E-JUST
الجامعة المصرية اليابانية للعلوم والتكنولوجيا
エジプト日本科学技術大学

Egypt – Japan University of Science and Technology

ENGINEERING POSTGRADUATE PROGRAMS

M.Sc. & Ph.D. DEGREES BYLAWS, CURRICULUM AND COURSES OUTLINES

June,2011

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エジプト日本科学技術大学

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NEW BORG EL-ARAB
ALEXANDRIA, EGYPT

CONTENTS

EGYPT-JAPAN UNIVERSITY OF SCIENCE AND TECHNOLOGY E-JUST

ARTICLE-1

E-JUST VISION:

EJUST enjoys a status of national and International recognition as

- a first class international academic institution known worldwide for the high standards of its educational system, the high standard of its graduates and for the achievements of its research centers;
- a world class Center of Excellence for higher education and research with regional and global reach;
- one of the top international universities within 10 years; and
- a success story and a living proof of Egyptian–Japanese cooperation that promotes human development in the region and the world".

ARTICLE-2

E-JUST MISSION:

- To become a role model for postgraduate education and research institutions in Egypt by fostering the Japanese educational standards, policies, and systems. In this regard, E-JUST will foster links of collaboration between Egyptian and Japanese academic institutions.
- To direct efforts for making academic degrees awarded to E-JUST graduates enjoy a status of international recognition and accreditation by Japanese, local and international accrediting bodies.
- To contribute to the enhancement/improvement of human resources in the region by providing superior education, and to offer pragmatic and

innovative solutions to address human needs through outstanding products and services.

- To promote and support the establishment of strong business, technical and commercial ties between Japanese industries and organizations, and their counterparts in countries and regions which are served by E-JUST.

ARTICLE-3

E-JUST OBJECTIVES:

- To implement state of the art educational systems based on Japanese academic concepts founded on project-based and problem based learning.
- To introduce modern and advanced interdisciplinary academic programs.
- To establish Centers of Excellence for basic and applied research related to community, industry and the environment.
- To promote multidisciplinary team work skills.
- To build partnerships with key Japanese academic and research institutions as well as industrial companies for conducting applied research, exposing the students and faculty to real life research activities, and getting acquainted with the Japanese systems know how and technology.
- To build strong interaction mechanisms with the local and regional industries.

ARTICLE-4

ENGINEERING SCHOOLS AND GRADUATE DEPARTMENTS

The university in its first phase is constituted of three engineering schools, which include seven graduate departments of multidisciplinary engineering specializations, namely:

1. School of Electronics , Communications and Computer Engineering:
    a. Department of Electronics and Communications Engineering.
    b. Department of Computer Science and Engineering.
2. School of Innovative Design Engineering:
    a. Department of Mechatronics and Robotics Engineering.
    b. Department of Industrial Engineering and Systems. Management.
    c. Department of Materials Science and Engineering
3. School of Energy ,Environmental and Process Engineering:
    a. Department of Energy Resources and Environmental Engineering.
    b. Department of Chemical and Petrochemicals Engineering.

ARTICLE-5

DEGREES AWARDED

The university, upon the request of the respective school council, grants the following degrees:

- Master of Science (M. Sc) and Doctor of Philosophy (Ph. D) degrees in the following specializations:
    1. Electronics and Communications Engineering.
    2. Computer Science and Engineering.
    3. Mechatronics and Robotics Engineering.
    4. Industrial Engineering and Systems Management.

5. Materials Science and Engineering.
6. Energy Resources and Environmental Engineering.
7. Chemical and Petrochemicals Engineering.

ARTICLE -6

ACADEMIC SEMESTERS AND REGISTRATION

1. The academic year is divided into three semesters:
    - The Fall semester starts at the beginning of the fourth week of September and continues for 15 weeks,
    - The Spring semester starts at the beginning of the third week of February and continues for 15 weeks,
    - The Summer semester, which is a condensed semester, starts at the beginning of the first week of July and continues for 6 weeks.
2. The registration for any degree should take place during the two weeks preceding each semester, after satisfying all registration requirements and the payment of tuition fees approved by the university.

ARTICLE -7

GENERAL ADMISSION REQUIREMENTS

1. To register for a M. Sc. degree, the student must possess a Bachelor degree in a specialization related to one of those cited in Article -5, from an Egyptian university or any other academic institution (in Egypt or abroad) recognized by the Supreme Council of Universities (SCU) in Egypt.
2. To register for a Ph. D. degree, the student must possess a M. Sc. degree in a specialization related to one of those cited in Article -5, from an Egyptian university or any other academic institution (in Egypt or abroad) recognized by the Supreme Council of Universities (SCU) in Egypt.

3. The student should complete and submit to the registrar office, all required documents approved by the respective school council.
4. The student should satisfy all other requirements approved by the respective school council such as passing successfully entrance examinations and interviews.
5. The student should be fully unoccupied for his study in the university.

ARTICLE -8

TUITION FEES

1. The university council determines the tuition fees annually.
2. The student pays the tuition fees at the beginning of the Fall and Spring semesters.
3. The registration of a student in a semester is terminated if he/she does not pay the tuition fees during 3 weeks from the beginning of that semester.
4. The student enrolled in a program and intended to withdraw from the program, cannot regain the tuition fees that he/she has paid.

ARTICLE -9

ACADEMIC ADVISOR

The related department council assigns an academic advisor of the rank of professor or associate professor, for each graduate student. The academic advisor will be responsible for:

- Advising the student during his /her course work.
- Helping the student to choose the elective courses relevant to the field he/she wishes to study.

- Recommending to the related department council (for its approval) any additional undergraduate courses that, in the opinion of the academic advisor, the student has to take.

ARTICLE -10

STUDY SYSTEM

The study in the graduate programs is in credit hours. The regulations and requirements are indicated in Articles -11 through 15.

ARTICLE -11

GRADUATE COURSES

1. A credit hour of any course is equivalent to contact hours of 50 minutes weekly throughout a full semester (15 weeks).
2. The student can register, in the Fall or Spring semester, in courses of up to 12 credit hours, and no less than 3 credit hours.
3. The student can register, in the Summer semester, in courses of up to 3 credit hours.
4. All graduate courses are taught in 15 weeks in the Fall and Spring semesters.
5. Courses of special nature can be condensed and taught in 6 weeks in the Summer semester (7.5 hours lectures per week)
6. The graduate courses are divided into:
    - Prequalifying courses of 400-level for M.Sc. students having bachelor degrees in specializations different from those of the M.Sc. programs to which they apply.
    - Courses of 500- level for M.Sc. students.
    - Courses of 600-level for Ph.D. students.
    - Courses of 700 - level, having project or research nature, for M. Sc. and Ph. D. students.
    - Courses of 800-Level for M.Sc. Thesis and Ph.D. Thesis.

7. The M. Sc. Student, with the aid of his academic advisor, is allowed to select 600-level courses of up to 6 credit hours, provided their prerequisites are satisfied.
8. The Ph. D. Student, with the aid of his academic advisor, is allowed to select 500-level courses of up to 6 credit hours, provided he/she has not studied these courses and benefited of their credit hours in his M. Sc. Degree.

ARTICLE -12

COURSE ADD/ DROP/ WITHDRAW

1. The student can add and/or drop courses during the first two weeks of a semester.
2. The student is allowed to withdraw from a course during the first eight weeks of the Fall and Spring semesters and during the first three weeks of the Summer semester.

ARTICLE -13

COURSE ATTENDANCE

The student is required to attend at least 75% of the lectures and other course activities. A student is deprived from attending the final examination of any course that he/she has not fulfilled the attendance requirements.

ARTICLE -14

COURSE CODES

The graduate courses are coded according to the following scheme:

PPP	**L**	**N**	**N**

PPP: Postgraduate program code

L : Course level (M.Sc.:5, Ph.D.:6, Project/seminar: 7)

NN: Sequence of course among its specialized group

Programs	Code
Electronics and Communications Engineering	ECE
Computer Science and Engineering	CSE
Mechatronics and Robotics Engineering	MTR
Industrial Engineering and Systems Management	IEsM
Materials Science and Engineering	MSE
Energy Resources and Environmental Engineering	ERE
Chemical and Petrochemicals Engineering	CPE

ARTICLE -15

GRADING SYSTEM

1. The Grade Point Average (GPA) and the corresponding grade for each course taken by the student are calculated according to the following table.
2. The total grade points of a course is calculated as its GPA multiplied by the number of credit hours of that course.
3. The Cumulative Grade Point Average (CGPA) is calculated according to the following formula:

$$CGPA = \frac{\text{Sum of total grade points of all courses attempted}}{\text{total credit hours attempted}}$$

4. The student is not allowed to withdraw from a course after the eighth week in a full semester and after the third week of the Summer semester. Also, the student is not allowed to attend the final examination in any course if his/her absence record exceeds 25% in that course. In such cases, a “FX” will be assigned to the course in the student transcript and it will not be accounted in calculating the CGPA.

Grade	GPA	Literal Grade	Percentage
A+	4.00	Excellent	≥ 95%
A	3.70		≥ 90% -less than 95%
B+	3.30	Very good	≥ 85%-less than 90%
B	3.00		≥ 80%-less than 85%
C+	2.50	Good	≥ 75%-less than 80%
C	2.00		≥ 70%-less than75%
D+	1.70	Insufficient	≥ 65%-less than 70%
D	1.00		≥ 60%-less than 65%
F	0.00	Fail	Less than 60%
I	–	Incomplete	–
W	–	Withdraw	–
FX	–	Fail-Absent	–
AU	–	Audit	–

5. The student will receive a grade “I” (Incomplete), if he/she cannot complete the entire course requirements for conditions beyond her/his control. The student must have completed at least 70% of these requirements. In this case, the course instructor has to sign a designated form and handle it to the respective school council. The student should be evaluated before the end of the tenth week of the next academic semester and his/her grade will be modified from “I” to the new grade, in such a case, the maximum grade allowed is "B". During this period, if the student is not able to complete the course

requirements, an “FX” grade will be assigned to the course in the student transcript and it will not be accounted in calculating the CGPA.

6. The student is allowed to re-register in the failed courses or any other passed courses to improve his/her CGPA for one time only.

ARTICLE -16

COURSE EVALUATION

Each course is evaluated according to the following guidelines:

1. 30% to 50% of the total marks of the course is assigned to the final written examination.
2. 20% of the total marks of the course is assigned to a mid-term written examination.
3. 30% to 50% of the total marks of the course are assigned to other activities such as assignments, projects, presentations, etc.
4. The written examinations of the 700-level courses can be replaced with a final oral examination.

MASTER OF SCIENCE DEGREE REGULATIONS

ARTICLE -17

ADMISSION REQUIREMENTS

Students are accepted for registration in the M.Sc. programs according to the following rules:

1. The student should hold a Bachelor degree in the field of specialization with a GPA of at least 2.5 (Grade C+).
2. Students having Bachelor degrees in specializations different from those of the M.Sc. programs, to which they apply, may be admitted in these programs. In this case, those students will be required to take a number of prequalifying courses of 9 to 18 credit hours, as determined by the respective department and approved by the respective school council, before registration in the program. The prequalifying courses are normally extended over two consecutive semesters and the student should pass successfully those courses before registration in the program.
3. Students from countries in which the official language is not English are required to submit official evidence of English language proficiency or to pass an English language test approved by E-JUST. The standardized test that a student may take is the international Test of English as a Foreign Language (TOEFL). A valid (maximum two years before the first registration) TOEFL score of 550 or higher is required.
4. The student should pass successfully the interviews, oral and written examinations required for admission to the program.
5. The student is required to pay the predetermined tuition fees approved by the university council or he/she should be supported by a scholarship or a grant.

ARTICLE -18

STUDY LENGTH

A student can complete the Master program study and obtain the degree in a period of at least two academic years and of no more than three academic years.

ARTICLE -19

DEGREE REQUIREMENTS

1. To obtain a Master degree, the student is required to complete a total of 36 credit hours including 18 credit hours for the course work and 18 credit hours for the thesis.
2. A minimum GPA of 2.5 in each course and a minimum CGPA of 3.0 in all the course work, are required.
3. Publishing at least one original paper in a specialized international Journal, or in a well recognized international conference, is a prerequisite condition before defending the thesis.

ARTICLE -20

COURSE TRANSFER

The respective school council can allow the student to transfer 6 credit hours (or as approved by the university council), if he/she passed those courses with, at least, grade “B” during his/her study in an equivalent non-terminating program in another university. The transferred courses must be equivalent to similar courses in the master program of the related department. In this case, the courses will not be included in calculating the CGPA for the student and will just be pointed to in the student transcript as transferred courses and will be accounted for the credit hour requirements.

ARTICLE -21

SUPERVISION COMMITTEE

1. From the beginning of the M.Sc. study, the related department council assigns for each student a supervision committee in which the academic advisor will be a member. The supervision committee will be officially approved by the University Education Council before the student registers in the thesis work.
2. The Supervision committee consists of at least two faculty members, one of them must be of the rank of professor or associate professor. The role of the committee is to approve the research topic and plan, and provide guidance to the student throughout his research work
3. If the student needs to do research in an academic institution or organization other than E-JUST, the respective school council may include a specialist from that institution or organization in the supervision committee.
4. Upon a request from the main supervisor and a recommendation from the related department council, the respective school council may amend the supervision committee by addition , removal or both.
5. At the end of every academic year, the main supervisor submits to the related department council a report on the advancement of student's research work. The main supervisor can recommend either the continuation of the student's enrollment or its termination.

ARTICLE -22

THESIS EXAMINATION COMMITTEE

1. Before appointing the thesis examination committee, the student should present a seminar on his/her research results in front of the supervision committee and the respective department council.
2. To form the thesis examination committee, the main supervisor submits the following documents to the respective department council:

- A report of suitability of the thesis for defense including achieved publications.
- A request for the appointment of the thesis examination committee.
- A draft of the thesis.

3. Upon the request of the main supervisor and a recommendation from the respective department council, the respective school council appoints a committee to judge and publicly discuss the thesis. The committee consists of no more than two supervisors; one of them is the main supervisor, both accounting for a single vote, and at least two external members. The thesis examination committee is headed by the senior member of the committee. The proposed committee must be approved by the “Education Council”.
4. If the individual reports from the thesis examination committee members are positive in favor of the thesis, the following actions are taken:
    - The school council sets a date for the thesis defense based on the request of the main supervisor.
    - The thesis defense is carried out in the set date with the presence of all members of thesis examination committee. If two members from the supervision committee are nominated in the thesis examination committee, the thesis defense can be held in the presence of only one of them.
5. After holding the thesis discussion, the thesis examination committee presents a collective report. If the collective report comes in favor of the thesis, it should include a statement indicating that the thesis examination committee recommends granting the student the M.Sc. degree in the field of specialization. The thesis evaluation has no grade; only its passing will be pointed to in the final certificate.
6. The thesis examination committee may recommend that the thesis be returned to the student to complete whatever deficiency it considers. A period of no more than three months can be granted to the student to

finish what he/she was asked to do. At the end of that period, the student defends the thesis before the same thesis examination committee.

