the recent extensions in higher education nationwide.
- Train the qualified human resources to contribute in the R&D areas related to the various industrial engineering fields
- Support the efforts of the practitioners in the industry in reducing the technical problems that face the sector through proposing PhD dissertations that consider and adequately solve real industrial problems.

Program Study Plan

Eighteen Credit hours and a thesis are necessary to fulfill the requirements of the doctorate of philosophy in industrial engineering as follows:

Courses No.	Type of Courses	C.H.
IE---	4 Core Courses of a track	12
IE---	2 Elective Courses from the track courses and/or Elective courses	6
IE---	Thesis	--
Total		24

Three Tracks

Manufacturing System Engineering

No.	Course No.	Course Title	C.H.
1	IE650	Advanced Computer Integrated Manufacturing (CIM)	3
2	IE651	Manufacturing systems Engineering	3
3	IE652	Advanced Manufacturing Technology	3
4	IE653	Advances in Automation of Manufacturing Systems	3
5	IE654	Advanced Topics in Manufacturing Processes	3
6	IE655	Manufacturing Strategies	3

Industrial Operation Systems and Logistics

No.	Course No.	Course Title	C.H.

1	IE620	Stochastic Modeling	3
2	IE621	Supply chain management	3
3	IE622	Logistics and distributions systems	3
4	IE623	Advanced Applications in Engineering Optimization	3
5	IE624	Advanced Topics in Industrial Operations management	3
6	IE625	Scheduling of Industrial Operations	3

Human Factors Engineering and Safety

No.	Course No.	Course Title	C.H.
1	IE630	Safety System and Accident Analysis	3
2	IE631	Advanced Human Factors Applications	3
3	IE632	Human-Machine Systems	3
4	IE633	Human Performance and Behavior	3
5	IE634	Occupational Biomechanics	3
6	IE635	Advanced Methods in Design and Work Measurement	3

Elective courses

No.	Course No.	Course Title	C.H.
1	IE611	Advance Topics in statistical Engineering	3
2	IE612	Advance Topics in Engineering Optimization	3
3	IE613	Heuristic Search Methods in Engineering Optimization	3
4	IE614	Engineering Reliability and maintainability	3
5	IE615	Advance Topics in Engineering Quality	3

Scheduling of Courses (Course numbers and titles are based on the selected track by students):

Semester	Course No.	Course Title	C.H.
1	IE6--	Course from specialized track courses	3
	IE6--	Course from specialized track courses	3
	IE6--	Course from other tracks and/or elective courses	3
2	IE6--	Course from specialized track courses	3
	IE6--	Course from specialized track courses	3
	IE6--	Course from other tracks and/or elective courses	3

Course Description

IE 611 Advanced Topics in Statistical Engineering
Advanced topics in statistical engineering such as the following: SEM family tree, Data preparation and screening, structural models with observed variables and path analysis (recursive models), structural models with observed variables and path analysis (non-recursive models, multiple group analysis), measurement models and confirmatory factor analysis, mean structures and latent growth models, and hybrid models with structural and measurement components.

IE 612 Advanced topics in Industrial optimization
Advanced topics in Linear Programming, Decomposition method, Column generation method, Interior point algorithm, Convex and non-convex optimization, Convex optimization, Non-convex optimization, Quasi-convex optimization, Topics in discrete optimization: TSP, QAP, VRP, Bin-Packing, Network models.

IE 613 Approximation Methods in Optimization
Constructive Heuristics, Local Search, Metaheuristics, Evolutionary Algorithms, Optimization-Based Heuristics, Polynomial Time Approximation Schemes.

IE 614 Reliability and Maintainability Engineering
Reliability analysis of dynamic systems, analysis of dependent failures, reliability of repairable systems, human reliability analysis methods and theory of logic diagrams and application to systems reliability; advanced maintainability analysis and systems effectiveness; reliability and maintainability concepts in conceptual, development, production, and deployment phases of industrial products; costing of reliability, methods of obtaining approximate reliability estimates and confidence limits; methods of reliability testing; current research and developments in the area of reliability and maintainability engineering.

IE 615 Advanced topics in quality engineering
Modern trends in assessment of quality; strategic quality management, Quality management techniques including: Total quality management, Kaizen technique, and ISO 9000, six-sigma methodology and its applications, ISO 9000 quality management system standards and their applications; Advanced applications techniques on continuous improvements and quality management.

