1442
2021

Kingdom of Saudi Arabia
King Saud University
College of Engineering
Industrial Engineering Department






# Industrial Engineering Department

## Academic Programs


# Preface

Whether you want to improve the world of manufacturing, services or logistic systems, IED has programs that lead you to your goals. In manufacturing systems, you will gain knowledge and skills to increase product quality for consumer, increase the profit by decreasing wastes and eliminating unnecessary processes, and ensure the safety of workers. In services and logistic systems, you will learn professional optimization, evaluation, and simulation tools to speed up and upgrade the services provided by reducing the delivery and service times, eliminating unnecessary operations, and decreasing waiting times and queue lines.

Since the IED is established in the year 1403H (1983 G), we, in IED, always taken pride in providing Saudi market with highly educated intellectuals and professionals whom hold key positions in all governmental and private sectors. We have well-known faculties, world-class courses, highly equipped laboratories, best students, and successful alumni. IED faculties are carrying out a broad range of research projects funded by public agencies and private sectors. In addition, IED has a strong collaboration with the Advanced Manufacturing Institute that enriches the frontiers of the relevant knowledge and extends the research of the IE areas. All of this provides an intellectually stimulating broad and rewarding environment for faculty, staff, and students to a simultaneously meet the goals of the 2030 vision and strategic goals of both the colleague of engineering and the university.

IED offers several programs for undergraduate, graduate, and professional studies. At the undergraduate level, it offers B.Sc. in Industrial Engineering. At the graduate level, the IED has M.Sc. and Ph.D. in three different tracks; Manufacturing Systems Engineering, Industrial Systems Engineering, and Human Factors Systems Engineering. In addition, the IED offers H.D. in Occupational Safety Engineering.

Prof. Ali Mohammed AlSamhan.
Industrial Engineering Department Chairman

## Overview

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 students 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 are 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 و 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.

## Industrial Engineering Department 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:

| | |
|---|---|
| 1 | Objective 1. Provide, improve and maintain high quality industrial educational program by (a) equipping the students with the knowledge, skills, and tools to design, operate and analyze industrial production systems, and (b) embedding in the students the understanding of industrial engineering profession, ethics, and responsibilities. |
| 2 | Objective 2. Establish and improve high level educational supports by (a) recruiting high quality faculty member, teaching assistants, and technicians, and (b) equipping the laboratories with latest educational facilities. |
| 3 | Objective 3. Provide industrial engineering graduate with leadership and longlife learning behavior by developing critical thinking for solving local industrial production systems (manufacturing and service) with innovated skills. |
| 4 | Objective 4. Promote and strengthen the relation with government, public and private sectors by organizing conferences, symposia and delivering short courses and seminars promoting consultancy, symposia and delivering short courses and seminars laboratory services. |
| 5 | 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. |
| 6 | 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 |
|---|---|---|---|---|---|
| 1. | Abdulrahman Al-Ahmari | Professor | Manufacturing Systems Engineering | University of Sheffield, UK | alahmari@ksu.edu.sa |
| 2. | Ali Alsamhan | Professor | Manufacturing Systems Engineering | University of Birmingham, UK | asamhan@ksu.edu.sa |
| 3. | Mohamed Zaki Ramadan | Professor | Human factors Engineering | University of West Virginia, USA | mramadan1@ksu.edu.sa |
| 4. | Anis Gharbi | Professor | Operation System Engineering | University de Tunis, Tunisia | a.gharbi@ksu.edu.sa |
| 5. | Ateekh Ur Rehman | Professor | Manufacturing Systems Engineering | Indian Institute of Technology Bombay, India | arehman@ksu.edu.sa |
| 6. | Emad Samir Abdelghany | Professor | Manufacturing Systems Engineering | University of Houston, USA | eabdelghany@ksu.edu.sa |
| 7. | Chintakindi Sanjay | Professor | Advanced manufacturing systems | Rajiv Gandhi Proudyogiki Vishwavidyalaya Technological University, India | schintakindi@ ksu.edu.sa |
| 8. | Rabiul Ahasan | Professor | Human Factors & Ergonomics | University of Oulu, Finland | rahasan@KSU.EDU.SA |
| 9. | Ibrahim Alharkan | Associate Professor | Operation System Engineering | Oklahoma State University, USA | imalhark@ksu.edu.sa |
| 10. | Adel Al-Shayea | Associate Professor | Operation System Engineering | Loughborough University, UK | alshayea@ksu.edu.sa |
| 11. | Khalid Al-Saleh | Associate Professor | Human factors Engineering | University of Birmingham, UK | kalsaleh@ksu.edu.sa |
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| 22. | Saad Alabdulkarim | Assistant Professor | Human Factors Engineering | Virginia Tech, USA | Alabdulkarims@ ksu.edu.sa |
| 23. | Woo Hyung Park | Assistant Professor | Human factors Engineering | Texas Tech University, USA | wpark@ksu.edu.sa |
| 24. | Abdullah Al-Faify | Assistant Professor | Advanced Manufacturing Engineering | University of Sheffield, UK | aalfaify@ ksu.edu.sa |

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|---|---|---|---|---|---|
| 25. | Marawan M. Al-Sultan | Assistant Professor | Operation System Engineering | KSU, KSA | maalsultan@ ksu.edu.sa |
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| 27. | Abdelsalam Altamimi | Assistant Professor | Manufacturing Engineering | University of Manchester, UK | aaaltamimi@ ksu.edu.sa |
| 28. | Mehdi Ali Tlija | Assistant Professor | Design & Manufacturing Engineering | University of Monastir, TN | mtlija@ ksu.edu.sa |
| 29. | Hamoud Sultan Binobaid | Assistant Professor | Operation System Engineering | University of Oklahoma | hsbinobaid@ksu.edu.sa |
| 30. | Mejdal Alqahtani | Assistant Professor | Quality Engineering | Rutgers University, USA | almejdal@ksu.edu.sa |
| 31. | Ibrahim Almhaidib | Assistant Professor | Occupational Safety and Health | West Virginia University, USA | ialmhaidib@ksu.edu.sa |
| 32. | Fahad Mesfer Alqahtani | Assistant Professor | Human Factors Engineering and Safety | West Virginia University, USA | afahad@ksu.edu.sa |
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| 38. | Osama Abdullah Al-Ateeq | Teaching Assistant | Operation System Engineering | University of Pittsburgh, USA | oalotaik@ksu.edu.sa |
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| 40. | Ibrahim Saleh Al-Rashed | Teaching Assistant | Manufacturing Systems Engineering | KSU, KSA | ibranna@hotmail.com |
| 41. | Abdul-Allah A. Al-Mosaad | Teaching Assistant | Operation System Engineering | KSU, KSA | Eng.almasad@gmail.com |
| 42. | Meshaal Fahd Al-Huzaily | Teaching Assistant | Manufacturing Systems Engineering | KSU, KSA | malhethaily@ksu.edu.sa |
| 43. | Bassem A. Al-Khalil | Teaching Assistant | Operation System Engineering | KSU, KSA | |

## Industry Advisory Board:

There is a well-established link between the IED and industry through the advisory board. The advisory board reviews the level of achievements of the educational objectives of the programs offered by the department. Advisory Board Members are blow and are presented at:

https://engineering.ksu.edu.sa/en/IE_Industrial_advisory_board.

- Prof. Ali Alsamhan (Member), Chairman of Industrial Engineering Department (KSU).
- Dr. Mohammed Alkahtani, Vice-dean of Advanced Manufacturing Institute (KSU).
- Dr. Khalid Al-Saleh (Member) CEO, Riyadh Valley Company, Associate Professor, Industrial Engineering Department (KSU).
- Dr. Ibrahim Al-harkan (Member), General Director for Entrepreneurship Institute (KSU).
- Prof. Abdulrahman Al-Ahmari (Member), Supervisor of Raytheon Chair for Systems Engineering (KSU).
- Dr. Adel Al-Shayea, Associate Professor, Industrial Engineering Department (KSU).
- Dr. Abdullah Yahia AlFaify, Coordinator of Academic Accreditation Unit, IED (KSU).
- Eng. Abdulaziz Al-khorayef (Member), General Manager Steel & Mechanical Works at Alkhorayef Industries Co.
- Eng. Bandar Al-Zamil (Member), Vice President of Zamil Group.
- Eng. Adel Alkhodairy (Member), CEO, Local Content and Government Procurement Authority.
- Eng. Suliman Almazroaa (Member), CEO, at National Industrial Development & Logistics Program "NIDLP".
- Eng. Saadon Alsaadon (Member), Senior Consultant, Devoteam Co.
- Dr. Riyad Al Elshaikh, Smaal & Medium Enterprises General Authority, KSA.
- Eng. Abdulmajeed ElSaady (Member), I-plast factory, KSA.
- Eng. Majed Alrefaay (Member), Vice President of Energy Sector, AEP.
- Eng. Abdullah Alsamhan (Member), General Manager for International Cable Systems Management, STC.