7. Based on the recommendations of the thesis examination committee, and the respective school council the “Education Council“ recommends to the university council granting the student the M.Sc. degree in the field of specialization.

ARTICLE -23

ENROLMENT TERMINATION AND RE-REGISTRATION

The respective school council recommends the student’s enrolment termination when:

1. The student requests to withdraw from the program.
2. The student fails twice in a course or more.
3. The student shows an inability to fulfill the conditions stated in the Article -19.
4. The final collective report of the thesis examination committee is not in favor of the thesis.
5. The student interrupts her/his studies or show lack of seriousness in the research, based on a report from the main supervisor.
6. The student exceeds the legal period for registration; three academic years.
7. The student does not settle her/his tuition fees according to the university rules.
8. The student, whose registration is terminated in any Master program, cannot re-register in the same program or in any other program before one academic year from the date of registration termination. The student, upon approval of the respective school council, can transfer 6 credit hours at most from courses passed in the previous registration.

DOCTOR OF PHILOSOPHY DEGREE REGULATIONS

ARTICLE -24

ADMISSION REQUIREMENTS

Students are accepted for registration in the Ph. D. programs according to the following rules:

1. The student should hold a M.Sc. degree (thesis-based) in a related field of specialization, with a GPA of 2.5 (Grade C+) or higher.
2. Students from countries in which the official language is not English are required to submit official evidence of English language proficiency or to pass an English language test approved by E-JUST. The standardized test that a student may take is the international Test of English as a Foreign Language (TOEFL). A valid (maximum two years before the first registration) TOEFL score of 550 or higher is required.
3. The student should pass successfully the interviews, oral and written examinations required to be admitted to the program.
4. The student is required to pay the predetermined tuition fees approved by the university council or he/she should be supported by a scholarship or a grant.

ARTICLE -25

STUDY LENGTH

The student can complete the Ph. D. program study and obtain the degree in a period of at least three academic years and of no more than five academic years.

ARTICLE -26

DEGREE REQUIREMENTS

1. To obtain a Ph. D. degree, the student is required to complete a total of 48 credit hours including 18 credit hours for the course work and 30 credit hours for the thesis.
2. A minimum GPA of 2.5 in each course and a minimum CGPA of 3.0 in all the course work, are required.
3. The student, before registering for the thesis work, should present the "Thesis Research Protocol" which must be approved by the department council.
4. Publishing at least two original papers in specialized international Journals, or in well recognized international conferences, is a prerequisite condition before defending the thesis.
5. The Ph.D. thesis must submit innovative solutions to related problems in his/her research project and should represent creative work in science and engineering.

ARTICLE -27

COURSE TRANSFER

The respective school council can allow the student to transfer 6 credit hours (or as approved by the university council), if he/she passed those courses with, at least, grade "B" during his/her study in an equivalent non-terminating program in another faculty or university. The transferred courses must be equivalent to similar courses in the Ph.D. program of the related department. In this case, the courses will not be included in calculating the CGPA for the student and will just be pointed to in the student transcript as transferred courses and will be accounted for the credit hour requirements.

ARTICLE -28

SUPERVISION COMMITTEE

1. From the beginning of the Ph.D. study, the related department council assigns for each student a supervision committee in which the academic advisor will be a member. The supervision committee will be officially approved by the University "Education Council" before the student registers in the thesis work.
2. The supervision committee consists of at least two faculty members, one of them must be of the rank of professor or associate professor. The role of the committee is to advise student to select his/her thesis research topic and prepare the thesis research protocol, and thereafter to provide guidance to the student throughout his/her thesis research work.
3. If the student needs to do research in an academic institution or organization other than E-JUST, the respective school council may include a specialist from that institution or organization in the supervision committee.

8. Upon a request from the main supervisor and a recommendation from the related department council, the respective school council may amend the supervision committee by addition, removal or both. This procedure must be approved by the “Education Council“.
4. Upon the proposal of the main supervisor, the respective school council approves the general field of research of the student.
5. At the end of every academic year, the main supervisor submits to the related department council a report on the advancement of student’s thesis research work. The main supervisor can recommend either the continuation of the student’s enrollment, probation or termination.

ARTICLE -29

THESIS RESEARCH PROTOCOL

1. During the first academic year and upon the request of the main supervisor and a recommendation from the related department council, the respective school council assigns a committee to approve the "Thesis Research Protocol" submitted by the Ph.D. student. This committee is consisting of a minimum of three and a maximum of five professors or associate professors; one of them is the main supervisor. The “Thesis Research Protocol” should be approved before the student registers in the thesis-work.

ARTICLE -30

THESIS EXAMINATION COMMITTEE

1. Before appointing the thesis examination committee, the student should present a seminar on his/her research results in front of the supervision committee and the respective department council.
2. To form the thesis examination committee, the main supervisor submits the following documents to the respective department council:
    - A report of suitability of the thesis for defense including achieved publications.
    - A request for the appointment of the thesis examination committee.
    - A draft of the thesis.
9. Upon the request of the senior supervisor and a recommendation from the respective department council, the respective school council appoints a committee to judge which must be approved by the “Education Council“. The committee must publicly discuss the thesis. The committee consists of no more than two supervisors; one of them is the main supervisor, both accounting for a single vote, and at least two external members. The thesis examination committee is headed by the senior member of the committee.

3. If the individual reports from the thesis examination committee members are in favor of the thesis, the following actions are taken:
    - The school council sets a date for the thesis defense based on the request of the main supervisor.
    - The thesis defense is carried out in the set date with the presence of all members of thesis examination committee. If two members from the supervision committee are nominated in the thesis examination committee, the thesis defense can be held with the presence of only one of them.
4. After holding the thesis discussion, the thesis examination committee presents a collective report. If the collective report comes in favor of the thesis, it should include a statement indicating that the thesis examination committee recommends granting the student the Ph.D. degree in the field of specialization. The thesis evaluation has no grade; only its passing will be pointed to in the final certificate.
5. The thesis examination committee may recommend that the thesis be returned to the student to complete whatever deficiency it considers. A period of no more than six months can be granted to the student to finish what he/she was asked to do. At the end of that period, the student defends the thesis before the same thesis examination committee.

10. Based on the recommendations of the thesis examination committee and the respective school council the “Education Council “ recommends to the university council granting the student the Ph.D. degree in the field of specialization.

ARTICLE -31

ENROLMENT TERMINATION AND RE-REGISTRATION

The respective school council terminates a student’s enrollment for a Ph.D. degree in the following cases:

1. The student requests the termination of his/her registration.
2. The student fails twice in a course or more.

3. The student shows an inability to fulfill the conditions stated in the Article -26.
4. The final collective report of the thesis examination committee is not in favor of the thesis.
5. The student interrupts her/his studies or shows a lack of seriousness in the research, based on a report from the main supervisor.
6. The student exceeds legal period for registration; four academic years.
7. The student does not settle her/his tuition fees according to the university rules.
8. The student, whose registration is terminated in any Ph.D. program, cannot re-register in the same program or in any other program before one academic year from the date of registration termination. The student, upon approval of the respective school council, can transfer 6 credit hours at most from courses passed in the previous registration.

1-ELECTRONICS AND COMMUNICATIONS ENGINEERING PROGRAM

ARTICLE- 32

INTRODUCTION

The Electronics and Communications Engineering graduate program aims to provide advanced analytical as well as technological knowledge in various fields of electronics and communications systems. This is to provide awareness of research in engineering sciences, and to encourage the development of inventiveness while searching for engineering solutions to technical problems. The program includes a number of core as well as elective courses, which permit the students to specialize in a particular area. The integrated skills of electronics and communications engineers are becoming increasingly valuable to the industry, especially in areas of: Electronic Design Automation (EDA) Tools Development, VLSI Design, Radio Frequency (RF) Integrated Circuit Design, Wired and Wireless Communication Systems and Networks, Signal Processing, and Microwave Wave Engineering.

ARTICLE- 33

VISION

1. To become a nationally and internationally leading institution of higher education.
2. To influence and contribute to the research directions in the fields of electronics and communications engineering.
3. To stimulate the intellectual environment wherein faculty, students, and staff can prosper and grow.

ARTICLE- 34

MISSION

4. To provide a high- quality, effective and efficient research environment.
5. To prepare future researchers able to perform multiple tasks efficiently.
6. To prepare qualified researchers capable to apply the state-of-the-art techniques in Electronics and Communications Engineering to improve product quality and system performance.
7. To prepare qualified researchers capable to lead research teams in R& D in industrial sectors.
8. To give an equal opportunity for students from all countries to enroll postgraduate programs.

ARTICLE- 35

OBJECTIVES

1. Provide the graduate students with profound knowledge of a specialization area in Electronics and Communications Engineering, and familiarity with allied areas.
2. Provide the graduate students with competence in performing independent research, in communicating effectively, and in learning independently.
3. Sets an example for advanced research at E-JUST, in Egypt, and in the region.
4. Advance the state-of-the-art in the specialized fields of Electronics and Communications Engineering.
5. Enhance the relationship between university and industry by finding solutions to engineering problems through profound researches.

ARTICLE- 36

M.Sc. PROGRAM COURSES:

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- Course-work of 18 credit hours, including core courses of 9 credit hours, elective courses of 6 credit hours and a Project-Based Learning course of 3 credit hours.
- Thesis-work of 18 credit hours.

Core Courses:

The 9 credit hours core courses are listed below. Each course weighs 3 credit hours.

ECE 501 Advanced Analog Integrated Circuits

ECE 502 Advanced Digital and Data Communications

ECE 503 Advanced Digital Signal Processing

Elective courses:

The elective courses are divided into two major areas: Electronics and Communications. Each course weights three credit hours. Students select the 6-credit elective courses from the sets of Electronics and/or Communications elective courses. Students can also select, with the aid of their academic advisors, elective courses from other interdisciplinary graduate programs.

Electronics Elective Courses:

ECE 504 Advanced Digital Integrated Circuits

ECE 505 Computer-Aided Verification of Electronic Circuits and Systems

ECE 506 Analysis and Design of VLSI Mixed-Signal Integrated Circuits

ECE 507 Advanced IC Processing and Layout

ECE 508 Advanced Solid State Devices

ECE 509 Advanced Integrated Circuits for Communications

ECE 515 VLSI Design: System Approach

ECE 516 Analysis and Design of Digital Integrated Circuits

Communications Elective Courses:

ECE 510 Information Theory

ECE 511 Error Control Coding

ECE 512 Digital Image Processing

ECE 514 Microwave Engineering

ECE 516 Statistical Signal Processing

ECE 519 Stochastic Processes

MTH 501 Advanced Mathematics and Statistics I

Project-Based Learning Courses:

Students select one of the following 3-credit hours Project-Based Learning courses:

ECE 701 Project-Based Learning in Electronics

ECE 702 Project-Based Learning in Communications

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Electronics/Communications.

ECE 801 M. Sc. Thesis

Prequalifying Courses:

M.Sc. students holding bachelor degrees in different specializations should pass successfully prequalifying courses of 9 to 18 credit hours, as determined by the department council and approved by the school council, before registering in the program. The credit hours of the prequalifying courses are not counted in the course-work requirements.

The prequalifying courses are selected from the following list; each course weighs 3 credit hours:

ECE 450 Microelectronics Circuits

ECE 451 Integrated Circuit Devices

ECE 452 Communications Systems Fundamentals

ECE 453 Communications Networks

ECE 454 Signals and Systems

ECE 455 Digital Signal Processing

ARTICLE- 37

Ph.D. PROGRAM COURSES:

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- Course-work of 18 credit hours, including elective courses of 9 credit hours, selected from the sets of Electronics and/or Communications elective courses, and research seminar courses of 9 credit hours. Students can also select, with the aid of their academic advisors, elective courses from other interdisciplinary graduate programs.
- Thesis-work of 30 credit hours.

Electronics Elective Courses (3 credit hours each):

ECE 601 Special Topics in Electronics

ECE 602 Quantum and Optical Electronics

ECE 603 Radio Frequency Integrated Circuits Design

ECE 604 Nanoscale Fabrications

ECE 605 Nanoelectronic Devices and Circuits

ECE 608 High-Speed Signal and Image Processing with VLSI

ECE 619 Complex Digital Systems

MTR 504- Microfabrication of Microelectromechanical Systems /Microsystems

Communications Elective Courses (3 credit hours each):

ECE 606 Mobile Communications

ECE 607 High Speed Communications Networks

ECE 609 Neural and Nonlinear Information Processing

ECE 610 Advanced Antenna Design

ECE 611 Wireless Sensor Networks

ECE 612 Numerical Electromagnetics

ECE 613 Advanced Wireless Communications Systems

ECE 614 Advanced Optical Communications Systems

ECE 615 Advanced Optimization Techniques

ECE 616 Statistical Signal Processing

ECE 617 Special Topics in Signal Processing

ECE 618 Special Topics in Communications

MTH 602 Advanced Mathematics and Statistics II

Research Seminar Courses:

Ph.D. students select three of the following 3 credit hours research seminar courses:

ECE 703 Seminars on Advanced Topics in Electronics I

ECE 704 Seminars on Advanced Topics in Electronics II

ECE 705 Seminars on Advanced Topics in Electronics III

ECE 706 Seminars on Advanced Topics in Communications I

ECE 707 Seminars on Advanced Topics in Communications II

ECE 708 Seminars on Advanced Topics in Communications III

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Electronics/Communications. The thesis should present a new contribution (s) in the respective field of research.

ECE 802 Ph.D. Thesis

2-COMPUTER SCIENCE AND ENGINEERING PROGRAM

ARTICLE-38

INTRODUCTION

The Computer Science and Engineering graduate program aims to prepare students for careers at the forefront of computer research, teaching and industry by providing advanced knowledge, both in theory and application on a wide variety of state-of-the-art computer hardware and software systems. The integrated skills of computer and software system engineers are becoming increasingly valuable for the Information Industry, especially in areas of: Computer System Design, Embedded System Design, Computer Networks, Distributed Systems, Software Systems, Intelligent Systems, etc.

ARTICLE- 39

VISION

1. To influence and contribute to the research directions in the fields of computer software and hardware systems.
2. To model and solve real-life large-scale problems related to society and environment using intelligent and high performance computing techniques.

ARTICLE- 40

MISSION

3. To provide a high-quality research environment having a national as well as international academic reputation.
4. To prepare future researchers able to make significant contribution to society and able to lead research teams in R&D sectors.
5. To give an equal opportunity for students from all countries to enroll in postgraduate programs.

ARTICLE-41

OBJECTIVES

1. To provide graduate students with a profound knowledge of a specialization area within Computer Science and Engineering, while remaining familiar with allied areas.
2. To provide the graduate students with competence in performing independent research, in communicating effectively, and in learning independently.
3. To advance the state of research at E-JUST, in Egypt, and in the region.
4. To advance the state-of-the-art in the specialized fields of Computer Science and Computer Engineering.
5. To enhance the relationship between university and industry by finding solutions to engineering problems through profound researches.