IE 620 Stochastic Modeling
Renewal processes and Applications, Discrete and Continuous-Time Markov Chains, Markovian decision processes, Algorithmic Analysis of Queuing Models.

IE 621 Supply Chain Management
Supply chain network design including raw material (RM), work in process (WIP), final good (FGI), and Spare parts Management; Assembly systems management; Modeling the Integrated production, inventory and distribution problems.

IE 622 Distribution and Logistics Systems

Modeling and optimizing distribution problems including: Traveling Salesman Problems (TSP), Vehicle Routing problems (VRP), and Capacitated Arc Routing Problems (CARP); Application studies of various types of distribution and logistics; Analysis and design of distribution and logistics systems.

IE 623 Advanced Applications in Industrial optimization
Advanced algorithms including: Newton method, Modification of Newton's Method, Quasi-Newton method, Gradient method, Levenberg-Marquardt and Trust Region Methods, Sub gradient Optimization Methods, Steepest ascent method; combined algorithms; Penalty and barrier methods; Methods of Feasible Directions.

IE 624 Advanced Topics in Industrial Operations Management
New trends in Production management Systems and structuring operation systems including: Manufacturing Resource Planning (MRP), Just-in-time (JIT), and Optimized Production Technology (OPT).

IE 625 Scheduling of Industrial Operations
Optimization algorithms, algorithm convergence; Advanced Shop Scheduling; Advanced Multiprocessor Scheduling; Scheduling Flexible Manufacturing Systems; Resource Constrained Project Scheduling; Multi-criteria Scheduling; Cyclic Scheduling.

IE630 Safety System and Accident Analysis
Procedures for conducting and understanding of accident investigation techniques; recent procedures followed after accidents; dealing with emergencies; developing emergency and evacuation plans; accident cost analysis; keeping accident records; control of hazardous substances and processes, and the protection of the worker.

IE631 Advanced Human Factors Applications
Application of current human factors engineering principles in the workplace including facility and work status; material handling; work place exposures and protection, and production operations. Human Factors input into manned-system design, development, testing, and evaluation. Emphasis will be on the systems approach to human-machine interfacing, with discussion and application of specific methodologies and analytical techniques. The course will allow students to apply human factors applications to industrial and commercial settings. The course will also An examine human attributes which may be reduced in disabled persons and which change with the aging process, and of the associated needs regarding work procedures and equipment with respect to the design of the domicile and of care facilities. Human Factors requirements for aids in transportation (individual and mass), personal hygiene, and environment are also topics of this course.

IE632 Human-Machine Systems
Various aspects of human interaction with systems for simple system (hand tools) and complex system (piloting an aircraft); An examination of human reception, information processing, and skilled performance capabilities and limitations in human-machine systems with an emphasis on models and techniques including psychophysics, signal detection theory, information theory, and decision theory.

IE 633 Human Performance and Behavior

Applications of human performance and behavior: This course will also demonstrate how successfully managing human performance and behavior in the workplace that enhance organizational behavior and improve work conditions. Tools and techniques used to measure human performance are also discussed in this course. The tools include observational methods, direct methods, surveys, body maps, and self-report on physical work load.

IE 634 Occupational Biomechanics
Application of engineering static and dynamics in determining biomechanical stresses on human in work environment; anthropometric measurement methodologies; determination of physiological stresses during work. The course also covers the structure and biomechanics of bone, cartilage, and skeletal muscle; dynamics and control of musculoskeletal system models. Physical exposure assessment techniques are also covered in the course such as observational methods (pen-paper based observational methods, videotaping and computer-aided observational methods), direct methods (posture assessment, postural strain or local muscle fatigue assessment), and Self-report on physical work load.

IE 635 Advanced Methods Design and Work Measurement
Design of work systems. Methods and techniques employed in measuring work. Current philosophy underlying improvement in work methods and procedures used to measure work perform. Task analysis, personnel selection and training, job and organization design, and criteria development and use. Human factors related to job design in order to increase job satisfaction and productivity. Details of work sampling, predetermined time systems, and standard data development. Effects of machine interference, machine pacing and fatigue on allowances, and statistical aspects of work measurement. Recent advances in work methods and measurement.