## Admission Requirements & Regulations for the B.Sc. Programs:

The College admits about 600 students every year, with a clear admission criterion that is based on having a General High School Certificate (Science Section) with a minimum composite score of 80%. The 100% composite score is distributed among: 30% for the high school test, 30% for Capabilities Test and 40% Achievement Test. It should be noted that the Capabilities Test administrated by the National Center for Assessment in ETEC is similar to the General Aptitude Test (GAT) or to the Scholastic Aptitude Test (SAT). The Achievement Test was introduced in 2007. It is a subject achievement test whose score is reported as a composite score of a test administered in the following subjects: Math, Physics, Chemistry, Biology, and English. Students are required to take this test prior to application for admission to the university. In addition, the student must have a minimum score of 87% in mathematics, physics and chemistry. However, such criteria can vary depending on the admission policy of the college.

The admission process is efficient, fair, and responsive to the needs of students entering the program. Clear information about student complaints is available under the following website: https://eservices.ksu.edu.sa/StudentsComplaints/. Mechanisms for student appeals and dispute resolution are clearly described, made known, and fairly administered.

### Admission of Students who have finished the Common-Year of Science Colleges

Students are accepted by merit according to the following rule:

- 0.25 x Mark of Achievement Test + 0.25 x Mark of Capabilities Test + 5 x cumulative GPA of Common first year+ points of the course Math101
- The college accepts about 550 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.

### Students Allocation to College Departments

After successfully passing 28 out of the 34 credit hours of the first year at the college, a student must submit, electronically, a request to the Deanship of Admission & Registration, prioritizing his preference of the different disciplines. Students are allocated in departments based on their GPA and department capacity.

However, during their first year at the college which is after the First Common year, students must attend introductory orientation presentations offered by the college departments to be acquainted with the nature of the different engineering disciplines.

### Student and Course Transfer

The policies for transfer students are clearly specified for three different cases as follows:

1. Transfers from other departments within the COE
2. Transfers from other colleges within the university (internal transfer)
3. Transfers from other universities (external transfer)

The details of these policies are accessible and posted in Arabic on the website: https://engineering.ksu.edu.sa/en

Qualified faculty members make all arrangements for student transfer or course transfer to ensure that all requirements and regulations are satisfied. These arrangements are made prior to the beginning of the semester so that the student will be informed about the decision in an adequately timed manner.

The following sub-sections briefly describe the transfer requirements for the different cases.

### Transfers from other departments within the College of Engineering

1. Students from another department of the college must have a cumulative GPA higher than the lowest GPA admitted to the department.
2. A prescribed form must be filled in by the student for final approval by the College Students Affairs Unit.
3. The priority of acceptance is given to the students with the higher grades, on the basis of available seats in each department.

### Transfers from other colleges within the university (Internal Student Transfer):

1. Students from Science Colleges of KSU must have a minimum cumulative GPA of 4.0 out of 5.0 and have a grade B in Math.
2. Students from KSU Health Colleges must have a minimum cumulative GPA of 4.35 out of 5.0, and they should have completed successfully or obtained an equivalence of the Common first year for the Science Colleges.
3. The cumulative GPA is calculated after a student completes at least 12 hours after the Common first year (not including courses of the university requirements: Islamic culture and Arabic language).
4. If the College's intake capacity is exceeded, the Dean of the COE may accept no more than fifty students satisfying the transfer criteria.
5. Acceptance of students is done by merit when all the conditions are satisfied.
6. Transfer from Humanities Colleges is not accepted.

### Transfers to the department of industrial engineering from other universities (External Student Transfer)

1. The student must have a minimum cumulative GPA of 4.25 out of 5.0 or its equivalent from an accredited college of engineering.
2. The student must have a minimum score of 80% in mathematics courses studied in his college.
3. The student must not have successfully completed more than 35 credit hours after the first common year or equivalent requirements for the college of engineering at his university.

4. If the student did not study a common first year in his college, the University has the right to ask the student to study the KSU Common first year for Science Colleges, or otherwise what the University deems suitable after carrying out all the equivalences for the student).
5. 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 COE at KSU. The 12 credit hours should not include courses in Islamic culture and Arabic language. The student must also obtain a GPA in that semester of at least 4.0 out of 5.

## 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 a prerequisite for transfer acceptance. The transferred credits should not be more than 40% of the total credits of a degree plan of the COE at KSU. Transferred credits are not included in the GPA, but a grade of at least C should be scored to pass courses

## Transfer Courses

Students can transfer courses that have been studied in other universities. The maximum allowable percentage of credit hours that could be transferred by students from other universities is 40% of the total credit hours in the industrial engineering curriculum. These courses are evaluated by the Department Academic Committee and faculties who teach these courses and approved by the Department Council. Students who want to study in other universities must do the following:

1. Students must fill in a course transfer form and submit it to the chairman of the department of industrial engineering.
2. The chairman consults the faculty who teaches the course.
3. The faculty reviews the syllabus of the transfer course in light of IE departmental course syllabus checking the equivalency of the syllabus and credits.
4. The chairman approves the equivalency and signs the form.
5. The student then should get the approval of the vice dean of academic affairs.
6. The student hands in the form to the university registrar's office and gets an official acceptance letter to study the course at the specified university.
7. After studying the course, the student should get an official completion letter and the transcript from the registrar's office of the university where the transfer course was completed.
8. Finally, the student should hand the official completion letter to the KSU registrar's office.

## Practical Training

In addition to formal coursework, students get a chance to apply the acquired engineering knowledge in real life though 10-week practical training at one of the public institutions or private companies. The student work is evaluated by a supervisor designated by the institution or company. This training work is carried out as follows:

- 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 not credited by hours, it is required to satisfy the undergraduate degree 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.

### Student Outcomes

The above program educational aims are achieved through assessing the learning outcomes. The learning outcomes are represented by set of abilities and knowledge that will be gained by the student and that will be reflected in handling his career work. The students' outcomes are:

(SO1) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

(SO2) An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

(SO3) An ability to communicate effectively with a range of audiences.

(SO4) An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.

(SO5) An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.

(SO6) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

(SO7) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

## Program Requirements (165 Credit Hours)

The duration of the program is five years divided into 10 semesters, with two semesters in the academic year. The Students need to successfully pass 165 credit hours with minimum GPA of (2.75 of 5) to complete graduation requirements. This includes the following:

| Requirements | Cr. Hr. | Description |
|---|---|---|
| First year | **32** | General Chemistry (4), Differential Calculus (3), Statistics (3), English (12), Writing Skills (2), University Skills (3), IT Skills (3), Entrepreneurship (1), Health and Fitness (1) |
| University | **8** | Islamic Studies: compulsory (2), Optional (6) |
| College | **48** | Compulsory (42), Complementary 6) |
| Department | **76** | Core (66), Project (4), Electives (6) |
| | **1** | Practical Training (1) without grade (NP) |
| | **0** | Research Project0 (NP) |
| **Total** | **165** | |

# RECOMMENDED SEMESTER SCHEDULE - INDUSTRIAL ENGINEERING PROGRAM

(X, Y, L): X = Lectures; Y = Tutorials; L = Lab. NP: No Grade (Pass or Fail)

**Level (1)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| ENGS 10X | English language | 6 (6,9,0) | | |
| MATH 101 | Differential Calculus | 3 (3,1,0) | | |
| ENT 101 | Entrepreneurship | 1 (1,0,0) | | |
| CHEM 101 | General Chemistry | 4 (3,0,2) | | |
| ARAB 100 | Writing Skills | 2 (2,0,0) | | |
| Total | | 16 | | |

**Level (2)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| ENGS 11X | English | 6 (6,9,0) | | |
| CUR 101 | University Skills | 3 (3,0,0) | | |
| CT 101 | IT skills | 3 (0,0,6) | | |
| STAT 101 | Introduction to Statistics | 3 (2,2,0) | | |
| EPH 101 | Health & fitness | 1 (1,1,0) | | |
| Total | | 16 | | |