ARTICLE- 41

M.SC. PROGRAM COURSES:

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- Course-work of 18 credit hours, including core courses of 6 credit hours, elective courses of 9 credit hours and a Project-Based Learning course of 3 credit hours.
- Thesis-work of 18 credit hours.

Core Courses:

The 6-credit core courses are listed below. Each course weighs three credit hours.

CSE 502 Design and Implementation of Programming Languages

CSE 503 Parallel Computing

Elective Courses:

Students select the 9-credit elective courses from the sets of Computer and/or Software Systems elective courses.

Computer Systems Elective Courses:

ECE 515 VLSI Design: System Approach

CSE 501 Advanced Computer Architectures

CSE 504 Digital Systems Design and Testing

CSE 505 Advanced Embedded System Design

CSE 511 Distributed Systems

CSE 515 Mobile Computing

CSE 516 Fundamentals of Networking

CSE 517 Network Security

Software Systems Elective Courses:

CSE 507 Combinatorial Algorithms and Data Structures

CSE 508 Computer-Aided Geometric Design and Modeling

CSE 510 Large Scale Database Design and Implementation

CSE 512 Neural Networks and Fuzzy systems

CSE 520 Machine Learning

CSE 521 Multi-Agent-Systems: Foundation and Applications

CSE 525 Formal Verification Techniques

CSE 540 Theory of Computability

CSE 542 Complexity Theory

CSE 544 Randomized Algorithms

CSE 560 Introduction to Bioinformatics

MTH 501 Advanced Mathematics and Statistics (I)

Project-Based Learning Courses:

Students select one of the following 3-credit Project-Based Learning courses:

CSE 701 Project-Based Learning in Computer Systems

CSE 703 Project-Based Learning in Software Systems

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Computer Systems / Software Systems.

CSE 801 M. Sc. Thesis

Prequalifying Courses:

M.Sc. students holding bachelor degrees in different specializations should pass successfully prequalifying courses of 9 to 18 credit hours, as determined by the department council and approved by the school council, before registering in the program. The credit hours of the prequalifying courses are not counted in the course-work requirements.

The prequalifying courses are selected from the following list; each course weighs 3 credit hours:

1. CSE 450 Digital System Fundamentals
2. CSE 451 Microprocessors
3. CSE 452 Computer Architectures
4. CSE 453 Computer Networks
5. CSE 454 Embedded Systems
6. CSE 455 Optimization

ARTICLE-42

Ph.D. PROGRAM COURSES:

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- Course-work of 18 credit hours, including 9 credit hours elective courses from the sets of Computer Hardware and/or Software Systems courses and research seminar courses of 9 credit hours. Students can also select, with the aid of their academic advisors, elective courses from other interdisciplinary graduate programs.
- Thesis-work of 30 credit hours.

Computer Systems Courses

ECE 608 High-Speed Signal and Image Processing with VLSI

MTR 601 Advanced Robotics

CSE 601 Parallel Processors

CSE 604 Compiler Optimization and Code Generation

CSE 605 Computer Systems Security

CSE 608 Queuing Theory

CSE 609 Information Theory for Communication Systems

CSE 615 Advanced Topics in Intelligent High Performance Computing

CSE 618 Advanced Computer Networks

CSE 620 Advanced Topics in Systems and Networks

Software Systems Courses

MTH 601 Advanced Mathematics and Statistics II

CSE 603 Computer Vision

CSE 606 Cryptography

CSE 607 Artificial Intelligence Approach to Natural Language Processing

CSE 625 Advanced Topics in Machine Intelligence

CSE 630 Advanced Topics in Programming Languages, Formal Methods and Software Engineering

CSE 635 Advanced Topics in Data Base and Information Systems

CSE 640 Advanced Topics in Theory and Algorithms

CSE 645 Advanced Topics in Graphics, Visualization and HCI

Research Seminar Courses:

Ph.D. students select three of the following 3 credit hours research seminar courses:

CSE 702 Seminars on Advanced Topics in Computer systems I

CSE 704 Seminars on Advanced Topics in Computer Systems II

CSE 705 Seminars on Advanced Topics in Computer Systems III

CSE 706 Seminars on Advanced Topics in Software systems I

CSE 707 Seminars on Advanced Topics in Software Systems II

CSE 708 Seminars on Advanced Topics in Software Systems III

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of computer

Systems / software systems. The thesis should present a new contribution (s) in the respective field of research.

CSE 802 Ph.D. Thesis

3-MECHATRONICS AND ROBOTICS ENGINEERING PROGRAM

ARTICLE-43

INTRODUCTION

The Mechatronics and robotics engineering is the synergistic integration of precision machinery, electronics and information technology to design innovative components and systems to create functional and smart products. The research priorities of the program are in the areas of bio-Mechatronics, autonomous robots, intelligent control systems, smart sensors/actuators, and Micro/Nano Electro Mechanical Systems (MEMS/NEMS) for industrial, automotive, and bio-medical applications.

ARTICLE-44

VISION:

The vision of Mechatronics and Robotics department is to stand among the best Mechatronics departments in the region through establishing the state of the art research and education environment for excellent research impact, outstanding graduates and quality of community service.

ARTICLE-45

MISSION

The mission of Mechatronics and Robotics Program is to conduct leading edge research and to prepare excellent postgraduates from all countries with equal chances, who can exploit the state of the art technologies, develop intelligent machines, and actively participate in industrial research and development centers, through introducing high quality research oriented education.

ARTICLE-46

OBJECTIVES:

1. To establish strong and effective co-operation with national and international research institutes, universities and industries relevant to Mechatronics.
2. To implement the recognition of the Mechatronics degrees by international accrediting bodies or dual degree with Japanese partner universities.
3. To take active role in addressing and providing solutions for current and potential future needs of regional and international industries.
4. To develop critical thinking skills for the evaluation of Mechatronics products and systems.
5. To develop communication skills of preparing professional proposals, reports, articles and presentations in national and international scientific events and communities.
6. To develop advanced experimental skills practicing in modern laboratories applying the Problem Based Learning methodology.
7. To develop integrated team work skills for interacting with other members from different specializations.

ARTICLE-47

M.Sc. PROGRAM COURSES:

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- 18 credit hours of course work, including 6-credit hours as core course, 6-credit hours as elective courses, a 6-credit hours Laboratory and Project-Based Learning courses.
- 18 credit hours research leading to a master thesis.

M.Sc. students have to pass successfully six courses with three credit hours each (two core courses, two elective courses, two laboratory/ Project-Based Learning courses).

Core courses:

MTR 501- Robots Kinematics, Dynamics and Control

MTR 502- Advanced Mechatronics Systems Design

Elective Courses:

The student has to select two courses from the following group or from any other graduate program, according to the recommendations of the main supervisor.

MTR 503- Advanced Control Systems

MTR 504- Microfabrication of Microelectromechanical Systems /Microsystems

MTR 505- Mobile Robots and Vision Systems

MTR 506- Advanced Topics in Mechanical Systems Design

MTH 501- Advanced Mathematics and Statistics I

Laboratory/Project-Based Learning Courses:

Master of Science students in Mechatronics have to attend successfully the Project Based Learning course to improve their design and professional skills. Students have to present innovative concepts and competitive solutions through the team work spirit. The total credit hours of the course are three.

MTR 701- Laboratory Based Learning in Mechatronics

MTR 702- Project Based Learning in Mechatronics

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Mechatronics and Robotics.

MTR 801 M. Sc. Thesis

M.Sc. students having bachelor degrees in different specializations should pass successfully prequalifying courses of (9~12) credit hours before registration in the program. The credit hours of the prequalifying courses are not accounted in the course-work requirements.

Prequalifying Courses:

The prequalifying courses can be selected from the list below according to the recommendation of the academic advisor and department council. Each course weights 3 credit hours.

ECE 202 Electronic Circuits (1)

INV 204 Mechanical Engineering Design Elements

INV 309 Measurements and Instrumentations

MTR 401 Automatic Control (2)

MTR 403 Mechatronics Laboratory

ESC 409 Embedded Systems

ARTICLE-48

Ph.D. PROGRAM COURSES:

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- 18 credit hours of course work, including 6-credit hours as core courses, 3-credit hours as elective courses and 9- credit hours as research seminar course work.

- 30 credit hours research leading to a doctorate dissertation.

Students have to attend successfully six courses with three credit hours each (two core courses, one elective course and three seminar courses).

Core courses:

MTR 601- Intelligent Control Systems

MTR 602- Advanced Robotics

Elective Courses:

Students have to select one course from the following group or from any other graduate program, according to the recommendations of the main supervisor.

MTR 603- Advanced Bio-Engineering Systems

MTR 604- Bio-Mechatronics Systems

MTR 605- Smart Sensors and Actuators

MTR 606- Design of Micro- Electromechanical Systems/ Microsystems

MTR 607- Learning Algorithms and Neural Networks

MTH 601 Advanced Mathematics and Statistics II

Seminars:

Ph.D. students have to participate in three seminars activities which are based on self learning and presentations of new advanced topics in her/his discipline. The total credit hours of the seminar are nine. The seminar MTR 703 will be conducted by distinguished Japanese and Egyptian Professors, while seminar MTR 704 will be conducted by students through presentations of recent Journals Papers. In seminar MTR 705 students shall present their progress in their research projects.

MTR 703 – Seminar on Advanced Mechatronics and Robotics

MTR 704 – Seminar on Mechatronics and Robotics Recent Topics

MTR 705 – Seminar on Mechatronics and Robotics Research Progress

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Mechatronics and Robotics. The thesis should present a new contribution (s) in the respective field of research.

MTR 802 Ph.D. Thesis

4-INDUSTRIAL ENGINEERING AN SYSTEMS MANAGEMENT PROGRAM

ARTICLE-49

INTRODUCTION

The Industrial Engineering and Systems Management graduate program provides advanced analytical as well as technological knowledge in various fields of industrial engineering, manufacturing engineering, mathematics and information technology, systems design and management as well as related business aspects. This is to provide awareness of research in engineering sciences, and to encourage the development of inventiveness while searching for engineering solutions to technical problems. The program includes a number of elective courses, which permit the students to specialize in a particular area. The program offers a comprehensive and integrated framework of required skills of industrial engineers, leaders and managers that are becoming increasingly valuable to the employers and the society, especially in areas of: Operations Research, Production and Operations Planning, Plant Design, Manufacturing Systems, Ergonomics and Occupational Biomechanics, Quality Control and TQM, Reliability, System Modeling and Simulation, Project Planning and Management, Classical and Heuristic Optimization, Supply Chain Strategies and Logistics, Productivity Enhancement Methods.

ARTICLE-50

VISSION:

The vision of the Industrial Engineering and Systems Management department is to be internationally recognized for leadership and excellence in teaching, research and cooperation with manufacturing and service industries with its innovative structure of interdisciplinary trends of industrial engineering, manufacturing engineering, mathematics and information, business, and, systems design and management.

ARTICLE-51

MISSION

1. To offer high quality, up-to-date, and internationally recognized educational programs where fusion of science, technology, and mathematics -as a liberal art- are supported by active researchers, a wealth of campus resources and an open minded, multi cultural environment.
2. To nurture graduates rational thoughts, intellectual capabilities and/or engineering and design knowledge foundation, to transform them into individuals who can find and solve problems, conduct research and contribute to society.
3. To provide faculties with adequate environment to conduct strong research activities.
4. To ensure strong cooperation with local, regional and international industry and organizations.

ARTICLE-52

OBJECTIVES

1. The department will be able to generate innovative ideas, products and services, obtain patents, and start spin-off companies.
2. The department will be able to establish and operate state of the art research laboratories and centers, which will produce internationally recognized scientific publications.
3. The department will organize international symposia, workshops and join in international conferences in areas of targeted research lines.
4. Graduates will be able to identify, define and implement effective solutions to realistic problems in the manufacturing and service systems by applying industrial engineering tools, contemporary knowledge and cutting-edge technologies.

5. Graduates will be able to acquire the required skills needed to design integrated systems combining people, machines, information, energy, materials and financial resources.
6. Graduates will be able to ethically communicate and work effectively and efficiently as individuals and/or team members.
7. Graduates will be able to assume leadership roles in their profession and communities.
8. Graduates will be able find problems, identify a research question, review literature, establish hypotheses, use research technology, collect and analyze data, interpret results, draw conclusions and recommend further research.
9. Graduates will be able to write research papers in the appropriate scientific style.

ARTICLE-53

M.Sc. PROGRAM COURSES

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- Course-work of 18 credit hours, including courses of 15 credit hours, from them two courses are core course with a total of six credits, and a Project-Based Learning course of 3 credit hours.
- Thesis-work of 18 credit hours.

CORE COURSES

IEM 521 – Project Planning and Management

IEM 531 – Operations Research I

ELECTIVE COURSES

Students have to select three courses from the following list:

Industrial Engineering Group Courses:

IEM 501 – Global IE I

IEM 511 – Ergonomics and Human Factors Engineering

IEM 512 – Operations Management

IEM 513 – Operations and Management in the Process Industry

Business Group Courses:

IEM 522 – Strategic Planning and Management

IEM 523 – Organizational Theory and Behavior

IEM 524 – Technology and Innovation Management

IEM 525 – Accounting

IEM 526 – Marketing

Math and Information Group Courses:

MTH 501 – Advanced Mathematics and Statistics I

IEM 532 – Applied Simulation Modeling and Analysis

IEM 533 – Applied Multivariable Data Analysis

IEM 534 – Soft Computing

IEM 535 – Management Information Systems

Manufacturing Systems Group Courses:

IEM 541 – Manufacturing Systems Engineering

IEM 542 – Computer Aided Engineering (CAE) Methods

IEM 543 – Advanced Manufacturing Processes

IEM 544 – Rapid Prototyping and Product Development

Systems and Services Group Courses:

IEM 551 – Systems Engineering and Analysis

IEM 552 – Systems Thinking

IEM 553 – Modern Trends in Quality Management

IEM 554 – Business Process Management

IEM 555 – Introduction and Applications of Petri Nets

Project-Based Learning Courses:

Master of Science students have to participate in a team work project which is based on self learning; Students have to present innovative concepts and competitive solutions. The total credits of the course are three.

IEM 701 – Project Based Learning in Industrial Engineering and Systems Management.

Research Seminar:

Upon recommendation of the academic advisor, an MSc student can participate in one elective seminar course which is based on self learning and presentations of new advanced topics in her/his discipline. The total credits of the seminar are three.

IEM 702 – Seminar on Current Trends in Industrial Engineering and Systems Management.

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Industrial Engineering and Systems Management.

IEM 801 M. Sc. Thesis

ARTICLE-54

Ph.D. PROGRAM COURSES

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- 18 credit hours of course work, including 15-credit hours courses 3-credit hours of research seminar.
- 30 credit hours research leading to a doctorate dissertation.