IE 650 Advanced Computer Integrated Manufacturing (CIM)
Advanced integration of manufacturing systems including: cellular manufacturing systems; Flexible Manufacturing Systems (FMS); industrial robots; Automated Material Handling Systems (AMHS); Automated Storage/ Retrieval Systems (AS/RS); modern integration of manufacturing systems functions; development of CIM structure and modern trends in enterprise Resources Planning (ERP).

IE 651 Manufacturing Systems Engineering
Advanced applications in performance of manufacturing systems including: flow line manufacturing systems; assembly systems, flexible systems. Modern methods for planning and designing intelligent manufacturing systems, and manufacturing systems layouts.

IE 652 Advanced Manufacturing Technology
Methods and methodologies of development and selection of Advanced Manufacturing Technologies (AMT). Application of AMTs in inspection and testing products. Modern programs in design, manufacturing and engineering analysis. Rapid prototyping, visual, and augmented technologies.

IE 653 Advances in Automation of Manufacturing Systems

Research topics in developing and design manufacturing system automation; Manufacturing system including process control, adaptive control and automatic data capture; Development of intelligent control system structure.

IE 654 Advanced Topics in Manufacturing Processes
The new trends in manufacturing processes including: non-traditional manufacturing processes; micro and nano-manufacturing processes; advanced design of manufacturing processes; design for manufacturing; design for assembly.

IE 655 Manufacturing Strategies
Modern manufacturing strategies; lean and agile manufacturing; new classifications of manufacturing systems; concepts and methodologies of analysis and design of manufacturing systems (conceptual modeling; information modeling; Petri Nets; Knowledge-Based Systems KBS, Computer Simulation), new trends in designing of manufacturing strategies.

IE 700 Doctorate Thesis

Laboratories

Laboratory work is vital to engineering students. Thus, most of the program courses include lab experience. The Industrial Engineering department is equipped with up-to-date laboratory facilities and these are continuously upgraded and maintained. The department possesses eleven labs as summarized below.

Metrology Lab.

The purpose of this laboratory is; to familiarize students with laboratory measuring devices, to study the measurements methods, to learn proper measuring techniques through simple measurements of mass, length, and time, and to learn to express the results of calculations so as to correctly reflect the effects of measurement uncertainty.

This laboratory also helps in measurement activities for researches and B. Sc. projects.

Courses served: IE339, IE 496 and IE 497.

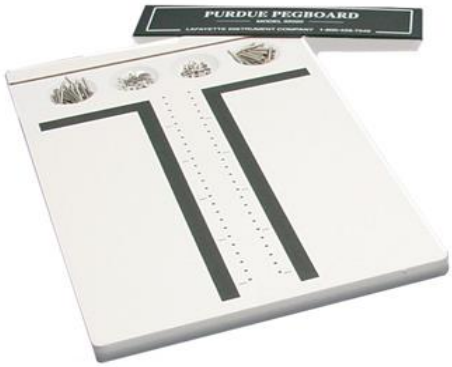
This laboratory has the following devices:

- Simple measuring tools: (Steel Rule, Inside calipers, Outside calipers, Telescoping, gauges, Combination set, Gauge blocks, Micrometers, Dial caliper, Small hole gages)
- Auto-Collimator (Higher& Watts 142/21) for measuring angles, straightness, flatness, squareness, and parallelism.
- Talyvel 5 (Taylor Hobson) for measuring straightness, and flatness.
- Digital Height Meter (Maher Dagmar "0.001, 1 µm, 10µm") for measuring center distances between bores and surfaces, widths of grieves and wedges, accurate checking of squareness.
- Universal length measuring device (ULM- Carl Zeliss Jena 01-600D) for measuring direct reading of current value, and periodic inspection of gauges.
- Talyrond 131 (Taylor Hobson) for measuring high precision of roundness and circular geometry.
- Perthometer (Rank Taylor Hobson – Surtronic 25) for measuring surface texture.
- Profile projector (VOM-2515).

- Microscope.
- Tow coordinate measuring microscopes.
- Taly surf CCI.
- Subtronc 25 (surface roughness).
- Talyrond 200.
- FT 100 Cutting Forces during Drilling.
- Ultrasonic thickness gauge.
- Form talysurf.

Motion and Time Study Lab.