**Level (3)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| IC 107 | Ethics of the Profession | 2(2,0,0) | | |
| PHYS 103 | General Physics (1) | 4(3,0,2) | | |
| MATH 106 | Integral Calculus | 3(3,2,0) | *MATH 101* | |
| MATH 107 | Vectors & Matrices | 3(3,2,0) | *MATH 101* | |
| ENGL 109 | Language & Communication | 2(2,1,0) | | |
| GE 104 | Basics of Engineering Drawing | 3(2,0,2) | | |
| Total | | 17 | | |

**Level (4)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| PHYS 104 | General Physics (2) | 4(3,0,2) | PHYS 103 | |
| MATH 203 | Differential and Integral Calculus | 3(3,2,0) | *MATH 106 MATH 107* | |
| GE 106 | Introduction to Engineering Design | 3(2,1,2) | *GE 104* | |
| GE 201 | Statics | 3(3,1,0) | *MATH 106 MATH 107* | |
| GE 203 | Engineering and Environment | 2(2,0,0) | *CHEM 101, MATH 101* | |
| ENGL 110 | Technical Writing | 2(2,1,0) | *ENGL 109* | |
| Total | | 17 | | |

**Level (5)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| GE 211 | Computer programming in C++ | 3(2,0,2) | | |
| MATH 204 | Differential Equations | 3(3,2,0) | MATH203 | |
| MATH 244 | Linear Algebra | 3(3,2,0) | MATH 107 | |
| IE 214 | Industrial operation Management (1) | 3(3,2,0) | STAT 101 | |
| IE 222 | Industrial Operations Analysis (1) | 3(3,1,1) | MATH107 | GE211 |
| IE 251 | Manufacturing Materials | 3(2,2,2) | PHYS104, CHEM101 | |
| Total | | 18 | | |

**Level (6)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| IE 314 | Industrial operation Management (2) | 3(3,2,0) | IE214 | |
| IE 322 | Industrial Operations Analysis (2) | 3(3,1,1) | IE222, GE211 | |
| IE 333 | Design & analysis of Experiments | 3(3,1,1) | STAT 101 | |
| IE 337 | Automatic Control Systems | 3(3,1,1) | MATH204, GE211 | |
| IE 252 | Manufacturing processes (1) | 3(3,2,1) | IE251, GE104 | |
| IC 1xx | Optional IC course | 2(2,0,0) | | |
| Total | | 17 | | |

**Level (7)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| IC xxx | Elective Islamic course | 2(2,0,0) | | |
| GE 403 | Engineering Economy | 2(2,1,0) | | |
| IE 339 | Quality Engineering | 3(3,1,1) | IE333 | IE352 |
| IE 341 | Human Factors Engineering | 3(2,1,2) | IE333 | |
| IE 352 | Manufacturing processes (2) | 4(4,2,1) | IE252 | |
| IE 360 | CAD/CAM | 3(2,1,2) | GE104 | IE352 |
| Total | | 17 | | |

**Level (8)**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| GE 402 | Engineering Projects Management | 3(3,1,0) | | |
| IE 420 | Industrial Systems Simulation | 3(2,1,2) | IE322 | |
| IE 438 | Engineering Reliability & Maintenance | 3(3,1,1) | IE314 | |
| IE 342 | Work Analysis & Design | 3(2,1,2) | IE352 | |
| IE 449 | Safety Engineering | 3(3,1,1) | IE341, GE203 | |
| IE 361 | Product Design and Innovation | 3(2,1,2) | GE106 IE339, IE360 | |
| Total | | 18 | | |

**Level 9**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| IE 405 | Manufacturing Economics | 3(3,1,0) | IE342 | |
| IE 450 | Industrial Facility Design | 3(3,1,1) | IE342 | |
| IE 462 | Industrial Information Systems | 2(2,1,1) | IE314 | |
| IE 469 | Manufacturing Systems | 3(3,1,1) | IE438 | IE450 |
| IE *** | Elective | 3 | | |
| IE 496 | Graduation Project (1) | 2(2,0,0) | Complete successfully 129 credits hours and passing all courses in levels 1-7. | |
| Total | | 16 | | |

**Level 10**

| Course Code | Course Title | Cr. Hr. (X,Y,L) | Pre-requisite | CO-requisite |
|---|---|---|---|---|
| *** | Free Course | 2 | | |
| IC *** | Elective Islamic Course | 2(2,0,0) | | |
| IE 461 | Computer Integrated manufacturing | 3(2,1,2) | IE360, IE450 | |
| IE *** | Elective | 3 | | |
| IE 497 | Graduation Project (2) | 2(2,0,0) | IE 496 | |
| IE 999 | Practical Training | 1 (NP) | Successful completion of 110 credit hrs. | |
| IE 998 | Research Project | 0 (NP) | Complete successfully 129 credits hours | |
| Total | | 13 | | |

## IE Course Description

**IE 214: Industrial Operations Management -1-** 3(3,2,0)

Introduction to operation management, evolution of operations management, productivity challenge, new trends in operations management; Demand forecasting, strategic importance of forecasting, forecasting approaches, monitoring and control of forecast, forecasting in service sector; Capacity planning, bottleneck analysis & theory of constraints and break even analysis; Supply chain, techniques for evaluating supply chain, managing bullwhip effect, supplier selection and transportation mode analysis; Management of Inventory, inventory models for independent demand, probabilistic inventory models and safety stock.

**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; physical and mechanical properties of materials; Ferrous materials; Heat treatment; Non-Ferrous alloys; Ceramics, Polymers, Composites; 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 314: Industrial Operations Management -2-** 3(3,2,0)

Aggregate sales and operations planning, aggregate planning approaches, revenue management, using software for aggregate planning; Short term scheduling, forward and backward scheduling, scheduling process focused facilities, finite capacity scheduling; production line balancing; Business analytics models, decision making tools. **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)**

Dimensional and geometric tolerances, Tool materials and geometry; Cutting tools assembly techniques; Cutting mechanics; Material removal operations; Effects of cutting variables on machining operations; Optimization of cutting variables for machining operations; Non-traditional machining; Process planning.

**Pre-requisite: IE 251, GE 104;** **Co-requisite: IE 252**

**IE 360: CAD/CAM** **3 (2,1,2)**

Introduction to CAD/CAM Systems, Components of CAD/CAM Systems, Geometric Modeling Systems, Geometric Transformations, Representation and Manipulation of Curves, Geometric Projections, Data Exchange between CAD/CAM Systems, Finite Element Modeling and Analysis, Introduction to Numerical Control (NC), Analysis of NC positioning system, Manual Part Programming. **Pre-requisite: IE 352**

**IE 361: Product Design and Innovation** **3 (2,1,2)**

Introduction to manage innovation; product development stages; Customer needs; Product specification; Quality function deployment; Product structure and components; Function Analysis; Value engineering principles; principle of reverse engineering; Idea generation; Theory of inventive problem solving (TIPS-TRIZ); Design for manufacturing and assembly (DFMA); Principles of robust design; Implementing prototype metrologies; product development and Entrepreneurship; product development project.

**Pre-requisite: GE106, IE339, IE360**

**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, Costing and Entrepreneurship. **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 analysis; Production analysis (product-process relation, industrial decisions, production-layout relation, process design and planning charts process); Capacity analysis (actual quantities, number of production units and labors, assembly line balancing); 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)**

Introduction and manufacturing systems; Industrial Robots; Material handling systems; Automated storage and retrieval system; Automated identification and data capture; Industrial Networks and Communication Systems; Industrial Information Systems; Computer Aided Process Planning; Inspection principles and technologies. **Pre-requisite: IE 360, IE 450**

**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 Metrics and Economics; Single-Station Manufacturing Cells; Modeling of Manufacturing Systems: Analytical Models, IDEF0, IDEF1X, Petri Nets; Automated Production and Assembly Lines; Group Technology and Cellular Manufacturing; and Flexible Manufacturing Systems (FMS).

**Pre-requisite: IE 438;** **Co-requisite: IE 450**

**IE 496: project -1-** **2 (1,1,2)**

Senior student selects 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.**

**Elective Courses:**

**IE 480: Production Systems Operation** **3 (2,1,0)**

Business plans to production operation systems, strategies to reach targets, production operations system's contribution to competitiveness, balancing production operations system and strategies. Production system operations performance, world-class successful production operations systems, productivity and efficiency what should be measured? Overall equipment effectiveness. Advance production system operations dynamic, bottleneck rates, internal benchmarking, and labor constrained production operation system. Just in time and lean manufacturing, implementing just in time, pull production operation system, Kanban, comparison of Conwip with Kanban and material requirement planning, production scheduling in pull environment. Advance aggregate and work force planning, product mix planning. Modern views of capacity management, forcing cycle time compliance, factory physics approach, capacity allocation and production line balancing. Production systems operation development in the future, key areas and success factors, future production from an international perspective.