Industrial Engineering Group courses:

IEM 601 – Global IE 2

IEM 611 – Supply Chain Network Design and Logistics

IEM 612 – Human Computer Interaction

IEM 613 – Contemporary Methods in Quality Design and Control

IEM 614 – Integrated Production Control Systems

IEM 615 – Reliability and Maintainability Engineering

Business Group courses:

IEM 621 – Innovation Theory

IEM 622 – Knowledge Management

IEM 623 – Financial Engineering

IEM 624 – International Business

Math and Information Group courses:

MTH 601 – Advanced Mathematics and Statistics II

IEM 631 – Operations Research II

IEM 632 – Applied Multivariate Data Analysis

IEM 633 – Information Technology and Management

Manufacturing Systems Group courses:

IEM 641 – Advanced Biomechanics

IEM 642 – Composites Engineering

IEM 643 – Tool Engineering

IEM 644 – Advanced Rapid Prototyping Applications

Systems and Service Group courses:

IEM 651 – Systems Theory

IEM 652 – Service Systems Engineering

IEM 653 – Service Operations and Customers Relationship Management

IEM 654 – Information Technology Services and e-Business Management

Research Seminar:

Ph.D. students have to participate in one seminar activities which are based on self learning and presentations of new advanced topics in her/his discipline. The total credits of the seminar are three.

IEM 703 – Seminar on Current Trends in Industrial Engineering and Systems Management.

Upon the recommendation of the academic advisor, a PhD student can also have another two elective seminar courses depending upon his/her line of research.

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Industrial

Engineering and Systems Management. The thesis should present a new contribution (s) in the respective field of research.

IEM 802 Ph.D. Thesis

5-MATERIALS SCIENCE AND ENGINEERING PROGRAM

ARTICLE-55

INTRODUCTION

Material comprehension is of major importance to the technology development in all issues of engineering. The internal structure of the different materials should be explained so that students can have clear understanding of nano, micro and macro characterization and usage of all different types of materials. E-JUST faculty have research programs covering all interdisciplinary areas of the field including nanotechnology, electronic materials, photonic materials, energy materials, biomaterials, computational materials and structural materials with applications in health care, communications, transportation, recreation, energy, environment and electronics.

ARTICLE-56

VISION:

"The department will be a nationally and internationally recognized leader in the education of students at the post graduate level in the field of materials science and engineering. Its graduates will attain prominence in industry, government service, and academia. Its faculty will be nationally and internationally recognized for scholarship in both instruction and discovery".

ARTICLE-57

MISSION:

"The Mission of the Department of Materials Science and Engineering is to provide our graduates with a well-rounded engineering education with specific emphasis on materials science and engineering in order to meet the needs of industry, academia, and government; to conduct research at the frontiers of the field; and to provide an integrating and leadership role to the broad multi-disciplinary materials community".

ARTICLE-55

OBJECTIVES:

1. To advance the state-of-the-art in the specialized fields of Materials Science and Engineering.
2. To facilitate technology transfer through either industrial affiliates or spin-off companies.
3. To develop distinctive education and training in materials science and engineering.
4. Graduates will be prepared to pursue a broad range of materials-related career opportunities.
5. Graduates will be recognized and valued for their strong foundation in the basic engineering and scientific principles which underlie the structure, processing, properties, and performance of materials, thereby enabling the effective adaptation or extension to new technology as the needs of the profession and society evolve.
6. Graduates will be able to ethically communicate and work effectively and efficiently as individuals and/or team members.

ARTICLE-56

M.Sc. PROGRAM COURSES:

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- 18 credit hours of course work, including 6-credit hours core courses, 9-credit hours elective course and 3-credit hours Project-Based Learning course.
- 18 credit hours research leading to a master thesis.

Core courses

MSE 501 - Chemical Change and Materials Properties

MSE 502 - Phase Equilibrium and Transformations

Elective courses

The student has to select three courses from the following group or from any other graduate program, according to the recommendations of the academic advisor.

MSE 503 - Crystallography and Diffraction

MSE 504 - Defects and Microscopic Studies

MSE 505 - Electronic and Photonic Properties of Materials

MSE 506 - Polymers Engineering

MSE 507 - Refractory Materials

MSE 508 - Advanced Deformation Processes

MSE 509 - Recycling and Processing of Engineering Materials

MSE 510 - Semiconductor Technology

MTH 501 - Advanced Mathematics and Statistics I

Project-Based Learning Courses:

Master of Science students have to participate in the following team work project which is based on self learning. Students have to present innovative concepts and competitive solutions. The total credits of the course are three.

MSE 701- Project Based Learning in Materials Development, Characterization and Integration in Engineering Systems.

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Materials Science and Engineering.

MSE 801 M. Sc. Thesis

Prequalifying Courses:

M.Sc. students having bachelor degrees in different specializations should pass successfully prequalifying courses before registration in the program.

The prequalifying courses can be selected from the list below according to the recommendation of the academic advisor and the department council. Each course weighs 3 credit hours. The credit hours of the prequalifying courses are not counted in the course-work requirements.

1- MSE 450 Materials Properties and Testing

2- MSE 451 Composite Materials

3- MSE 452 Principle of Plastic Deformation

4-MSE 453 Introduction to Crystallography

5- ERE 451 Thermodynamics

6- MTR 451 Measurements and Instrumentation

ARTICLE-57

Ph.D. PROGRAM COURSES:

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- 18 credit hours of course work, including 3-credit hours core course 6-credit hours elective course and 9-credit hours seminar.
- 30 credit hours research leading to a doctorate dissertation.

Students have to attend successfully six courses with three credits each (two core courses, three elective courses and a seminar).

Core courses

MSE 601- Surface science and corrosion

Elective courses

The student has to select two courses from the following group or from any other graduate program, according to the recommendations of the principal supervisor.

MSE 602 - Composite materials and fiber science.

MSE 603- Building materials and ceramics.

MSE 604- Solid-state and thin-film reaction kinetics.

MSE 605 - Nanomaterials and Technology

MSE 606 - Biomaterials

MSE 607 - Magnetic and Superconducting Materials

MSE-608 **-** Materials for Photovoltaic devices

MTR 605 - Smart Sensors and Actuators

MTR 606 - Design of Micro- Electromechanical Systems/ Microsystems

MTH 601 - Advanced Mathematics and Statistics II

Seminars:

Ph.D. students have to participate in three seminars activities which are based on self learning and presentations of new advanced topics in her/his discipline. The total credit hours of the seminar are nine. The seminar MSE 702 will be conducted by distinguished Japanese and Egyptian Professors, while seminar MSE 703 will be conducted by students through presentations of recent Journals papers. In seminar MSE 704 students shall present their progress in their research projects.

MSE 702– Advanced Research Seminar on Materials Science and Engineering

MSE 703 –Research Seminar on Recent Topics in Materials Science and Engineering

MSE 704 –Research Seminar on Research Progress in Materials Science and Engineering

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Materials Science and Engineering. The thesis should present a new contribution (s) in the respective field of research.

MSE 802 Ph.D. Thesis

6-ENERGY RESOURCES AND ENVIRONMENTAL ENGINEERING PROGRAM

ARTICLE- 58

INTRODUCTION

Depletion of traditional fuel and limited water resources, moreover the exponential increase of energy use, makes water and energy resources are important issue worldwide. In addition, the increasing knowledge of the effects of combustion in global warming and the harmful effect to mankind had increased the awareness on the importance of Environmental Engineering. Excessive consumption of fossil fuels and Environmental Degradations are the greatest threat to our planet this century. In addition, a complete understanding of Energy Resources on the Global Scale and the interactions between the human activities in the energy field and the environment has become crucial. Tools for addressing such situations include but not limited to Renewable Energy, Alternative resources for energy and water, energy storage, Energy and Water Resources Management, Wastewater Recycling, Solid Waste Reuse, and Air Pollution Control.

It is believed that the M.Sc. and Ph.D. programs in E-JUST will contribute to the understanding of such subjects.

ARTICLE-59

VISION

The vision of the Energy Resources and Environmental Engineering Department is to be a unique regional program, which cornerstone is sustainability and it is specially designed and strictly structured with latest innovative technology in the field of Energy and Environmental Engineering to meet the challenges of the growing energy and water resources demands integrated with environmental requirements.

ARTICLE-60

MISSION

The mission of the Energy Resources and Environmental Engineering Program is to prepare students well acquainted with the basic of the theoretical and practical knowledge, as well as, the research tools and acquiring professional skill development to tackle the current energy crisis and environmental problems. This includes supervision and undertaking of Research on topics caused by the dwindling conventional energy sources, the impacts of fossil fuels on the environment and the limited water resources. examples are renewable energy, alternative resources for energy and water, energy storage, energy and water resources management, wastewater recycling, solid waste reuse, and air pollution control.

ARTICLE-61

OBJECTIVES

1. To prepare graduates who are able to interact with the community towards better environmental conditions and more utilization of new sources of energy.
2. To prepare creative graduate to design, manage and operate energy generating equipment and energy systems with environmental background.
3. To prepare qualified graduates to apply latest technology for improvement of life quality by considering and addressing environmental issues in water and energy sources and sustainability, with emphasis on national and local problems.
4. To give an equal opportunity for students from all countries to enroll to the energy resources and environmental engineering programs.
5. To establish strong and effective co-operation with different national and international research institutes, centers, universities and industries relevant to energy resources and environmental engineering.
6. To develop integrated team work skills interacting with other members from different disciplines.

ARTICLE-62

M.SC. PROGRAM COURSES:

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- 18 credit hours of course work, including 6-credit core courses, 6-credit elective courses, a 3-credit Project-Based Learning course and 3-credit hours for research seminar.
- 18 credit hours research leading to a master thesis.

M.Sc. students have to pass successfully six courses with three credit hours each (two core courses, two elective courses, one Project-Based Learning course and one research seminar).

Core courses

ERR 501- Energy Resources Engineering

ERE 502- Advanced Topics on Water Resources and Environmental Engineering

Elective courses

The student has to select two courses from the following group or from any other graduate program, according to the recommendations of the main supervisor.

ERE 503- Atmospheric chemistry

ERE 504- Solar Energy

ERE 505- Fuels and Processes:

ERE 506- Industrial Ecology

ERE 507- Transport Phenomena

ERE 508- Introduction to Computational Fluid Dynamics

ERE 509- Thermal Hydraulics in Power Technology

ERE 510- Electrochemical Energy Conversion and Storage

ERE 511- Thermal and Cogeneration Systems

ERE 512- Climate Change

ERE 513- Water Quality and Environmental Analysis

ERE 514- Biological Processes for Wastewater Treatment

ERE 515- Fires and Explosions

ERE 516- Oil and Gas Utilization

ERE 517- Arid Land Hydrology and Water Management

ERE 518- Groundwater Hydrology

ERE 519- Advanced Hydraulics

ERE 520- Remote Sensing and GIS in Energy and Water Resources

ERE 521- Water Pollution Control Processes

MTH 501- Advanced Mathematics and Statistics I

Project-Based Learning Courses:

Master of Science students in Energy Resources and Environmental Engineering have to participate in a teamwork project, which is based on self-learning, Students have to present innovative concepts and competitive solutions. The total credits of the course are three.

ERE 701- Project Based Learning on Energy Resources and Environmental Engineering

Seminars:

M.Sc. students have to participate in one seminar activity which is based on self learning and presentations of new advanced topics in her/his discipline. The total credit hours of the seminar are three.

MTR 702- Research Seminar on Energy Resources and Environmental Engineering

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Energy Resources and Environmental Engineering.

ERE 801 M. Sc. Thesis

Prequalifying Courses:

M.Sc. students holding bachelor degrees in different specializations should pass successfully prequalifying courses of 9 to 18 credit hours, as determined by the department council and approved by the school council, before registering in the program. The credit hours of the prequalifying courses are not accounted in the course-work requirements.

The prequalifying courses are selected from the following list; each course weights 3 credit hours:

EEE 301- Fluid Mechanics

EEE 302- Heat and Mass Transfer

EEE 303-Measurements and Instrumentation

EEE 304- Thermodynamics

EEE 201- Combustion and Air Pollution

MSE 407-Materials testing and analysis techniques

ARTICLE-63

PH. D. PROGRAM COURSES:

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- 18 credit hours of course work, including 6-credit hours as core courses, 3-credit hours as elective courses and 9- credit hours as research seminar course work.
- 30 credit hours research leading to a doctorate dissertation.

Students have to pass successfully six courses with three credits each (two core courses, one elective course and three seminar courses).

Core courses

ERE 601- Environmental Systems and Processes

ERE 602- Sustainable Energy Utilization

Elective courses

Students have to select one course from the following group or from any other graduate program, according to the recommendations of the main supervisor.

ERE 603- Turbulence

ERE 604- Advanced Computational Fluid Dynamics

ERE605- Refrigeration and Indoor Environmental Control

ERE 606-Turbomachinery

ERE 607- Energy Management:

ERE 608- Alternative Energy Systems

ERE 609- Transportation Systems Analysis: Dynamics, Demand and Economics

ERE 610- Advanced Topics in Fuel and Energy

ERE 611- Earth Observation for the Environment

ERE 612- Seawater and Brackish Water Desalination

ERE 613- Hazardous Waste Management

ERE 614- Environmental Physical-Chemical Processes.

ERE 615- Industrial Waste Treatment

ERE 616- Advanced Irrigation and Drainage

ERE 617- Integrated Water Resources Management

MTH 601- Advanced Mathematics and Statistics II

Research Seminar Courses:

Ph.D. students have to participate in three seminars activities which are based on self learning and presentations of new advanced topics in her/his discipline. The total credit hours of the seminar are nine. The seminar ERE 703 will be conducted by distinguished Japanese and Egyptian Professors, while seminar ERE 704 will be conducted by students through presentations

of recent Journals papers is the student research field. In seminar ERE 705 students shall present the progress in their research projects.

ERE 703- Advanced Research Seminar on Energy Resources and Environmental Engineering

ERE 704- Research Seminar on Recent Topics in Energy Resources and Environmental Engineering

ERE 705- Research Seminar on Research Progress in Energy Resources and Environmental Engineering

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Energy Resources and Environmental Engineering. The thesis should present a new contribution(s) in the respective field of research.

ERE 802 Ph.D. Thesis

7- CHEMICAL AND PETROCHEMICALS ENGINEERING PROGRAM

ARTICLE-64

INTRODUCTION

Graduate study program is intended to prepare the student to carry out basic and applied scientific research in the fields relevant to chemical and petrochemicals industries, in order to develop new products and/or improve the properties of existing ones. Also, the student should be able to understand, realize and apply the basic principles of clean and green technology in the design and running different units for producing different chemical and petrochemical goods.

ARTICLE-65

VISION:

1. To prepare creative engineers to design, manage and operate process units related to chemical and petrochemicals engineering systems applying green technologies.
2. To stay ahead in chemical and petrochemicals engineering education quality and research.