Motion and time study lab focuses on experiments that develop a group of skills enabling the student to understand and absorb the basics and fundamentals of motion and time study. These skills will lead to the shortest time to accomplish a task using least effort. This is reflected on work place design, work tools and equipment, and attempting to reach ideal levels of the environment surrounding the worker.



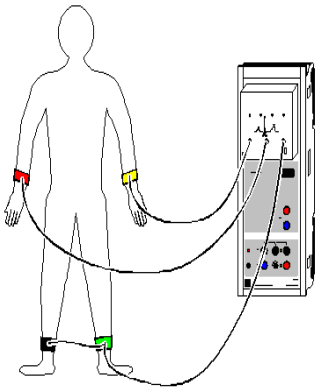
Courses served: IE342, IE 496 and IE 497.

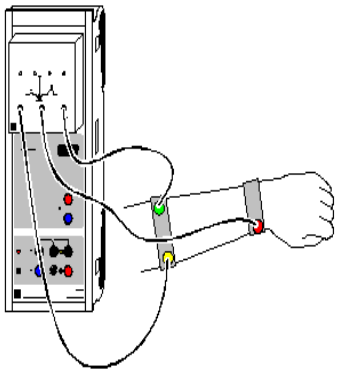
Equipment

- Hearing measurement instrument (Lafayette INSTRUMENT Co., Portable Audiometer 109-1988).
- Noise measurement instrument (B&K, Sound Level Meter 22608 -1999).
- An instrument to evaluate the ability to perform fine and precise tasks (Lafayette Instrument Co., Purude Peg Board Test 32020 - 2000).
- Dexture speed measurement instrument (Lafayette Instrument Co., Hand Tool Dexture 32521 – 2000).
- Hand and finger dexture speed measurement instrument (Lafayette Instrument Co., Steadiness Tester Hole Type 32011 - 2000), (Lafayette Instrument Co., Single Impulse Tester 58024C*C – 2000).
- An instrument to measure and evaluate human ability to lift loads (Lafayette Instrument Co., Jamar Hydraulic Hand Tester Hole Type 32011 - 2000).
- Maynard MOST package to measure the standard time for various tasks.

Human factors lab

The Lab. presents a manual concerning measurements of pulse (Anthropometry) , EMG, EKG, skin resistance, and reaction time. All experiments are run by each individual student.





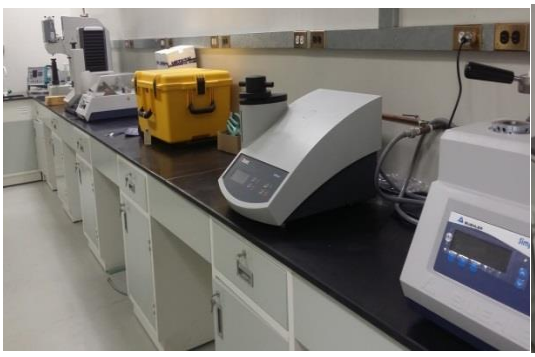
Courses served: IE341, IE496 and IE497.

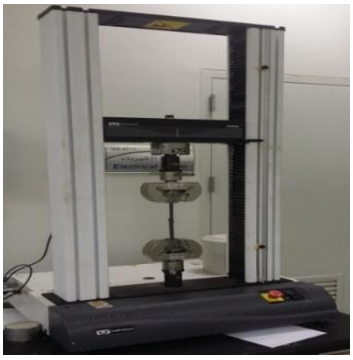
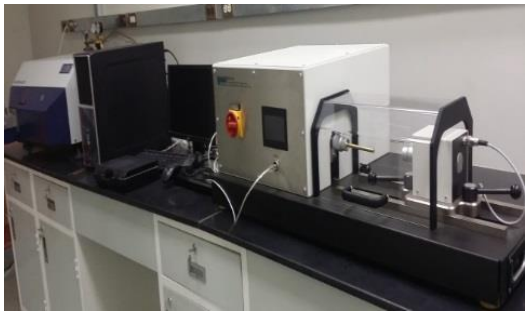
Equipment