**Pre-requisite: IE314; Successful Completion of 120 Cr Hr.**

**IE 481: Supply chain and Logistics** **3 (3,1,0)**

Reviewing supply chain and logistics; design of the supply chain network; Analysis and design of domestic and international logistics systems; Application of supply chain and logistics decision-making tools and skills; Application of analytical tools useful for logistic systems for a better competitive advantage; Analysis of the characteristics of logistics system elements and their interrelationships within a company.

**Pre-requisite: IE314; Successful Completion of 120 Cr Hr.**

**IE 482: Decision Analysis** **3 (3,1,0)**

This course provides an overview of modeling techniques and methods used in decision analysis, including utility models, decision trees, and Bayesian models. Elicitation techniques for model building are emphasized. Practical applications through real-world model building are described and conducted.

**Pre-requisite: IE322; Successful Completion of 120 Cr Hr.**

**IE 483: Engineering Analytics** **3 (3,1,0)**

Students explore all three areas of Analytics, namely Predictive Analytics, Descriptive Analytics, and Prescriptive Analytics. The Predictive Analytics covers advanced forecasting techniques such as regression methods and neural networks. Descriptive Analytics deals with data mining techniques such as clustering and classifications. Prescriptive Analytics consists in applying heuristic methods to solve hard optimization problems, including Constructive Heuristics, Improvement Heuristics, and Metaheuristics.

**Pre-requisite: IE322; Successful Completion of 120 Cr Hr.**

**IE 484: Advanced Quality Engineering** **3 (3,1,1)**

This course provides students with the analytical and quality management tools necessary skills to solve manufacturing quality problems and implement effective quality management systems. Topics include overview of quality management methodologies, total quality management (TQM), the Six Sigma (DMAIC) problem solving methodology, Kaizen methodology, 5S methodology, failure mode and effects analysis (FMEA), quality function deployment (QFD), measurement system analysis (MSA), Taguchi quality engineering approach

**Pre-requisite: IE339; Successful Completion of 120 Cr Hr.**

**IE 485: Advanced Safety Engineering** **3 (3,1,1)**

Course covering hazard identification and risk analysis, safe system design, safety analysis techniques, system hazard analysis, and safety cases. Techniques covered include: Hazard and Operability Studies (HAZOP) and Computer Hazard and Operability Studies (CHAZOP), Functional Failure Analysis (FFA), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Failure Modes and Effects Analysis (FMEA) and Failure Modes Effects and Criticality Analysis (FMECA), and Goal Structured Notation (GSN), and others.

**Pre-requisite: IE449; Successful Completion of 120 Cr Hr.**

**IE 486: Ergonomics design** **3 (3,1,1)**

This course covers mainly theories/methods that influence the assessment of physical, social, and psychological human factors. Development of user needs with application to designed products that interact with human body. In addition, application of design to meet human needs. Design of fabricated products, tools/machines, software/hardware interfaces, art/culture, living environments, and complex sociotechnical systems.

**Pre-requisite: IE341; IE342; Successful Completion of 120 Cr Hr.**

**IE 487: Advanced Manufacturing Technologies** **3 (3,1,1)**

Manufacturing with lasers: overview of laser manufacturing processes, laser cutting, laser hardening, laser welding of metals; Manufacturing with additive processes: overview of additive manufacturing processes, binder jetting, directed energy deposition, material extrusion, ultrasonic lamination technology, hybrid additive process; Manufacturing Micro parts and micro features: micro manufacturing overview, micro mechanical drilling, micro milling, micro electrical discharge machining, electrochemical discharge machining.

**Pre-requisite: IE352; Successful Completion of 120 Cr Hr.**

**IE 488: Additive Manufacturing Technologies** **3 (3,1,1)**

Basic Principles of additive manufacturing, Technologies of Additive Manufacturing, Generalized process chain, additive manufacturing processes, Direct write technologies, guideline of process selection, Software issues for additive manufacturing, Direct digital manufacturing, Applications for Additive Manufacture.

**Pre-requisite: IE352; IE360; Successful Completion of 120 Cr Hr.**

**IE 489: Manufacturing System Modeling** **3 (3,1,1)**

Definition and classification of factory models; Process time variability; Multi stage single product factory models; Multiple product factory models; Models of various forms of batching; Serial limited Buffer models; Simulations techniques in manufacturing.

**Pre-requisite: IE469; Successful Completion of 120 Cr Hr.**

### IE 490: Maintenance Engineering 3 (3,1,1)

Maintenance functions, Preventive Maintenance, Concepts, Modelling, and Analysis, Maintenance Work Measurement, Maintenance Material Control, Maintenance Operations and Control, Maintenance Quality Control, Reliability-Centered Maintenance, Total Productive Maintenance, and Intelligent Maintenance.

**Pre-requisite: IE438; Successful Completion of 120 Cr Hr.**

### IE 491: Reliability Engineering 3 (3,1,0)

Introduction to reliability, Reliability measures, and Probability models. Reliability of state-independent system. State-independent systems. Stress-strength model. Design for reliability. Maintainability and Design for Maintainability. Data Collection and Empirical Methods. Reliability testing. Identifying Failure and Repair Distributions. Statistical Tests.

**Pre-requisite: IE438; Successful Completion of 120 Cr Hr.**

### IE 498: Research Project

Definition and classification of factory models; Process time variability; Multi stage single product factory models; Multiple product factory models; Models of various forms of batching; Serial limited Buffer models; Simulations techniques in manufacturing.

**Pre-requisite: Successful Completion of 129 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.

## General Admission Requirements for Graduate Studies

1. Applicant should be a Saudi or on a formal scholarship if not a Saudi
2. Holding a university degree from a Saudi university or from another recognized one.
3. Proving a good conduct and being medically fit.
4. Submitting two academic recommendations from professors who have taught applicant.
5. Employer's approval, if applicant is an employee; in very limited circumstances this approval may be postponed until enrollment into courses.
6. Msc. studying requires full time study and University Council may make exception when the need arises

## Additional requirements

1. Holding a bachelor degree in Industrial Engineering with a GPA of at least "Very Good" (3.75 out of 5) or “Good” (2.75 out of 5) with cumulative GPA of indusial engineering courses that is not less than 3.75 out of 5.

2. Applicants from other engineering disciplines should hold a bachelor degree with a GPA of at least "Very Good".
3. Scoring a minimum of 61 points in (TOEFL-IBT), or 500 points in (IELTS), or 75 points in (SEPT).

## 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.

## Mission

To provide world-class Ph.D. education and research in industrial engineering and to prepare scholars for top careers in academia, government, and industry.

## Program Objectives

The objectives of the program are to:

- Develop the state of art, knowledge, and technologies in industrial engineering
- Provide qualified doctorates to contribute in research and development, and education related in industrial engineering fields
- Cooperate effectively in cross-disciplinary research groups through an open attitude to other scientific fields

## Program Outcomes

The Outcomes of the program are to:

1. Perform research and apply scientific research methodology and place the results in a broader context and critically evaluate their own and others' research
2. Manage multi research activities with ethical research behavior
3. Convey and transfer the state of knowledge in professionally
4. Address with excellence the acquired knowledge to various institutions, including universities, industry and research labs, think tanks, and also which that enhances scholarship and public impact
5. Develop clear and effective written description and oral presentation of substantive technological content of publications, grant projects and conference presentations

## General Admission Requirements for Graduate Studies

1. Applicant should be a Saudi or on a formal scholarship if not a Saudi.
2. Holding a university degree from a Saudi university or from another recognized one.
3. Proving good conduct and being medically fit.
4. Submitting two academic recommendations from professors who have taught the applicant.
5. Employer's approval, if the applicant is an employee; in very limited circumstances this approval may be postponed until enrollment into courses

6. Ph. D. studying requires full-time study and University Council may make an exception when the need arises

## Additional requirements

1. Holding a master's degree in Industrial Engineering or a related discipline with (very good).
2. Scoring a minimum of 61 points in (TOEFL-IBT), or 500 points in (IELTS), or 75 points in (SEPT).
3. Total full-time for a period of not less than two academic years after termination of courses and registration of the Ph. D thesis.
4. Personal meeting with the department.