ARTICLE-66

MISSION:

To give the student a good idea about the different aspects of the studied courses in the graduate program, the student should be able to apply the scientific bases he acquired from these courses in the different fields of chemical and petrochemical industries. Moreover the student should be able to conduct scientific research in the relevant fields of these industries to develop new products and improve the properties of the existing products. Also, the student should be able to follow green technology principles in different aspects of chemical and petrochemical industries.

ARTICLE-67

OBJECTIVES:

1. To prepare graduates for teamwork research programs in different parts of the world.
2. To prepare creative engineers to design, manage and operate equipment related to chemical and petrochemicals engineering applications and systems.
3. To prepare qualified students who can apply latest technologies to improve life quality by considering and addressing environmental issues.
4. To give an equal opportunity for students from all countries to enroll post graduate programs.
5. To establish cooperation channels between E-JUST and industry.
6. To establish cooperation with different universities and research centers.

ARTICLE-68

M.Sc. PROGRAM COURSES:

M.Sc. students must complete a total of at least 36 credit hours, within the following guidelines:

- 18 credit hours of course work, including 6-credit hours core courses, 9-credit hours elective courses and 3-credit hours Project-Based Learning course.
- 18 credit hours research leading to a master thesis.

Students have to pass successfully six courses with three credits each (two core courses, three elective courses and a Project-Based learning course).

Core courses

CPE 501 Transport Phenomena

CPE 502 Advanced Unit Operations

Elective courses

The student has to select three courses from the following group or from any other graduate program/s, according to the recommendations of the principal supervisor.

CPE 503 Modeling and Simulation of Chemical and Petrochemical Processes
CPE 504 Advanced Electrochemistry
CPE 505 Advanced Separation Technologies
CPE 506 Advanced Process Control
CPE 507 Nanotechnology in Chemical and Petrochemical Industries
CPE 508 Gas Storage and Transportation
CPE 509 Surface and Interface Analysis Techniques
CPE 510 Conducting Polymers
MTH 501 Advanced Mathematics and Statistics I

Project-Based Learning Course:

M.Sc. students have to participate in a one of the following team work projects which is based on self learning. Students have to present innovative concepts and competitive solutions. The total credits of the course are three hours.

CPE 701- Project Based Learning on Chemical and Petrochemicals Engineering.

M.Sc. Thesis:

The M.Sc. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Chemical and Petrochemicals Engineering.

CPE 801 M. Sc. Thesis

Prequalifying Courses:

M.Sc. students holding bachelor degrees in different specializations should pass successfully prequalifying courses of 9 to 18 credit hours, as determined by the department council and approved by the school council, before

registration in the program. The credit hours of the prequalifying courses are not counted in the course-work requirements.

The prequalifying courses are selected from the following list; each course weighs 3 credit hours:

1-EEE 302- Heat and Mass Transfer
2-CPE 404: Chemical Processes Principles
3- CPE 407: Process Plant Design
4- MSE 407- Materials testing and analysis techniques
5- MTR 401 Automatic Control
6- EEE 303- Measurements and Instrumentation

ARTICLE-69

Ph.D. PROGRAM COURSES:

Ph.D. students must complete a total of at least 48 credit hours, within the following guidelines:

- Course-work of 18 credit hours, including core courses of 6 credit hours and elective courses of 6 credit hours selected from the Chemical and Petrochemical elective courses, and research seminar courses of 6 credit hours. Students can also select, with the aid of their academic advisors, elective courses from other interdisciplinary graduate programs.
- Thesis-work of 30 credit hours.

Core courses

CPE 601 Advanced Chemical Reactions and Reactor Design
CPE 602 Advanced Polymerization Engineering

Elective courses

The student has to select two courses from the following group or from any other graduate program, according to the recommendations of the principal supervisor.

CPE 603 Process Optimization
CPE 604 Catalysis Engineering and Design

CPE 605 Particle Science and Handling Engineering

CPE 606 Biochemical Engineering

CPE 607 Pollution control in Chemical and Petrochemical Industries

CPE 608 Micro - Chemistry and Micro - chemical Engineering

CPE 609 Petrochemical industries

CPE 610- Petroleum refining

CPE 611-Electrochemical Methods in Chemical and Petrochemical Industries

CPE 612- Analytical Instrumentation

MTH 601- Advanced Mathematics and Statistics

Research Seminar Courses:

Ph.D. students select two of the following 3 credit hours research seminar courses:

CPE 702- Seminars on Advanced Catalysis applications in Petrochemical industries

CPE 703- Seminars on Advanced Nanotechnology in Chemical/ Petrochemical Processes

CPE 704- Seminars on Recycling Technologies in Petrochemical industries

CPE 705- Seminars on Polymeric compounding Processes

CPE 706- Seminars on Electrochemistry Applications in Industry

Ph.D. Thesis:

The Ph.D. candidate should prepare and defend a thesis dissertation based on a high-valued research work in one research topic in the fields of Chemical and Petrochemicals Engineering. The thesis should present a new contribution (s) in the respective field of research.

CPE 802 Ph.D. Thesis

COURSES OUTLINES

ARTICLE-70

Advanced new courses and courses' contents/outlines must be checked annually and can be modified or updated in order to match progresses in science and engineering technologies. These enhancements should be done upon the request of the respective school council and the approval of the university council without the need of any higher administrative decree and are not considered as a change in the present bylaws.

1- ELECTRONICS AND COMMUNICATIONS ENGINEEING

ECE 501- Advanced Analog Integrated Circuits: Analysis and optimized design of monolithic operational amplifiers and wide-band amplifiers; methods of achieving wide-band amplification, gain-bandwidth considerations; analysis of noise in integrated circuits and low noise design. Precision passive elements, analog switches, amplifiers and comparators, voltage reference in NMOS and CMOS circuits, Serial, successive-approximation, and parallel analog-to-digital converters. Switched-capacitor and CCD filters. Applications to codecs, modems. Use of SPICE and other computer aids.

ECE 502- Advanced Digital and Data Communications: Fundamentals of wireless communications. Modeling of the wireless multipath fading channel and its basic physical parameters. Coherent and noncoherent reception. Diversity techniques over time, frequency, and space. Spread spectrum communication. Multiple access and interference management in wireless networks. Frequency re-usessectorization. Multiple access techniques: TDMA, CDMA, OFDM. Capacity of wireless channels. Opportunistic communication. Multiple antenna systems: spatial multiplexing, space-time codes. Examples from existing wireless standards.

ECE 503- Advanced Digital Signal Processing: Advanced techniques in signal processing. Stochastic signal processing, parametric statistical signal models and adaptive filtering. Application to spectral estimation, speech and

audio coding, adaptive equalization, noise cancellation, echo cancellation, and linear prediction.

ECE 504- Advanced Digital Integrated Circuits: Architectural and circuit level design and analysis for digital System-on-a-Chip (SoC), in state of the art CMOS technologies. Fundamentals of high-speed and low-power CMOS circuits, microprocessor and DSP (digital signal processor) architectures, RTL (register transfer level) design with HDL (hardware description language), processor prototyping with FPGA (field programmable gate array).

ECE 505- Computer-Aided Verification of Electronic Circuits and Systems: Techniques for the verification of correct behavior of complex electronic circuits and systems including algorithms and systems for the detailed simulation of integrated circuits at the transistor level in the time and frequency domain, discrete-event logic simulation, cycle-based logic simulation, RTL and behavioral simulation, equivalence checking, timing analysis, and power estimation.

ECE 506- Analysis and Design of VLSI Mixed-Signal Integrated Circuits: Architectural and circuit level design and analysis of integrated analog-to-digital and digital-to-analog interfaces in CMOS and BiCMOS VLSI technology. Analog-digital converters, digital-analog converters, sample/hold amplifiers, continuous and switched-capacitor filters. RF integrated electronics including synthesizers, LNA's, mixer, voltage controlled oscillator. Low power mixed signal design. VLSI design and analysis using CAD tools such as Agilent ADS (Advanced Design System),Momentum (EM-simulator) andGoldenGate tools.Layout optimization with Virtuoso (Layout editor and Schematic editor), Assura (Design Rule Checker, Layout Vs Schematic Verifier and Parasitic Extractor),and MMSIM (Spectre/RF/Ultra Sim/AMS Designer) tools.

ECE 507- Advanced IC Processing and Layout: The key processes for the fabrication of integrated circuits. Optical, X-ray, and e-beam lithography, ion implantation, oxidation and diffusion. Thin film deposition. Wet and dry etching and ion milling.Effect of phase and defect equilibrium on process control.

ECE 508- Advanced Solid State Devices: Physical principles and operational characteristics of semiconductor devices. Emphasis on MOS field-effect transistors and their behaviors dictated by present and probable future technologies. Metal-oxide-semiconductor systems, short-channel and high field effects, device modeling, impact on analog, and digital circuits.

ECE 509- Advanced Integrated Circuits for Communications: Analysis, evaluation and design of present-day integrated circuits for communications application, particularly those for which nonlinear response must be included. MOS, bipolar and BICMOS circuits, audio and video power amplifiers, optimum performance of near-sinusoidal oscillators and frequency-translation circuits. Phase-locked loop ICs, analog multipliers and voltage-controlled oscillators; advanced components for telecommunication circuits. Use of new CAD tools and systems.

ECE 510- Information Theory: An introduction to information theory methods used in the analysis and design of communication systems. Typical topics include: entropy, relative entropy and mutual information; the asymptotic equipartition property; entropy rates of stochastic process; data compression;Kolmogorov complexity; channel capacity; differential entropy; the Gaussian channel; maximum entropy and mutual information; rate distortion theory; network information theory; algebraic codes.

ECE 511- Error Control Coding: Basics of error control coding for reliable digital transmission and storage. Reed Muller codes, cyclic codes, Reed Solomon codes, convolution codes, concatenated codes, turbo codes, and low density parity check codes.

ECE 512- Digital Image Processing: 2-D sequences and systems, separable systems, reconstruction from projections and partial Fourier information, Z- transform, different equations, recursive computability, 2D DFT and FFT, 2D FIR filter design; human eye, perception, psychophysical vision properties, photometry and colorimetry, optics and image systems; image enhancement, image restoration, geometrical image modification, morphological image processing, halftoning, edge detection, image compression: scalar quantization, lossless coding, huffman coding, arithmetic

coding dictionary techniques, waveform and transform coding DCT, KLT, Hadammard, multiresolution coding pyramid, subband coding, Fractal coding, vector quantization, motion estimation and compensation, standards: JPEG, MPEG, H.xxx, pre- and post-processing, scalable image and video coding, image and video communication over noisy channels.

ECE 513- Sensors and DSP Systems Design: A study of theory and practice in the design and implementation of DSP algorithms on programmable processors, multiprocessors, and ASICs. Specification, evaluation, and implementation based environments of real-time DSP software applications on embedded DSP.

ECE 514- Microwave Engineering: Fundamentals of modern microwave engineering with emphasis on microwave network analysis and circuit design. Review of Microwave transmission lines, including waveguide, coax, microstrip, and stripline. Microwave circuit theory, including S-parameters, ABCD matrices, equivalent circuits, and signal flow graphs. Analysis and design of passive microwave circuits and components including matching networks, microwave resonators, power dividers, directional couplers, filters, and ferrite components. Noise and noise effects in microwave systems. Analysis and design of active microwave circuits, including detectors, mixers, PIN diode switches, transistor amplifiers, and oscillators.

ECE 515- VLSI Design: System Approach: Unified top-down and bottom-up design of integrated circuits and systems concentrating on architectural and topological issues. VLSI architectures, systolic arrays, self-timed systems. Trends in VLSI development. Physical limits. Tradeoffs in custom-design, standard cells, gate arrays. VLSI design tools.

ECE 519– Stochastic Processes: Definitions of Probability; Bernoulli Random Trials; Conditional CDF and PDF; Mean, Conditional Mean, Variance; Function of an RV; Characteristic Functions; One Funct. of 2 RV's, Two Functs. of 2 RV's; Joint Moments; Conditional Distributions and Densities; Conditional Probability and Conditional Expectation; Sequences of RV's; Stochastic Processes; Stationarity and Ergodicity; Optimal Linear

Systems; Wiener Filters; Markov Chains in discrete time; The Poisson Process; Markov Processes in continuous time.

ECE 601- Special Topics in Electronics: Students in this course will learn topics in signal the state-of-the-art areas of Electronics. For example, this course could include new trends in Analog Integrated Circuits and systems and Digital LSI Systems.

ECE 602- Quantum and Optical Electronics: Interaction of radiation with atomic and semiconductor systems, density matrix treatment, semi classical laser theory (Lamb's), laser resonators, specific laser systems, laser dynamics, Q-switching and mode-locking, noise in lasers and optical amplifiers. Nonlinear optics, phase-conjugation, electro-optics, acousto-optics and magneto-optics, coherent optics, stimulated Raman and Brillouin scattering.

ECE 603- Radio Frequency Integrated Circuits Design (*Pre: ECE 501*): Techniques of analog circuit technology in the high-frequency regime above 1 GHz. Transmission lines and distributed circuit elements; S-parameter design of high-frequency active circuits; computer-aided analysis and design. Emphasis on design of planar high-frequency integrated circuits employing CMOS and SiGe technology. Circuit building blocks for broadband wired and wireless communication will be emphasized including voltage-controlled oscillators, low-noise amplifiers, and power amplifiers.

ECE 604- Nanoscale Fabrication (*Pre: ECE 507*): Various top-down and bottom-up approaches to synthesizing and processing nanostructured materials. The topics include fundamentals of self assembly, nano-imprint lithography, electron beam lithography, nanowire and nanotube synthesis, quantum dot synthesis (strain patterned and colloidal), postsynthesis modification (oxidation, doping, diffusion, surface interactions, and etching techniques). In addition, techniques to bridging length scales such as heterogeneous integration will be discussed. Electronic, optical, thermal, mechanical, and chemical properties brought forth by the very small sizes.

ECE 605- Nanoelectronic Devices and Circuits (*Pre: ECE 508*): This course will cover the limits of silicon electronics integration and how the nanoworld provides alternative approaches to devices and circuits. Quantization of electron motion in nanoscale devices will be introduced and examined. Solutions of Schrodinger equations for different devices will be discussed in detail. The operation principles and concepts of nanoelectonics devices, spintronics, bioelectronics, and self-assembled-nanostructures will be examined.

ECE 606- Mobile Communications: Introduction to cellular mobile systems, frequency reuse, mobile radio environment – Signal propagation in Urban and suburban environment, models for path loss, Rayleigh fading and lognormal shadowing- Co-channel interference reduction - Mobile communication protocols – Messaging and capacity Spread-spectrum and CDMA – Paging, information theoretic capacity of communication channels and wireless systems, radio resource allocation in mobile communications systems.

ECE 607- High Speed Communications Networks: Descriptions, models, and approaches to the design and management of networks. Optical transmission and switching technologies are described and analyzed using deterministic, stochastic, and simulation models. FDDI, DQDB, SMDS, Frame Relay, ATM, networks, and SONET. Applications demanding high-speed communication.