- Two units of Leybod Model 524-046; Germany
- Two units of Leybod Model 524-049; Germany
- Two units of BioBench #321612A-01; USA
- Four units of INVICTA; England
- Two units of Leybod Model 662-144; Germany.
- Body Taylor Lithium Electronic Scale; China.
- Jackson strength eval; indian.
- Viberation Instrument (2); Denmark.
- Environment Control Compact Hygro Thermomet; USA.
- Insta pulse Fitness Heart rate monitor; Canada.
- Termometro Clinico Digitale; Italy.
- Proscope Lightwight stethoscope; Taiwan.
- Kestrel 4000 pocket weather tracker; USA.
- Stop Watch; China.
- Electronic Wind speed indicator; USA.
- Tape Measure 60 : 150 cm; Taiwan.
- Digital Automatic Blood Pressure Monitor (3); Japan.
- Thermoscan; Germany.
- Digital Blood Pressure Monitor; China.
- Body weight Ikea; France.
- Humidifier (2); China.
- Light Meter Lux / FC; Taiwan.
- Noise Dosimeter With PC Intrface 407355; Taiwan.
- EMG model 6000, 8 channel (WLAN INTERFERENCE); Finland.

Manufacturing materials lab

This lab is designed in such a way that it provides the students the broad knowledge about manufacturing materials' properties, behaviors and their recognition.



Courses served: IE 251, IE 496 and IE 497.

Equipment:

- Abrasive Cutter
- Servo cut 301 - MA
- Zwick / Roell (ZHU)
- Grinder – Polisher
- Metaserv 250 (Grinder – Polisher)
- Automatic mounting press (Simplimet 1000)
- Citopress-1 (Struers company)
- Metallurgical Microscope (IMM901)
- Precision Saw (Isomet 1000)
- Dura Scan
- Hardness Tester (HBRV-187.5)
- Hardness Tester
- Torsion Testing Machine, 200Nm
- Foundry-Master
- Zwick / Roell (Z100)
- Instron 3369

Manufacturing processes lab.

This lab focuses on developing the students' skills towards metal cutting activities, through introducing different metal cutting machines and processes. It also develops the

skill of the students towards process planning, machine and process selection. The lab also focuses on machining difficult-to-cut materials using nontraditional machining processes.

Courses served: IE 252 , IE352, IE 496 and IE 497.

Equipment

A. Machining Lab

- Horizontal and vertical milling machines (MILL Star)
- Turning machine
- Band Saw (MEBAR)
- CNC milling machines (DMC 635V)
- CNC turning machines (EMCO – E300)
- Grinding machines (ARCA 1730AGC)

B. Casting Lab

- Electrically heated melting furnace
- Permeability tester
- Universal strength tester
- Mould strength and hardness testers
- Electrical cell
- Displacement tester

C. Welding Lab

- Gas welding machine
- Arc welding

- Resistant spot welding

D. Non-Traditional Machining Lab

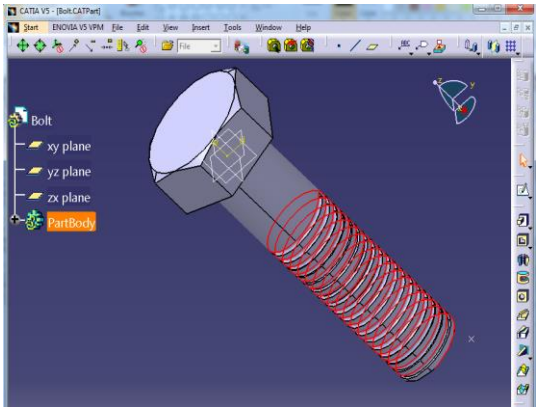
- CNC Laser system (K2CM-L2)
- Ultrasonic milling machines (SonicMill)
- Wire cut EDM

E. Forming Lab

- Hydraulic press machine
- Mechanical press machine
- Shear cutting machine

CAD/CAM Lab

The main objective of this lab is to train IE students in the area of CAD/CAM and familiarize them how CAD/CAM is implemented in the real world. It provides the broad knowledge about the areas of computer aided drafting, solid modeling, part programming, and CNC machining. The students get hands on experience in setting up and machining the workpieces on trainer lathe and milling machines.



Courses served: IE 360, IE 496 and IE 497.

Equipment

- Desktop trainer CNC milling machines (Charly4You).
- Desktop trainer CNC lathe machines (Boxford).
- CAD/CAM software (CATIA).
- CNC EMCO Concept lathe
- CNC EMCO Concept machining center

Control and Automation Lab.

This laboratory is concerned with providing experience and training for the IE students on the principle of automating the manufacturing processes and machinery using PLC (Programmable Logic Controller) and also using PC as controller.