## 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

This course provides students with advanced knowledge and skills in engineering statistical methods; which are covered in the following topics: 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

The course will allow students to understand, design and experiment optimization models for various engineering problems.

### IE 613 Approximation Methods in Optimization

The course will allow students to solve approximately hard and complex optimization problems. The resolution is performed over the heuristics and meta-heuristics algorithms. These algorithms include the constructive heuristics, Local search, Meta-heuristics, Evolutionary algorithms, Optimization-Based heuristics, Polynomial time approximation schemes.

### IE 614 Reliability and Maintainability Engineering

The course will allow students to understand the 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

The course will allow students to apply advance level statistical process control (SPC) techniques to monitor univariate and multivariate quality characteristics for industrial and engineering processes, applications of quality engineering principles in the workplace including manufacturing processes and production operations, fundamental methods about anomaly and change detection in processes. Methods covered include the univariate and multivariate analysis for continuous and discrete data, data pre-analyses (such as dimension reduction) for process monitoring and performance analysis.

This course is designed for PhD students in the industrial engineering fields to learn about the advance concepts and practical tools for performing anomaly and change detections. It will help doctoral students in both system engineering and manufacturing fields broaden their knowledge base and get exposed to new applications.

### IE 620 Stochastic Modeling

The course will allow students to analyze and model systems with uncertain environments across a wide range of industries where time-dependent random phenomena can evolve over time. This course focuses on building a framework to formulate and analyze probabilistic systems to understand potential outcomes and use them in decision-making.

### IE 621 Supply Chain Management

The course will allow students to apply the tools for managing processes and customer demands at the level of the firm. Also, the course will provide the students with the tools and perspectives, the students will need to manage the flow of materials, information, and funds between suppliers, firm, and customers.

This course is designed for PhD students in the industrial engineering fields to learn about the advance concepts and practical tools for designing effective supply chains. It will help doctoral students in both supply chains and logistics systems and integrating the supply chain, broaden their knowledge base and get exposed to new applications.

### IE 622 Distribution and Logistics Systems

The course will allow students to understand and solve engineering problems in Logistics and Distribution.

### IE 623 Advanced Applications in Industrial optimization

The course will allow students to apply some advanced algorithms to solve non-linear optimization problems that stem from engineering environment, especially the industrial one. These algorithms are including the Newton method, Modification of Newton's Method, Quasi Newton Method, Gradient Method, Levenberg-Marquardt and Trust Region Method, Sub Gradient Optimization Methods, Steepest ascent Method, Combined Algorithms, Penalty and barrier methods, and Methods of feasible Directions.

### IE 624 Advanced Topics in Industrial Operations Management

The course will allow students to apply advanced topics in industrial operations management. The course also focusses on evolution of new trends in operations and production management systems; new trends and advance managerial concepts and quantitative techniques related to manufacturing resource planning, forecasting, capacity management, inventory management, just-in-time, optimized production technology; and recent development in decision making tools.

### IE 625 Scheduling of Industrial Operations

This course deals with advanced problems in the area of scheduling of industrial operations. It includes optimization algorithms, algorithm convergence; Advanced Shop Scheduling; Advanced Multiprocessor Scheduling; Scheduling Flexible Manufacturing Systems; Resource Constrained Project Scheduling; Multi-criteria Scheduling; Cyclic Scheduling. The course will also cover some improvement type algorithms such as simulated annealing, tabu search and genetic algorithms to solve computationally difficult scheduling problems.

### IE630 Safety System and Accident Analysis

The course will allow students to apply 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

The course will allow students to apply human factors applications to industrial and commercial settings. Applications of current human factors engineering principles in the workplace including facility and work status; materials handling; work place exposures and protection, and production operations. Human factors input into manned-system designed, 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 also examine human attributes which may be reduced in disabled persons and which change with the aging process.

### IE632 Human-Machine Systems

This course explores the various aspects of human interaction with various systems from simple systems (hand tools) to complex system (piloting an aircraft). The course focuses on examination of human perception, information processing, skilled performance, and 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

The course will allow students to apply techniques to represent 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

The course will allow students to apply biomechanics to industrial and commercial settings. Applications of biomechanics principles to the workplace including facility and work status; materials handling; work place exposures and protection, and production operations. The course will focus on the injury mechanisms during repetitive works, with discussion and application of specific methodologies and analytical techniques.

### IE 635 Advanced Methods Design and Work Measurement

The course will allow students to design 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 integrated 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

The course will allow students to develop analytical approximation models and their use in evaluating factory performance. Developed tools needed for the analytical approach: Introduction to Factory Models, Single Workstation Factory Models, Processing Time Variability, Multiple-Stage Single-Product Factory Models, Multiple Product Factory Models, Models of Various Forms of Batching, WIP Limiting Control Strategies, Serial Limited Buffer Models.

### IE 652 Advanced Manufacturing Technologies

Advanced manufacturing technologies including: Reverse Engineering; Additive Manufacturing, and Virtual Manufacturing. The selection process of advanced Manufacturing technologies and digital manufacturing.

### IE 653 Advances in Automation of Manufacturing Systems

Research topics cover developing and design manufacturing system automation and how can be modeled using MATHLAB. This include manufacturing process control and adaptive control strategies. The second research topic cover automatic data capture and logger using Data Acquisition and control modules and software e.g. LABVIEW. Also cover student research on WebScience and presentation on development of intelligent control system structure in manufacturing.

### IE 654 Advanced Topics in Manufacturing Processes

The course focus on the new trends in manufacturing processes including: non-traditional manufacturing processes, advanced design of manufacturing processes; design for manufacturing; design for assembly. The course mainly covers three units, the first unit product design for assembly and manufacturing the second unit cover the selection of manufacturing material and manufacturing processes, while the third units cover the non-traditional machining processes.

The course design for PhD student in industrial engineering fields to lean about the advance topics in product design for assembly and manufacturing, material and process selection, and non-traditional machining processes.

### IE 655 Manufacturing Strategies

Principles of strategy, Modern manufacturing and production strategies; lean and agile manufacturing, new trends in designing of manufacturing strategies; manufacturing strategy in a factory, manufacturing strategy in an international network of factories; manufacturing strategy and business strategy,

# 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.

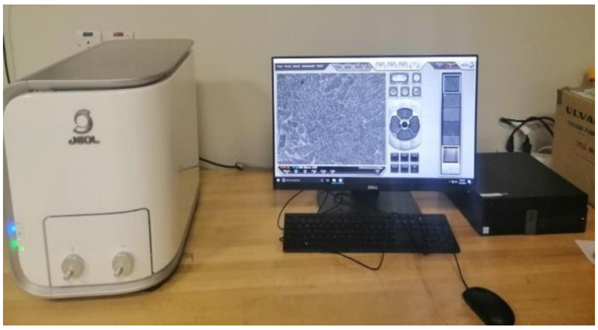
## 1) Metrology Lab.

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.

**Lab Equipment:**

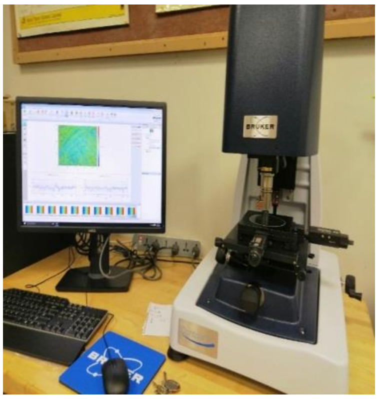
### 1- Scanning electron microscope (SEM) with backscattered imaging capability

A tabletop scanning electron microscope (SEM) (Model JCM 6000Plus) from Jeol, Tokyo, Japan can be used to examine the surface morphologies and materials phase analysis.




### 2- 3D Profile

A 3D optical profilometer (Contour GT-K) from Bruker (Berlin, Germany) is used to measure the roughness and 3D surface characteristics.




### 3- Profile projector

this is machine is used to measure and inspect all kinds of surface and outline of complicated work-pieces, such as cam, screw thread, gear, milling cutter, tool, dies, press components and so on.


### 4- form talysurf

Form Talysurf 50i Series 2 (S3C) for Measuring Form and Surface Finish.

### 5- Tool maker's microscope

This is device used to measure up to 1/100th of a mm. these microscope suitable for such functions as the inspection and measurement of various miniature mechanical and electronic parts.


### 6- Autocollimators

This is device used for measuring angles, straightness, flatness, squareness and parallelism.


### 7- Vernier Calipers & Micrometer

This instruments may be used to measure outer dimensions of objects (using the main jaws), inside dimensions (using the smaller jaws at the top), and depths (using the stem).