ECE 608- High-Speed Signal and Image Processing with VLSI (*Pre: ECE 515*): The design of ASCA (Application Specific Computer Architectures) for signal and image processing; topics include an overview of VLSI architectural design principles, signal and image processing algorithms, mapping algorithms onto array structures, parallel architectures and implementation and systolic design for neural network processing.

ECE 609- Neural and Nonlinear Information Processing: Principles of massively parallel real-time computation, optimization, and information processing via nonlinear dynamics and analog VLSI neural networks, applications selected from image processing, pattern recognition, feature

extraction, motion detection, data compression, secure communication, bionic eye, auto waves, and Turing patterns.

ECE 610- Advanced Antenna Design: This course provides the students with an understanding of advanced antenna structures and presents an overview of analytical and numerical methods used to analyze and design these antenna structures. This course includes broadband antennas, frequency independent antennas, aperture antennas, horn antennas, microstrip antennas, and reflector antennas. Students will work on a research paper on a selected antenna design topic.

ECE 611- Wireless Sensor Networks: This course covers all aspects of sensor networking, from design through performance issues to application requirements. The course starts with the design issues and challenges that are associated with implementations of sensor network applications. This includes dealing with mobility, disconnections, and awareness of battery power consumption. The course then provides a detailed treatment of proactive, reactive, and hybrid routing protocols, in addition to the various clustering approaches. Next, it covers the IEEE 802.11 Wireless LAN and Bluetooth standards and discusses their characteristics and operations. The course also discusses research topics that involve collaboration among mobile devices, service discovery, and data caching.

ECE 612- Numerical Electromagnetics: Principles and applications of numerical techniques for solving practical electromagnetic problems. Time domain solutions of Maxwell's equations. Finite difference time domain (FDTD) methods. Numerical stability, dispersion, and dissipation. Absorbing boundary conditions. Perfectly matched layer methods. Explicit and implicit methods. FDTD modeling of propagation and scattering in dispersive and anisotropic media.Near-to-far-zone transformations. Computational problems require programming and use of MATLAB and other tools.

ECE 613- Advanced Wireless Communication Systems: Information theory and coding. Error control coding: CRCs, trellis codes, convolution codes and Viterbi decoding. Quantization and digitization of speech: PCM, ADPCM, DM, LPC and VSELP algorithms. Carrier recovery and

synchronization. Multiplexers: TDM and FDM hierarchies. Echo cancelers, equalizers and scrambler/ unscrambles. Spread spectrum communication systems. Mobile communications: digital cellular communication systems and PCS. Encryption techniques. Introduction to computer communication networks.

ECE 614- Advanced Optical Communications Systems: Introduction to Optical Communication Systems; Evolution of Light wave Systems; Components of a Light wave System; WDM Systems; Basic WDM Multiplexers; Advanced Light wave Systems; Receiver Noise and Direct Detection; Optical SNR; Electrical SNR; Receiver Sensitivity and Q Factor; Coherent Detection; Demodulation Schemes; Signal Propagation in Fibers; Impact of Nonlinear Effects; Optical Amplifiers; Noise in Optical Amplifiers; Periodically Amplified Light wave Systems; OFDM principles; Optical OFDM Systems; Various Types of Optical OFDM; Signal Propagation in Fibers; Dispersion Impairments; MIMO-OFDM Perspective.

ECE 615- Advanced Optimization Techniques: Principles of optimization to solve optimization problems that arise in engineering: the steepest descent and Newton methods for unconstrained optimization; golden section, quadratic, cubic and inexact line searches; conjugate and quasi-Newton methods; fundamentals of constrained optimization theory; convex sets, functions, and optimization problems, basics of convex analysis, simplex methods for linear programming; modern interior-point methods; active-set methods and primal-dual interior-point methods for quadratic and convex programming; least-squares, linear and quadratic programs, semidefinite programming, optimality conditions, duality theory, sequential quadratic programming and interior-point methods for nonconvex optimization and software packages/algorithms for optimization will be covered.

ECE 616- Statistical Signal Processing (*Pre: ECE 519***):** An understanding of random processes is crucial to many engineering fields-including communication theory, computer vision, and digital signal processing in electrical and computer engineering. The filtering, estimation, and detection of random processes in noisy environments are critical tasks necessary in the analysis and design of new communications systems and useful signal

processing algorithms. Random Processes: Filtering, Estimation, and Detection clearly explains the basics of probability and random processes and details modern detection and estimation theory to accomplish these tasks. The course covers the following interrelated topics:

- Probability and characterizations of random variables and random processes.
- Optimum estimation theory including both Wiener and Kalman Filters
- Detection theory

ECE 617- Special Topics in Signal Processing: Students in this course will learn topics in signal processing which will depend on the state-of-the-art areas. For example, this course could include new trends in adaptive filtering, wavelets and filterbanks, array signal processing, etc.

ECE 618- Special Topics in Communications: Students in this course will learn topics in communications which will depend on the state-of-the-art areas. For example, this course could include new trends in Wireless Communication Systems and Network, Optical Communication Systems and Networks, Wireless Sensor Networks, etc.

ECE 619- Complex Digital Systems Design: This course is a project-oriented course to teach new methodologies for designing multi-million-gate CMOS VLSI chips using high-level synthesis tools in conjunction with standard commercial EDA tools. The emphasis is on modular and robust designs, reusable modules, correctness by construction, architectural exploration, and meeting the area, timing, and power constraints within standard cell and FPGA frameworks.

ECE 701 - Project-Based Learning in Electronics: Students participate in Project-Based Learning activities in new advanced topics in Electronics, suggested by one or more faculty staff members.

ECE 702 - Project-Based Learning in Communications: Students participate in Project-Based Learning activities in new advanced topics in Communications, suggested by one or more faculty staff members.

ECE 703 - Seminars on Advanced Topics in Electronics I: Ph.D. students participate in predetermined series of research seminars conducted by specialists in different advanced research topics in the fields of Electronics. The student's evaluation is based on his/her understanding of the presented topics.

ECE 704 - Seminars on Advanced Topics in Electronics II: Series of research seminars conducted by Ph.D. students and based on self-learning and presentations of new advanced topics in Electronics selected by professors specialized in these topics. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

ECE 705 - Seminars on Advanced Topics in Electronics III: Series of research seminars conducted by Ph.D. students and based on presentations of recent Journals papers in advanced research topics in Electronics related to students' thesis themes. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

ECE 706 - Seminars on Advanced Topics in Communications I: Ph.D. students participate in predetermined series of research seminars conducted by specialists in different advanced research topics in the fields of Communications. The student's evaluation is based on his/her understanding of the presented topics.

ECE 707 - Seminars on Advanced Topics in Communications II: Series of research seminars conducted by Ph.D. students and based on self-learning and presentations of new advanced topics in Communications selected by professors specialized in these topics. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

ECE 708 - Seminars on Advanced Topics in Communications III: Series of research seminars conducted by Ph.D. students and based on presentations of recent Journals papers in advanced research topics in Communications related to students' thesis themes. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

M.Sc. Prequalifying Courses:

ECE 450- Microelectronics Circuits:

Analog Circuits: Biasing techniques in analog ICs (Current sources and sinks, voltage and current references) – Bipolar, CMOS, and BiCMOS IC differential and operational amplifiers – Switched capacitor circuits – Computer aided analysis and design using SPICE.

Digital Circuits: Switching characteristics of electronic devices. Performance parameters: speed limits, noise margins, and power dissipation. MOS digital integrated Circuit: NMOS, Static-CMOS, PTL, dynamic-CMOS, and BiCMOS. Timing Circuits. Semiconductor memories/D and D/A converter circuits.

ECE 451- Integrated Circuit Devices: Integrated circuit technology: semiconductor crystal growth, oxidation, diffusion, lithography, contacts and interconnections. Carrier transport phenomena in semiconductors. Operation principles and device modeling of p-n junctions, metal-semiconductor contacts, bipolar and MOS transistors, and related devices (Thyristors, MESFETs, and CCDs).

ECE 452- Communications Systems Fundamentals: Introduction to analogue and digital communication systems, Fundamentals of analogue and digital modulation techniques: AM, FM, and pulse modulation techniques: ASK, PSK, and FSK, Data communication: Data transmission, data encoding, data communication interface, multiplexing and communication protocols.

ECE 453- Computer Networks: The OSI model, data link layer, frame format: character stuffing, bit stuffing, error control, automatic-repeat request and sliding, window protocols, data-link protocols: HDLC, BSC, PPP, the MAC sub-layer, local area networks: Ethernet, token ring and FDDI, wireless LANs, circuit switching versus packet switching, routing algorithms.

ECE 454- Signals and Systems: Classification of continuous and discrete-time signals and systems. Fourier transform. Linear and time-invariant (LTI) systems: impulse response, step response, transfer function. Band-pass signals: Hilbert transform, pre-envelope, complex envelope. Convolution and correlation functions. Energy and power spectral densities. Transmission of

continuous random signals through LTI systems. Introduction to sampling theorem and reconstruction of signals. Application of taped delay line filters.

ECE 455- Digital Signal Processing: Discrete-time signals and systems: Z-transform, DFT, 2-dimensional versions. Fast Fourier transformer(FFT). Digital system realization using different structures: parallel, lattice, etc. Digital filter design methods: windowing, frequency sampling, S-to-Z methods, frequency-transformation methods. Multi-rate sampling. Discrete random signals through systems.

2- COMPUTER SCIENCES AND ENGINEERING

CSE 501- Advanced Computer Architecture: Survey of contemporary computer organizations: early systems, CPU design, instruction sets, control, processors, busses, ALU, memory, I/O interfaces, connection networks, virtual memory, pipelined computers, multiprocessors, and case studies. Term paper or project is required.

CSE 502- Design and Implementation of Programming Languages: Selected topics from: analysis, comparison, and design of programming languages, formal description of syntax and semantics, advanced programming techniques, structured programming, debugging, verification of programs and compilers and proofs of correctness. Compiler construction. Lexical analysis, syntax analysis. Semantic analysis, code generation and optimization. Storage management. Run-time organization.

CSE 503- Parallel Computing: Models for parallel programming. Fundamental algorithms for linear algebra, sorting, FFT, etc. Survey of parallel machines and machine structures. Existing parallel programming languages, vectorizing compilers, environments, libraries and toolboxes. Data partitioning techniques. Techniques for synchronization and load balancing. Detailed study and algorithm/program development of medium sized applications.

CSE 504- Digital Systems Design and Testing: A course on digital systems testing and testable design; test economics, fault modeling, logic and fault simulation, testability measures, test generation for combinational and sequential circuits, memory test, delay test, scan design, built-in self test, and boundary scan.

CSE 505- Advanced Embedded System Design: Principles of embedded system design. Focus on design methodologies and foundations. Platform-based design and communication-based design and their relationships with design time, re-use, and performance. Models of computation and their use in design capture, manipulation, verification, and synthesis. Mapping into architecture and system platforms. Performance estimation. Scheduling and real-time requirements. Synchronous languages and time-triggered protocols to simplify the design process. Simulation techniques for highly programmable platforms. Synthesis and successive refinement: meta-model of computation. Use of design tools and analysis of their capabilities and limitations: Ptolemy, POLIS, Metropolis, VCC, Co-ware.

CSE 507- Combinatorial Algorithms and Data Structures: Design and analysis of efficient algorithms for combinatorial problems. Network flow theory, matching theory, matroid theory; augmenting-path algorithms; branch-and-bound algorithms; data structure techniques for efficient implementation of combinatorial algorithms; analysis of data structures; applications of data structure techniques to sorting, searching, and geometric problems.

CSE 508- Computer-Aided Geometric Design and Modeling: Mathematical techniques for curve and surface representation, including: Hermite interpolation, interpolatory splines, Bezier curves and surfaces, B-splines, Beta-splines, Coons patches, tensor product forms, as well as subdivision end/bounding conditions and computational considerations.

CSE 510- Large Scale Database Design and Implementation: Implementation of database systems on modern hardware systems. Considerations concerning operating system design including: buffering, page size, pre-fetching, etc. Query processing algorithms, design of crash recovery

and concurrency control systems. Implementation of distributed databases and data base machines.

CSE 511 - Distributed Systems: An exploration of protocols and methods for allocating to more than one processor various parts of the work associated with a single task. Emphasis is on environments such as array processing, parallel processing and multiprocessor systems, and communication among cooperating processes. Issues discussed include reliability, security, and protection, as well as how these issues affect the development of programs and systems.

CSE 512 - Neural Networks and Fuzzy Systems: Introduction to NN, artificial and biological neurons, an engineering approach (a simple network layers, transfer functions, perceptrons, the learning process, back propagation algorithm for training, recurrent networks, associative memory, applications to speech, vision and control problems. Classical sets and fuzzy sets, classical relations and fuzzy relations, membership functions, fuzzy–to-crisp conversions, fuzzy arithmetic, Numbers, Vectors, and the extension principle.Neuro-Fuzzy Systems, Fuzzy rule-based systems, Fuzzy decision making, Fuzzy classification, Fuzzy pattern recognition, Fuzzy control systems

CSE 515 - Mobile Computing: Covers the current trends in mobile computing systems. It focuses on the fundamental challenges of building mobile systems, as compared to traditional ones, mobile applications, enabling services, energy efficiency, cloud computing, virtualization, security, privacy and future directions.

CSE 516 - Fundamentals of Networking: fundamental concepts in the design and modeling of computer networks. Analytical approach to network design, dimensioning, and routing followed by examples implemented in practice. Topics covered include introduction to networking and layered protocol stacks, Birth-death processes, Poisson Queues, Networks of queues, Description of error detection, correction, and recovery, Analysis of error recovery mechanisms, Fundamentals of Routing.

CSE 517 - Network Security: Introduction to network security and privacy. confidentiality using conventional Encryption. Public-Key Crypto Systems. Authentication Techniques. Digital Signatures. Intruders, Viruses and Worms. Cryptographic Algorithms: DES, RSA, IDEA, SHA, MD5, AES, DSS. Key Exchange Protocols: Kerberos. Network Management Security, Electronic-mail security: PEM,PGP, E-Commerce, Secure Multiparty Computations, Zero, Knowledge Proof systems. Principles of wide-area networking with a focus on protocols, implementations, and issues specific to the Internet. We will begin with a retrospective on packet switching, study the basis for traditional Internet protocols (such as IP and TCP) and investigate a set of selected advanced topics in networking.

CSE 520 - Machine learning: This course provides a broad overview of the current paradigms and techniques of machine learning, in particular statistical learning, modeling, and self-organizing systems. Topics include Bayesian learning, artificial neural networks, linear and non-linear methods for regression, decision tree learning, case-based reasoning, and reinforcement learning.

CSE 521 - Multi-Agent-Systems: Foundation and Applications: Distributed Problem Solving. Distributed Planning. Learning and Communication in multi-agent systems. Agents Development frameworks and languages. Agent Oriented methodologies. Agent oriented analysis and design.