In this lab the student is introduced to different electric, optical, pneumatic and electronic sensors, and actuators. Furthermore, the student trained how to connect those units mechanically and electrically together using PLC or PC as controller. Moreover, the students are trained how to program PLC/PC to control these integrated electric-mechanical systems.

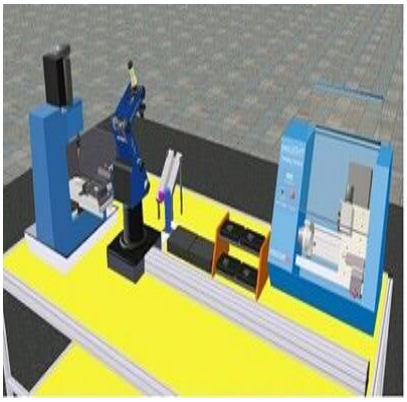
Courses served: IE 337, IE 496 and IE 497.

Equipment

- Five Stations of Siemens PLC and HMI.
- Proximity, optical and contact logic sensors.
- Logic pneumatic sensor and actuators.
- Electric servo-motors and amplifiers.
- Set of mechanical and electric fixture to build the controlled system.

Computer Integrated Manufacturing (CIM) Lab.

CIM lab, at Industrial Engineering Department, is concerned with providing the students with practical knowledge and training on a CIM applications and technologies. This is through programming and operating the FMS lab, CNC machines, Industrial Robot and carrying out the related experiments.



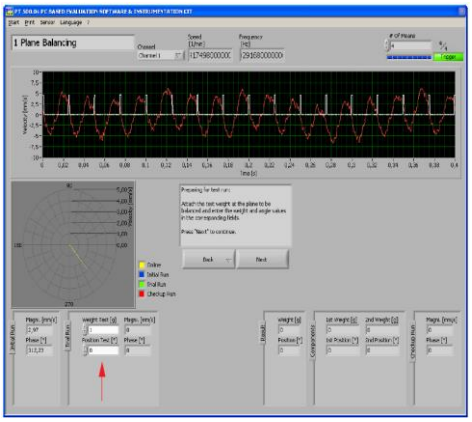
Courses served: IE 461, IE 496 and IE 497.

Equipment

- CNC milling (Intelitek Expert Mill VMC-0600)
- CNC lathe (Intelitek ProLight Turing Center)
- Three Industrial Robots (Intelitek SCORA – ER14/4U)
- FMS (Intelitek)
- FANUC serial robot
- FANUC parallel robot

Maintainability & Reliability Lab:

This Lab is intended for undergraduate industrial engineering students to provide the broad knowledge about the areas of machine diagnostic, calibration and maintenance.



Courses served: IE 438, IE 496 and IE 497.

Equipment

- PT 500 Machinery Diagnostic System, Base Unit
- PT 500.04 Computerised Vibration Analyser
- PT 500.05 Brake and Load Unit
- PT 500.10 Elastic Shaft Kit
- PT 500.11 Crack Detection
- PT 500.12 Roller Bearing Faults Kit
- PT 500.12 Roller Bearing Faults Kit
- PT 500.14 Belt Drive Kit
- PT 500.14 Belt Drive Kit
- PT 500.15 Damage to Gear Kit
- PT 500.19 Electromechanical Vibrations Kit
- IA 110 Calibrating a Pressure Sensor
- IA 120 Principles of Industrial Sensors
- MT 181 Assembly & Maintenance - Multi Stage Centrifugal Pump
- MT 184 Assembly & Maintenance Exercise Piston

Product design and prototyping lab

This laboratory provides an interactive learning environment where students can mimic real life product design and development projects. It intends to develop in students an

understanding of the impact of innovation on product design and its profitability. Also to understand how advanced technologies in measurements and computer aided design fits into the product design, and development.




Courses served: IE 301, IE496 and IE497.

Lab equipment:

- Camera
- Measuring Tool Set
- 3D Laser Scanners
- CAD Software (CATIA, SOLIDWORK)

Computer lab

This lab is intended to provide students with skills of using latest softwares. The computer lab is equipped with 25 PC systems. The softwares installed in the PC systems include the following.

- Design/DEF
- Exsys
- VisOjtNet
- IBM Maximo
- Minitab
- Arena