### 8- Surtronic 25

The Surtronic 25 is a portable, self-contained instrument for the measurement of surface texture and is suitable for use in both the workshop and laboratory.

Parameters available for surface texture evaluation are:

- Ra, Rz, Rt, Rp, Rmr, RPc, Rv, Rz1max, Rsk, Rda

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

**Courses served: IE339, IE 496 and IE 497.**

**<u>This laboratory has the following devices:</u>**

- 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.
- 3D optical profilometer.
- Scanning electron microscope (SEM).

## 2) 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.

**<u>Lab Equipment:</u>**

- 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.

## 3) 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.

**Lab Equipment:**

1. **MOXUS Metabolic System:**

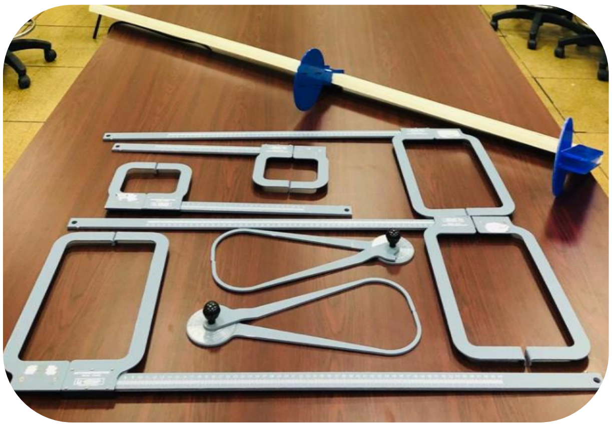
The MOXUS is the only completely modular metabolic cart currently available today. The MOXUS uses the legendary CD-3A & S-3A analyzers recognized worldwide as the standard for respiratory gas measurement for over 45 years. The MOXUS is Ideal for Research, Teaching and Clinical metabolic measurements with the fastest response time available, unsurpassed accuracy and unwavering stability guarantees data you can depend on today, tomorrow and in years to come.

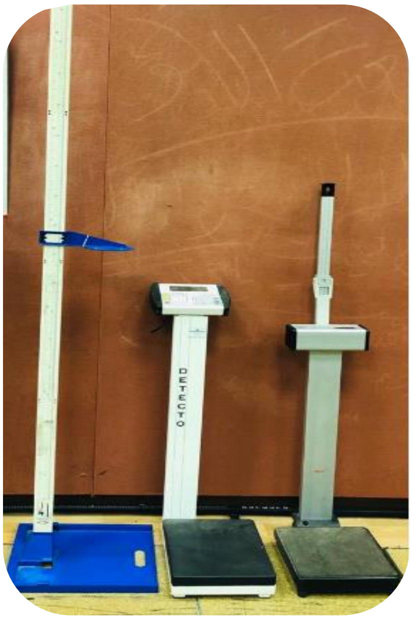
2. **Light-Meter-LT300:**

Congratulations on your purchase of the Extech LT300 Digital Light Meter. The LT300 measures light level (illuminance) to 400,000 Lux (40,000 Fc). The LT300 offers a backlit display, MAX/MIN, Data Hold, Relative, Peak, and Reset features. This instrument is shipped fully tested and calibrated and, with proper use, will provide years of reliable service. Please visit our website (www.extech.com) to check for the latest version of this User Guide, Product Updates, and Customer Support.


3. **Anthropometric Measurement:**

The objective of this experiment is to Highlighting the importance of body size variation through self-measurement.





### 4. Noise Dose Meter Type 4444:

Type 4444, Noise dose meter a lightweight and instrument has been used for recording assessment and of noise levels associated with auto drivers in Kolkata city. This meter type 4444 comes with different seven built in setups, which includes OSHA, MSHA, DOD, ACGIH (USA
Standards) and ISO 85A, ISO 90A (International Standard) which corresponds to today's most widely used standard. There are two sound level meter setups: SLM which gives on-screen results only and cannot store data to memory.

### 5. programmable temperature and testing machine:

Programmable Temperature Humidity Testing Machine is designed for testing the capability of heat-endurance, cold-endurance, dryness-endurance, and humidity-endurance, suitable for quality control of the industries of electron, electrical equipment, vehicle, metal, foodstuffs, chemistry, building materials, luggage, adhesion tape, printing, packaging, etc.

### 6. Reaction Time:

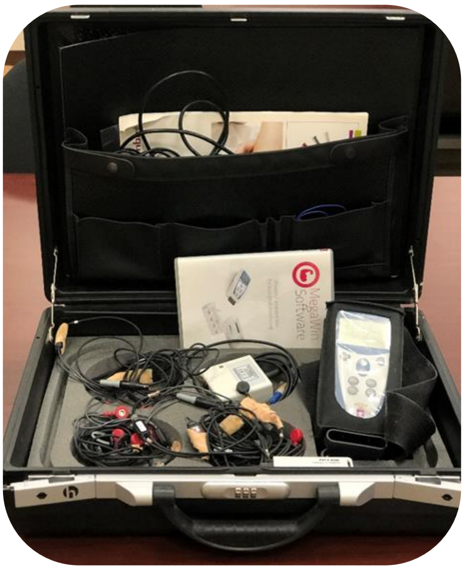
Reaction test module: Three LEDs 1, different in color are operated by chance (random generator). Upon lamination of one of the LEDs the push button 2 has to push. The delay time between lamination of the LED and pushing the button is displayed by the reaction time module as 1/100 sec.

Reaction time module: Red, 26-mm, 3-digit LED display 3 (1/100) that can be read from a distance of 10 m.

**7. SENSOR-CASSY:**

The Sensor-CASSY measuring instrument is ideal for the acquisition of measurement data in complex demonstration experiments. The instrument can be connected to a PC via an USB port or WiFi adapter (see WiFi adapter). Beyond its two sensor inputs, one impressive feature of Sensor-CASSY 2 is its built-in capability for measuring voltage and current. No additional sensors are required.

**8. EMG model 6000, 8 channel (WLAN INTERFERENCE)**



**Courses served: IE341, IE496 and IE497.**

## 4) 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.

**Lab Equipment:**

### 1- PRECISION SAW

Precision saw used to cut material from the stock to a desired size

### 2- GRINDER- POLISHER

The grinding and polishing setup are used for microstructure characterization of materials

### 3- AUTOMATIC MOUNTING PRESS

The mounting used for convenience in handling and to protect the edges of the specimen.


### 4- METALLURGICAL MICROSCOPE

The microscope setup are used for microstructure characterization of materials.

### 5- STRUERS DURASCAN

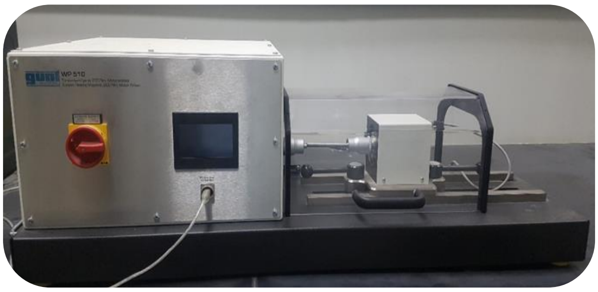
The microhardness machine is used to measure subsurface microhardness of the of material.

### 6- HARDNESS TESTING ZWICK/ROEL

The hardness machine is used to measure the bulk hardness of the of material.

### 7- TORSION TESTING

This machine is used to conduct torsion test on mild steel or cast iron specimens to find out modulus of rigidity.



### 8- IMPACT TESTER

Charpy Impact Test is used to measure the impact strength of different steel specimens.

### 9- TENSILE TEST ZWICK/ROEL

Tensile test used for strength characterization of material and to know the mechanical properties of material.


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

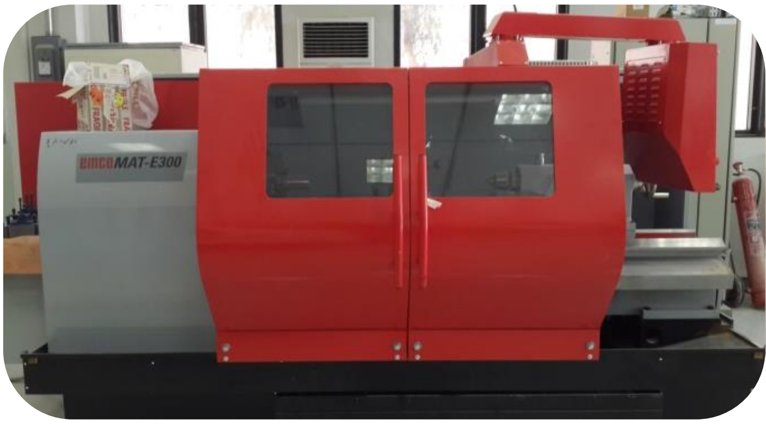
## 5) Manufacturing processes lab.