CSE 525 - Formal Verification Techniques: Linear Time Logic/ Computational tree logic, Binary decision diagrams and symbolic model checking. Theorem Proving, High Order Logic. Hardware and software specification and verification.

CSE 540 – Theory of Computability: The course covers different models of computation including finite state machines, push down automata, Turing machines. The concepts of non-determinism, alternation, different versions of Kleene's theorem will be investigated. Grammars that are equivalent to the former models will be studied including regular grammars, context-free grammars, context-sensitive grammars, unrestricted grammars. The notion of uncomputability (unsolvability) will be covered including the famous halting

problem. A brief introduction to the degrees of unsolvability will be given. Extensions of the basic Turing machine models will be given such as Type II Turing machines, quantum Turing machines, etc.

CSE 542- Complexity Theory: Introduction to time and space complexity classes and the relations between them. Topics covered include the polynomial hierarchy, alternating time and space complexity classes, non-uniform complexity classes, counting classes, interactive and zero-knowledge proofs, PCP and the hardness of approximation. Also a brief introduction to quantum computation, quantum classes, analog complexity classes, algebraic characterizations of complexity classes will be given.

CSE 544 - Randomized Algorithms: Randomness has been playing a crucial role in computer science research over the last three decades. Randomized algorithms are algorithms that make random choices as they proceed, and have had a fundamental impact on several areas of computer science (e.g., distributed algorithms, cryptography, resource allocation, approximation algorithms). This course presents the basic concepts in the design and analysis of randomized algorithms. Topics covered include: probabilistic inequalities, the minimax principle, limited independence, random walks, Markov chains, randomized approximation algorithms, hashing, randomized algorithms in machine learning, number-theoretic algorithms, andquantum computation.

CSE – 560 Introduction to Bioinformatics: Introduction to molecular biology (cells, DNA, RNA, genes, proteins, transcription translation, amino acids, etc.). Sequence Alignment: Pair-wise and Multiple alignment, Local and Global alignment. Profiles, and Motif finding. Phylogeny. Gene Finding. DNA Micro-array data Analysis.A Brief introduction to Protein Folding. A Brief introduction to Gene networks. Exploring bioinformatics software tools.

CSE 601 - Parallel Processors: In-depth study of the design, engineering, and evaluation of modern parallel computers. Fundamental design: naming, synchronization, latency, and bandwidth. Architectural evolution and technological driving forces. Parallel programming models, communication primitives, programming and compilation techniques, multiprogramming

workloads and methodology for quantitative evaluation. Latency avoidance through replication in small-scale and large-scale shared memory designs; cache-coherency, protocols, directories, and memory consistency models. Message passing: protocols, storage management, and deadlock. Efficient network interface, protection, events, active messages, and coprocessors in large-scale designs. Latency tolerance through prefetching, multithreading, dynamic instruction scheduling, and software techniques. Network design: topology, packaging, k-ary n-cubes, performance under contention. Synchronization: global operations, mutual exclusion, and events. Alternative architectures: dataflow, SIMD, systoltic arrays.

CSE 603 - Computer Vision: .Paradigms for computational vision. Relation to human visual perception. Mathematical techniques for representing and reasoning, with curves, surfaces and volumes. Illumination and reflectance models. Color perception. Image segmentation and aggregation. Methods for bottom-up three dimensional shape recovery: Line drawing analysis, stereo, shading, motion, texture. Use of object models for prediction and recognition.

CSE 604 - Compiler Optimization and Code Generation: Table-driven and retargetable code generators. Register management. Flow analysis and global optimization methods. Code optimization for advanced languages and architectures. Local code improvement. Optimization by program transformation. Selected additional topics. A term paper or project is required.

CSE 605 - Computer Systems Security: Survey of modern topics in computer security, including protection, access control, distributed access security, firewalls, secure coding practices, safe languages, mobile code, and case studies from real-world systems. May also cover cryptographic protocols, privacy and anonymity and/or other topics as time permits.

CSE 606 - Cryptography: Survey of modern topics on theory, foundations, and applications of modern cryptography. One-way functions; pseudo randomness, encryption, authentication, public-key cryptosystems, notions of security.May also cover zero-knowledge proofs, multi-party cryptographic protocols, practical applications and/or other topics, as time permits.

CSE 607 - Artificial Intelligence Approach to Natural Language Processing: Representation of conceptual structures, language analysis and production, models of inference and memory, high-level text structures, question answering and conversation, machine translation.

CSE 608 - Queuing Theory: A course that covers Poisson counting and renewal processes; Markov chains and decision theory, branching processes, birth death processes, and semi-Markov processes; simple Markovianqueues, networks of queues, general single and multiple-server queues, bounds and approximations.

CSE 609 - **Information Theory for Communication Systems:** This course studies information theoretic limits of communication (channel coding) and compression (source coding) in networks. The focus is on basic coding techniques for simple network models, with the ultimate goal of understanding fundamental principles behind information flow over general networks. Topics include multiple access channels, broadcast channels, interference channels, relay channels; channels with state, channels with feedback, two-way channels; Slepian-Wolf distributed data compression, source coding with side information, multiple descriptions; multiple-antenna (MIMO) Gaussian networks, asymptotic capacity of networks, network coding.

CSE 615 Advanced Topics in Intelligent High Performance Computing: Selected topics in High Performance Computing as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 618 - Advanced Computer Networks: This course covers the principles of wide-area networking with a focus on protocols, implementations, and issues specific to the Internet. This includes classic Internet protocols, study the basis for scaling Internet-wide services, and investigate a set of advanced topics. Emphasis is places on distributed protocols that scale to Internet-wide deployment. This includes addressing, user privacy, mobile wireless networks, peer-to-peer protocols, quality of service issues in wide-area networks, cognitive networks, and new architectural changes being introduced in the current Internet.

CSE 620 Advanced Topics in Systems and Networks Selected topics: Selected topics in Systems and Networks as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 625 Advanced Topics in Machine Intelligence: Selected topics in Machine Intelligence as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 630 Advanced Topics in Programming Languages, Formal Methods and Software Engineering: Selected topics in Programming Languages, Formal Methods and Software Engineering as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 635 Advanced Topics in Data Base and Information Systems: Selected topics: Selected topics in Data Base and Information Systems as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 640 Advanced Topics in Theory and Algorithms: Selected topics in Theory and Algorithms as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 645 Advanced Topics in Graphics, Visualization and HCI: Selected topics in Graphics, Visualization and HCT as per the requirements of the academic advisor and recommendation of the supervisors.

CSE 701 - Project-Based Learning in Computer Systems: Students participate in Project-Based Learning activities in new advanced topics in Computer Systems, suggested by one or more faculty staff members.

CSE 703 – Project-Based Learning in Software Systems: Students participate in Project-Based Learning activities in new advanced topics in Software Systems, suggested by one or more faculty staff members.

CSE 702 - Seminars on Advanced Topics in Computer Systems I: Ph.D. students participate in predetermined series of research seminars conducted by specialists in different advanced research topics in the fields of Computer

Systems. The student's evaluation is based on his/her understanding of the presented topics.

CSE 704 - Seminars on Advanced Topics in Computer Systems II: Series of research seminars conducted by Ph.D. students and based on self-learning and presentations of new advanced topics in Computer Systems selected by professors specialized in those topics. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

CSE 705 - Seminars on Advanced Topics in Computer Systems III: Series of research seminars conducted by Ph.D. students and based on presentations of recent Journals papers in advanced research topics in Computer Systems related to students' thesis themes. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

CSE 706 - Seminars on Advanced Topics in Software Systems I : Ph.D. students participate in predetermined series of research seminars conducted by specialists in different advanced research topics in the fields of Software Systems. The student's evaluation is based on his/her understanding of the presented topics.

CSE 707 - Seminars on Advanced Topics in Software Systems II: Series of research seminars conducted by Ph.D. students and based on self-learning and presentations of new advanced topics in Software Systems selected by professors specialized in those topics. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

CSE 708 - Seminars on Advanced Topics in Software Systems III: Series of research seminars conducted by Ph.D. students and based on presentations of recent Journals papers in advanced research topics in Software Systems related to students' thesis themes. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

Prequalifying Courses:

CSE450 Digital System Fundamentals: Number systems & coding, Boolean algebra and gate circuits. combinatorial circuits design, function minimization: tabular method, Karnaugh maps. MSI and LSI logic design (Decoder, Multiplexer, ROM), arithmetic -logic unit, flip-flops, synchronous and asynchronous counters using T or JK flip-flops, memory element, Input/ Output devices. Sequential logic circuits.

CSE 451 Microprocessors: Microprocessor architecture and bus concept. Microprocessor families. Addressing modes. Representation of data. Instruction sets. Assembly language programming. Memory and input/output mapping. Interfacing microprocessors to memory and I/O devices. Specialized controller chips for interrupts, DMA, arithmetic processing, graphics and communications are discussed. DSP theories and concepts, digital spectra analysis, DFT, Sampling Transforms, Digital Filters.

CSE 452 Computer Architectures: Principles, techniques, and trade-offs used in designing modern processor architectures. Topics include: benchmarking and performance evaluation, long-latency instruction pipelining, hardware and software techniques for exploiting instruction-level parallelism (out-of-order, speculative, and predicated instruction execution; multithreading; loop unrolling, software pipelining, and trace scheduling), high performance memory systems, and multiprocessor systems and programming. Modeling and Simulation of Digital Circuits.

CSE 453 Computer Networks: The OSI model, data link layer, frame format: character stuffing, bit stuffing, error control, automatic-repeat request and sliding, window protocols, data-link protocols: HDLC, BSC, PPP, the MAC sub-layer, local area networks: Ethernet, token ring and FDDI, wireless LANs, circuit switching versus packet switching, routing algorithms. Performance evaluation

CSE 454 Embedded Systems: Overview of embedded systems: architecture, custom single purpose processors. Peripherals: Digital I/O,ADC, DAC, timers, counters, watchdog timers, interrupts, PWM, real time

clocks, Serial protocols, interfacing, programming, interrupt driven routines, Applications.

CSE 455 - Optimization: This course introduces modern numerical methods for solving constrained and unconstrained linear and nonlinear optimization problems in finite dimensions. It covers the design of computational algorithms and the analysis of their properties.

3- MECHATRONICS AND ROBOTICS ENGINEERING

MTR 501- Robots Kinematics, Dynamics and Control: Basics of robotics. Analysis and design of robotic systems including arms and vehicles. Kinematics, Inverse Kinematics, and Dynamics of robots. Trajectory planning, motion control and force control of robot. Visual servo. Case studies applied on SCARA manipulator.

MTR 502- Advanced Mechatronics Systems Design: Introduction to Mechatronics Design: Mechatronics Design philosophy. Mechatronics Design Versus Traditional Design. Concurrent Design philosophy. Modeling and simulation of Mechatronics Systems: Modeling Approaches of Mechatronics Systems. Simulation Software of Mechatronics Systems (20Sim, MATLAB, LabView). Introduction to Intelligent systems in Mechatronics: Intelligent Controllers, Intelligent Sensors, and Intelligent Actuators. Control and its role in Mechatronics. The case studies will be presented and students will be asked to design and build a Mechatronics product applying simulation software packages (20Sim, MATLAB- SIMULINK, LabView) through contests between students team work groups.

MTR 503 - Advanced Control Systems: Stability of linear control systems. PID controller design and tuning. State space modeling. Controllability and Observability. State feedback controller and observer design. Linear Quadratic Regulator (LQR). Least squares system identification. Introduction to nonlinear systems. The Describing function method. The Phase plane method. Introduction to Lyapunov stability theory, Variable structure control systems and sliding modes. Case studies applied to Inverted Pendulum and Magnetic levitation using Matlab and Labview.

MTR 504 - Microfabrication of Microelectromechanical Systems/ Microsystems: Fabrication technologies for MEMS (surface, bulk micromachining, and LIGA). MEMS Material. structural mechanics. Basic sensing and actuation principles. MEMS packaging, assembly and testing. MEMS markets and applications.

MTR 505 - **Mobile Robots and Vision Systems**: (Prerequisite: MTR 501) Introduction to Mobile Robots, Kinematic models, Trajectory planning, Navigation Techniques, Simultaneous Localization and Mapping, Behavior Based control structure. Structure of vision systems, Hardware and Software. Camera design, Image formation, Basic Image processing, Stereo Vision, 3D reconstruction methods.

MTR 506- Advanced Topics in Mechanical Systems Design: Kinematic models of Mechanical Systems, Modeling of Mechanical Systems. Bearings, Magnetic Bearing, Friction and its modeling, Power transmission, Parallel Mechanisms, Case studies using ADAMS software.

MTR 601- Intelligent Control Systems: Fuzzy control systems, PID + Fuzzy control, Learning and Neural network. Adaptive Neuro-Fuzzy inference system ANFIS. Genetic and evolutionary algorithms for optimization, Case studies for application of intelligent approaches on control systems design.

MTR 602- Advanced Robotics: (Prerequisite: MTR 502) Static force and compliance, robot dynamics redundancy, trajectory planning, robot control, robot sensing. Sensing systems for grippers including tactile and force sensing. Environmental perception applying sensors and computer vision.

MTR 603- Advanced Bio-Engineering Systems: Bioprocess engineering, Computational biosystems, Cell and tissue engineering, Nanobiotechnology and biomaterials, Biomedical devices and technologies, Drug development practices and neuroscience.

MTR 604- Bio-Mechatronics Systems: Introduction to Biomechatronics, Bio Interfaces for diagnostics and control. Active and passive prosthetic limbs and joints. Bio electrical signal processing. Haptic Devices. Robot-based surgery. Medical Imaging. Rehabilitation and assistive devices.

MTR 605- Smart Sensors and Actuators: Classification of smart materials: electrostrictive, piezoelectric ceramics, shape memory alloys. Magnetostrictive materials, and electrorheological fluids. Characteristics of smart sensors and actuators. The applied driving forces: electrical, thermal, and magnetic fields – Working principles of the different smart materials.

MTR 606- Design of Micro- Electromechanical Systems/ Microsystems:

(Prerequisite: MTR 504) MEMS Initial design considerations. Fabrication process design. Mechanical design, including using the finite element method. Design of microfluidic network systems with a case study. Computer-aided design in MEMS and Microsystems. Introduction to CoventorWare for micro device design, fabrication and analysis.

MTR 607- Learning Algorithms and Neural Networks: Introduction to Neural Networks, artificial and human neurons, an engineering approach, a simple network layers, perceptrons, the learning process, transfer functions, teaching process, back propagation algorithm for training, recurrent networks, associative memory, applications to speech, vision and control problems. Supervised and unsupervised networks, reinforcement learning.

MTR 701- Laboratory Based Learning in Mechatronics: Students will attend laboratory to do a set predefined experiments to expose him to many devices that will be met during his research work.