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.

**Lab Equipment:**

### 1- Turning machine EMCO 600 CNC lathe

This machine can precisely turn cylindrical samples.





### 2- Engine Lathe Machine

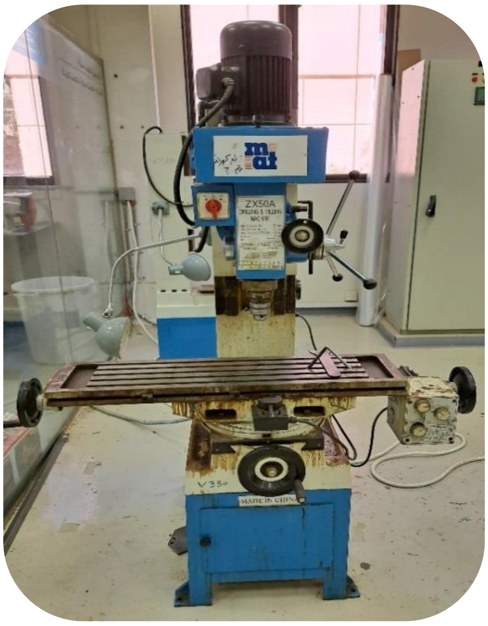
This machine can cut and form the cylindrical samples. it runs manually no need for programming.

### 3- Surface Grinding machine

This machine used for grinding surfaces for obtaining finished surface.

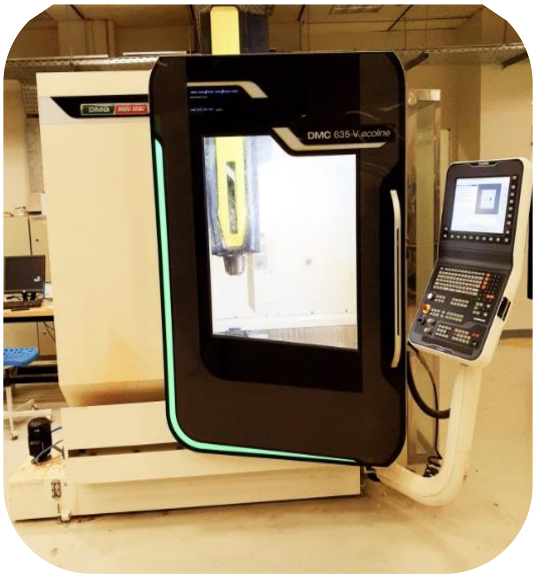

### 4- Vertical milling and drill

Vertical drill it can be used for milling and any vertical machining, it is a semi-automated the bed can be move automatically in x, y, z arises with different speeds. Also spindle speed can be changed.



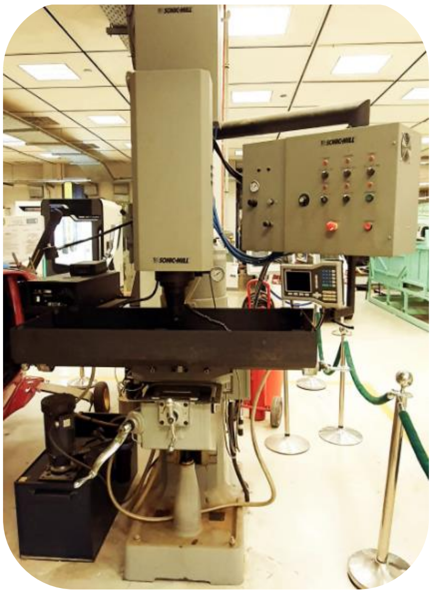

### 5- DMG Milling machine

The milling experiments were carried out using a vertical milling machine with three axes CNC (DMC 635 V Ecoline) from DMG Mori, Oelde, Germany. The milling machine has a maximum feed rate of 24 m/min, a positioning resolution of 1 μm, and 8000 rpm of maximum spindle speed.



### 6- Sonic mill machine

The rotary ultrasonic machine uses a power supply that converts conventional line voltage to 20Khz electrical energy. This high-frequency electrical energy is provided to a piezolectric converter that changes the high-frequency electrical energy into mechanical motion. The ultrasonic motion from the converter is amplified and transmitted to the rotary spindle. This causes the diamond tool attached to the spindle to vibrate perpendicular to the tool face thousands of times per second.



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

**Lab 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

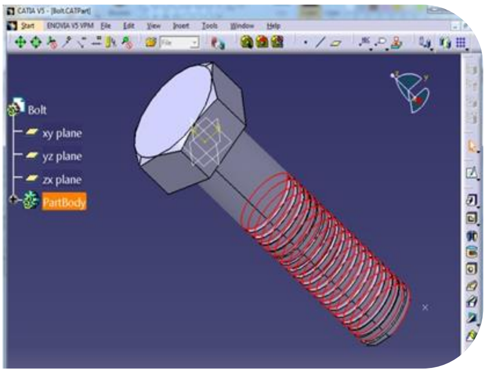
- CNC Laser system (K2CM-L2)
- Ultrasonic milling machines (SonicMill)
- Wire cut EDM

## E. Forming Lab

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

## 6) 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.




**Lab Equipment:**

**1- Desktop trainer CNC lathe machines (Boxford)**


The PC controlled Boxford 160TCL lathe is used for training students in a CAD/CAM course. Operating on PC computer, the inclusive user-friendly software has routines for Computer Aided Design [CAD] at both simple and sophisticated levels and will process the drawings through to a full machining routine.

**2- Desktop trainer CNC milling machines (Charly4U).**

This machine used for milling soft materials, it allows to drill and cut out electronic circuits, cut and engrave plates and boxes plastics, to engrave, drill aluminum front panels.
This device was made to work soft materials in general with a tool with a maximum diameter of 15 mm, i.e. wood, plastics, aluminum, epoxy and resins, all types of non-metallic and non-ferrous sheet materials.

**3- CNC EMCO milling and lathe machines.**


**4- CAD/CAM software (CATIA).**

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

## 7) 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.**

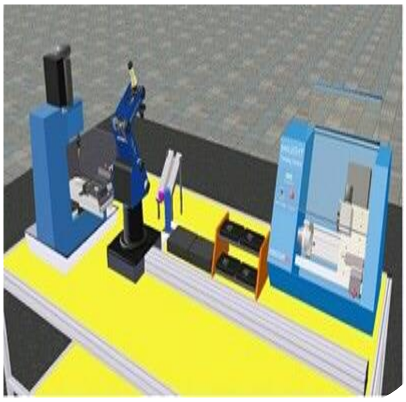
**Lab Equipment:**

- 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.

## 8) 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.**

**<u>Lab Equipment:</u>**

- 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

## 9) Maintainability & Reliability Lab:

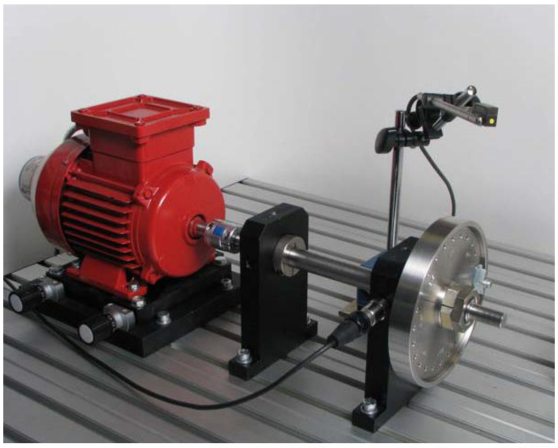
This Lab is intended for undergraduate industrial engineering students to provide the broad knowledge about the areas of machine diagnostic, calibration and maintenance.

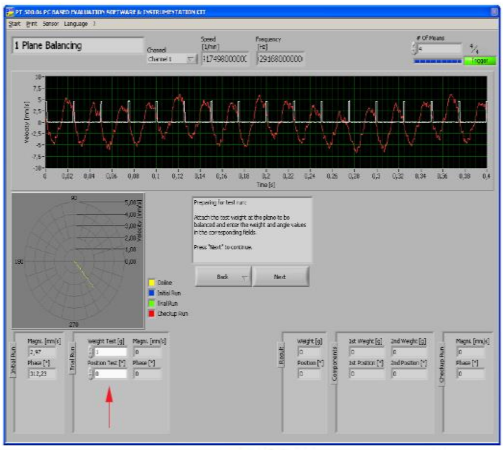
### Machinery diagnosis system.

The aim of machinery diagnosis, also known as machinery status monitoring or condition monitoring system (CMS), is to conduct needs-based maintenance or repair and therefore to minimize the repair and downtimes of a machine.

**Machinery diagnosis is used for:**

- Weak-point analysis to optimize a process or to detect expected errors in good time.
- condition-based maintenance
- avoid or minimize failures thanks to pre-determined maintenance






### Lab 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

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

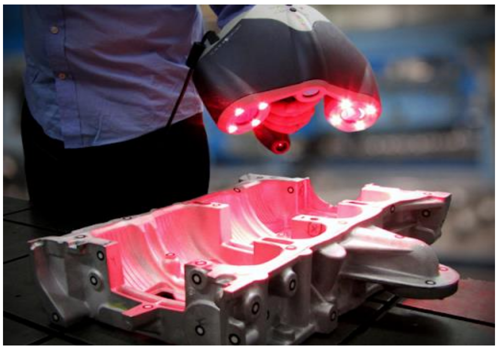
## 10) Product design and prototyping lab

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.

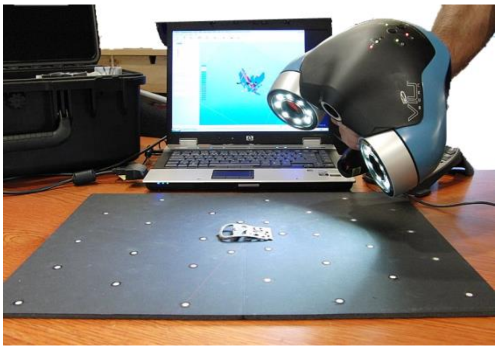
**Lab Equipment:**

**1- 3D Scanners**

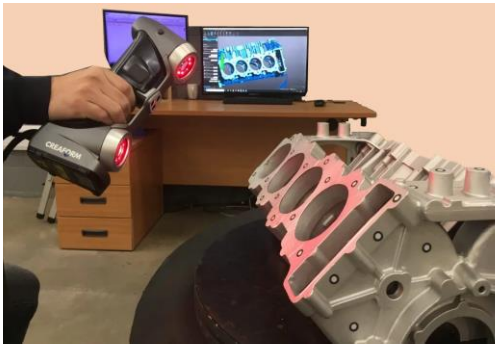
The 3D scanners are used in fast prototyping and reverse engineering to the act of digitally recreating a real-life part by scanning it all around to get its dimensions, multiple screenshots of the part scanned are taken, then fused together into a 3D model. It is also possible to scan very small parts, as well as huge parts.



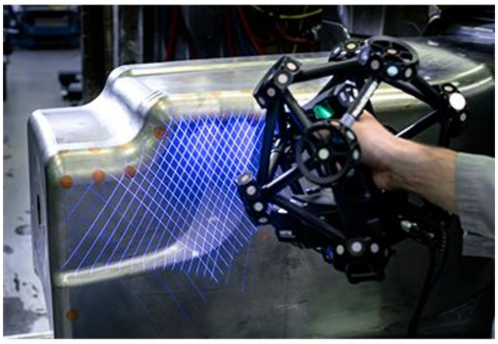
**EXA Scan**



VIU Scan



**3D HAND SCAN 700**



**Metra Scan**

**2-** Color 3D Printer (Pro-jet 460)

This machine is used to create beautiful, photo-realistic parts in CMY color with the ability to use full texture/UV mapping to better evaluate the look, feel, and style of product designs, without paint. Students can better visualize design intent, and can make faster and more effective decisions.

3- CAD Software (CATIA, SOLIDWORK)

**Courses served: IE 301, IE496 and IE497.**

## 11) Computer lab

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

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

**Courses served:** IE 222, IE 322, IE 333, IE 420, IE 469, IE 496 and IE 497.

## Research Capabilities

The IE's labs and their capabilities allow the faculty and students to conduct high-quality research work in many areas. The research works at the IE department lies in the key areas: Industrial Systems Engineering, Manufacturing Systems Engineering and Human Systems Engineering. Although students and faculties are progressing well in regards to achieve their research objectives, and it is self-evident from their research published in quality impact factor journals and conferences.

Multiple sources of funding are available to support the research and projects, sample links provided as follows:

https://engineering.ksu.edu.sa/en/Research_Centers_and_chairs

https://www.kacst.edu.sa/

https://dsrs.ksu.edu.sa/en/node/505

https://dsrs.ksu.edu.sa/ar/raed

## Department Committee

The IED leadership is managed by the IED Chair, who has clear and sufficient authority to ensure compliance with formally established or agreed upon policies, procedures, developments and recommendations that had been approved by the department's faculty members through regular IED council meetings. In addition, there are several well-established committees formed from the IED's faculty members that are responsible for administering different tasks including academic matters. Each committee has a coordinator to lead its activities and report to the IED's chair its achievements throughout the academic year.

1. Students' Counseling Unit
2. Academic Accreditation Unit
3. Quality Unit
4. Graduate Studies Committee
5. Graduation Projects Committee
6. Promotion and Appointments Committee
7. Teaching Assistants and Scholarships Committee
8. Community Service and Continuing Education Committee
9. Statistics and Information Committee
10. Practical Training Committee
11. Alumni and Employment Committee
12. Laboratories and Purchasing Committee
13. Registration Study Schedules and Exams Committee
14. Study Plan Committee
15. Scientific Committees
16. Strategic Plan Unit

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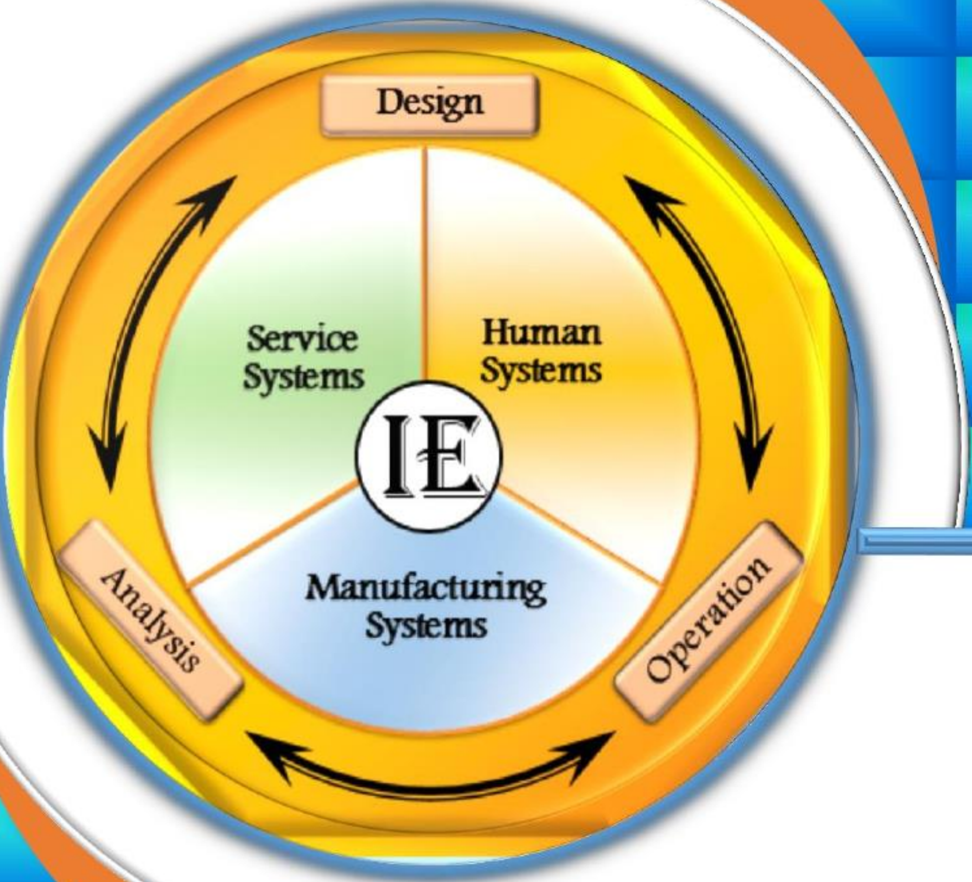


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