MTR 702- Project Based Learning in Mechatronics: Students will be grouped into teams to solve real world projects to solve open ended problems, carefully selected, in which they design the system, implement it and evaluate the performance.

MTR 703- Seminar on Advanced Mechatronics and Robotics: Students will attend lectures given by distinguished professors and study in depth new published papers.

MTR 704- Seminar on Mechatronics and Robotics Recent Topics: Students will read recent papers and present and discuss with faculty and colleagues the recent topics.

MTR 705- Seminar on Advanced Mechatronics and Robotics Research Progress: Students will present their research progress and have discussions with faculty and colleagues about their problems and findings.

M.Sc. Prequalifying Courses:

ECE 202- Electronic Circuits (1): Introduction to semiconductor physics, junction diodes: construction, I-V characteristics, circuit models, applications, special purpose diodes: Zener diodes, light-emitting diodes (LED), photo detectors (PD), Bipolar junction transistors (BJT) and field effect transistors (FET): types, physical structures, basic configurations, characteristic curves, circuit models, biasing circuits, small-signal amplifiers, computer aided analysis using SPICE.

MTR 204- Mechanical Engineering Design Elements: Design synthesis, fundamental principles of standard design elements, mechanical elements, formal mechanical design drawing requirements, component specification and optimization.

MTR 309- Measurements and Instrumentations: Introduction and generalized measuring system , Practical examples to emphasize the importance of measurements, Static sensitivity, accuracy and precision and linearity. Static characteristics , Dynamic Characteristics , Error analysis , probable error and uncertainties. Temperature transducers, Measuring circuits for temperature measurements, Pressure transducers, Measuring circuits for pressure measurements, Level transducers, Flow transducers(orifice meter , ultrasonic flow meters, electromagnetic flow meter). Strain measurements, Load cells, force and torque measurements.

MTR 401- Automatic Control (2): State space representation of MIMO control systems – Introduction to optimal control – controllability and observability - pole placement applying state variable feedback – state observer design. Design of feedback control systems applying MATLB. Introduction to digital control systems: Signal processing – Z- transform - Design of digital control systems - Controllability testing – Design of digital control systems using root locus method. Design of digital PID Controller – Design of digital control systems applying state Variable Feedback. Case studies applying MATLAB.

MTR 403- Mechatronics Laboratory: Dynamic response of position control Servosystems, Digital control of Inverted pendulum system, Digital control of a Magnetic Levitation system, Interfacing microprocessor to a stepper motor - position control of DC motor – Microcontroller position control of a 2-axis manipulator – Computer Numerically Controlled machine (CNC) – Motion programming of a 5-axis robot., Application of robots in pick and place operation and in assembly tasks. Conveyors control applying PLC.

CSE 409- Embedded Systems: Overview of embedded systems: architecture, custom single purpose processors. Peripherals: Digital I/O,ADC, DAC, timers, counters, watchdog timers, interrupts, PWM, real time clocks, Serial protocols, interfacing, programming, interrupt driven routines, Applications.

4- INDUSTRIAL ENGINEERING AND SYSTEMS MANAGEMENT

IEM 501 – Global IE 1: Selected Topics in contemporary industrial engineering and systems management.

IEM 511 – Ergonomics and Human Factors Engineering: Fundamentals of ergonomics and human factors engineering – Occupational bio-mechanics – anthropometry – Work physiology – Human machine interaction.

IEM 512 – Operations Management: Forecasting – Product and service design – Capacity planning – Process selection – Layout and location – Supply chain management –Inventory management – Aggregate planning – Materials requirement planning – Enterprise resource planning – Operations scheduling – Introduction to service operations management.

IEM 513 – Operations and Management in the Process Industry: Introduction to process industry – Plant life cycle – Process planning and design – Production management – Plant maintenance – Safety management – Environmental aspects.

IEM 521 – Project Planning and Management: Fundamentals of Project Management – Project planning – Activity networks – Computer systems and programs applied – Resource consideration in project planning networks – Project cost management – Project risk management – Project execution and control.

IEM 522 – Strategic Planning and Management: Historical development of strategic management – Developing business strategy – Successful organizational performance: vision- mission – objectives – competitiveness – Sustaining competitive Advantage – Corporate strategy.

IEM 523 – Organizational Theory and Behavior: Individual behavior – interpersonal behavior – organizational behavior – groups and teams – Organizing and designing organizations – Organizational Change

IEM 524 – Technology and Innovation Management: Integrating technology and strategy – design of strategy – development of innovative capabilities – innovation challenges.

IEM 525 – Accounting: Accounting Cycle – Financial Statements – Accounting Systems – Cash – Receivables – Fixed Assets – Current Liability – Allocation of cost – The balanced scorecard.

IEM 526 – Marketing: Marketing concepts and principles – Margins and profits- product and portfolio management – Pricing strategy – Promotions – Marketing and finance – Distribution strategy.

IEM 531 – Operations Research I: Linear Programming – Linear programming formulations – cases of linear programming- solution procedures - post optimality analysis – Integer Programming - non linear programming – Goal Programming.

IEM 532 – Applied Simulation Modeling and Analysis: Review of basic probability and statistics – basic simulation modeling – modeling complex systems -simulation software – building simulation models – selecting inputs distributions – output data analysis

IEM 533 – Applied Multivariable Data Analysis: Regression – Linear models and experimental design – Simple and multiple linear regression – single- and multi-factor studies – Analysis of variance – Analysis of covariance – Model selection – Diagnostics – Data analysis using statistical software.

IEM 534 – Soft Computing: Heuristics and meta-heuristics – Evolutionary algorithms – Fuzzy systems – simulated annealing – Genetic algorithms – Neural networks – Artificial neural networks – Tabu and scatter search – Ant colony optimization – Particle swarm optimization.

IEM 535 – Management Information Systems. Information systems in management – Competing with information technology – Computer hardware and software – Telecommunications and networking – e-Business systems – Enterprise business systems – e-commerce systems – Developing business

and implementing business systems – Security, ethics and globalization challenges.

IEM 541 – Manufacturing Systems Engineering: Concepts of manufacturing systems engineering – Manufacturing strategy – Plant and facilities layout – Lean manufacturing and supply chain management – CAD/CAM – Operation and control of manufacturing.

IEM 542 – Computer Aided Engineering (CAE) Methods: Application of computer hardware and software to the design of products and systems – geometric modeling – engineering computational methods – overview of engineering analysis software which includes finite element analysis – manufacturing simulation – solid modeling.

IEM 543 – Advanced Manufacturing Processes: Unconventional Machining Process overview – Water Jet Machining – Ultrasonic Machining – Electro Discharge Machining – Chemical Machining, Electro-chemical Machining – Laser Beam Machining – Plasma Arc Machining and Electron Beam Machining.

IEM 544 – Rapid Prototyping and Product Development: Introduction to Rapid Prototyping Processes – Selection of Solid Freeform Fabrication (SFF) – Applications of SFF Technologies – CAD Requirements in RP- Materials for Rapid Prototyping – Rapid Tooling Techniques – Reverse Engineering – Rapid Manufacture.

IEM 551 – Systems Engineering and Analysis: Introduction to System Engineering – The System Engineering Process – System Design Requirements – Engineering Design Methods and Tools – Design Review and Evaluation – System Engineering Program Planning – Organization for System Engineering – System Engineering Program Evaluation.

IEM 552 – Systems Thinking: Concepts and Definitions – Systems and Models – Concept of Structure – Business dynamics – Social network analysis – Continuous and Discrete state space representation – State machine and formal language – Turing machine – Goal-seeking systems representation

IEM 553 – Modern Trends in Quality Management: Concept and principle of TQM – Quality management standards – Quality assurance concept – Quality improvement concept – Project approach and problem solving – Benchmarking – Quality function deployment – Quality costing – Quality improvement implementation process.

IEM 554 – Business Process Management: Business Process Analysis and Design – Technology Support for Business Processes – Workflows and Business Process Management Systems – Managing Processes Metrics and Dashboards – Process Innovation – Governing BPM Efforts – Process Management Maturity.

IEM 555 – Introduction and Applications of Petri Nets: Introduction to Petri Nets – Condition/Event Petri nets – Place/Transition (P/T) Petri Nets, analysis problems – Analysis of P/T Petri nets by reachability tree – Invariants of P/T Petri nets – Petri nets languages. Marked graphs and Free choices Petri nets, Petri nets with inhibitors – Coloured Petri nets (CPN), CPN Design, applications – Analysis of Coloured Petri nets – Hierarchical Coloured Petri nets and Object oriented Petri nets – Petri Nets software packages.

IEM 601 – Global IE 2: Selected Topics in contemporary industrial engineering and systems management.

IEM 611 – Supply Chain Network Design and Logistics: Understanding the supply chain – designing the supply chain network – planning demand and supply in a supply chain – Planning and managing inventories in a supply chain – Designing and Planning transportation networks.

IEM 612 – Human Computer Interaction: Study of the relationship between man and his environment – Design techniques of a specific environment – Ergonomics and interface design – Cognitive engineering – Perception and representation – Knowledge and mental models – Interface metaphors – Social and organizational aspects – Input, output and interaction -

IEM 613 – Contemporary Methods in Quality Design and Control: Selected topics related to the latest methods used in quality design and control.

IEM 614 – Integrated Production Control Systems: Systems engineering as a methodology for systems design – Technical elements of systems engineering – The Manufacturing System – Introduction to Design and Location Product/Process Modeling for System Design/planning – Flow Improving Strategies – Material Handling and Storage Systems – Equipment Location Strategies – Production Planning &Control, and Information Decision Systems – Shop Floor Management Systems- Inventory Management and Supply Chains – Advanced Topics in Production Systems Design and Control

IEM 615 – Reliability and Maintainability Engineering: Reliability Engineering – Maintainability engineering – Reliability and Safety – Failure types and analysis – Maintenance types and objectives – Statistical analysis of maintenance data.

IEM 621 – Innovation Theory: Nature of Creativity: Person, Process, Product and Environment – Nature of Innovation: Making the Idea a Reality – Need for Creativity and Innovation in Organizations – Assessing self Creativity and Ability to Innovate – Enhancing self Creative and Innovative Abilities – Entrepreneurial Tools for Creativity and Innovation — Exploring the Intersection – Observation Lab – Developing and Contributing to a Creative-Innovation Team – Managing for Creativity and Innovation – Evolving a Culture of Creativity and Innovation in Organizations.

IEM 622 – Knowledge Management: Managing Knowledge – Methods and tools for knowledge management – managing and measuring intellectual capital – management of innovation and technology – business intelligence – Information sources – KM blue prints – maintaining the system – resources and tools.

IEM 623 – Financial Engineering: Products and markets – Cash flow – credits – Financial engineering – Simple interest rates derivatives – Swap engineering – Options Engineering – Risk – market environment.

IEM 624 – International Business: Introduction -The future and challenge of globalization – Globalization and economic development – Economic, legal, and political system – Culture – Ethics and International Business – Trade

between countries – Firms and international trade – Governments and the regulation of international trade – Foreign direct investment – Regional trade blocks – Bilateral agreements – Currency markets and FX rates – The international monetary system – international monetary system and the reform – Firm strategy in international business – Foreign market entry modes – Coordination and control: the challenges of international growth.

IEM 631 – Operations Research II: Combinatorial problems - Optimization algorithms and heuristics - Continuous and discrete optimization domains with emphasis on NP complete combinatorial problems - Game theory.

IEM 632 – Applied Multivariate Data Analysis: Introduction to multivariate analysis methods – Principal components analysis (PCA) – Factor analysis (FA) – Canonical correlation analysis (CCA) – Multivariate classification techniques – Discriminant analysis – Cluster Analysis.

IEM 633 – Information Technology and Management: Computer Applications in Business – Business Information Systems & Technologies – Business Application Development – Operations & Business Process Management – Systems Analysis and Design – Communications, Networking, and Security – Business Application Implementation – Enterprise Application Development and Management.

IEM 641 – Advanced Biomechanics: Mechanical properties of human bones – Tissue and joint mechanics and their applications – Electric and electromechanical properties – Teeth and connective tissues – Biomechanical job analysis – Electromyography techniques in the analysis of worker fatigue and injury – Strength testing for worker evaluation and placement – Applications of biomechanics.

IEM 642 – Composites Engineering: Mechanical and physical behavior of composites – Influence of geometry to materials properties – Functions of composites relating to applications in electronic packaging – Thermal management – Smart structures – Design and analysis of composite structures – Machining of composite materials – Performance testing,

characterization and quality control of composites – New types of composite materials as well as the recent development trends.

IEM 643 – Tool Engineering: General considerations in Tool Design – Tool material and tool making practices – Design of Metal cutting tools – Single and multiple point tools form tools – Design of press working tools for shearing, bending, forming and drawing operations – Design of drill jigs and fixture for Milling, Broaching, Grinding and Turning Operation – Design of tools for joining processes – Tooling for castings – Using plastics as tool materials – Tool design for numerical control machine tools

IEM 644 – Advanced Rapid Prototyping Applications: Rapid prototyping applications and technologies – Rapid tooling – reverse Engineering using RP – case studies.

IEM 651 – Systems Theory: Definition of a system – Systemic properties – Basic problems in systems theory – Decomposition of a system – Checkland methodology – Network systems.

IEM 652 – Service Systems Engineering: Process Analysis – Service Productivity – Work Measurement – Service Facility Layout – Service Facility Location – Forecasting – Managing Waiting Lines – Simulation – Capacity Planning – Service Supply Relationships – Vehicle Routing – Inventory Management – Aggregate Planning – Service Scheduling.

IEM 653 – Service Operations and Customers relationship Management: Introduction to service operations – Service operations principles – Service Operations processes – Common Service Operations Activities – Organizing Service Operations – Technology Considerations – Implementation Considerations – Challenges and Critical Success Factors and Risks – Overview of Customer Relationship Management (CRM) – Developing a Customer Strategy – Customer Lifecycle Management and Lifetime Value – CRM Technology – Operational CRM – Analytical CRM – Collaborative CRM – CRM Project Management – Building a Business Case for CRM.

IEM 654 – Information Technology Services and e-Business Management : Electronic Services – electronic business – electronic

government – Introduction to Strategic e-Business – e-Business Corporate Strategy – e-Business Business Strategy – Strategic E-Business Challenges, Strategic e-Business Applications, e-Business Architecture – e-Supply Chain Management – Building an e-Business – Trends in mobile commerce.

IEM 701 – Seminar - Current Trends in Industrial Engineering and Systems Management

IEM 702 – Seminar - selected readings in Industrial Engineering and Systems Management

IEM 703 – Seminar - selected topics in Industrial Engineering and Systems Management

IEM 801 – M.Sc. Thesis

IEM 802 – Ph.D. Thesis

MTH 501 – Advanced Mathematics and Statistics I : Selected topics in mathematics and statistics.

MTH 601 – Advanced Mathematics and Statistics II : Selected topics in advanced mathematics and statistics.

M.Sc. Prequalifying Courses:

The prequalifying courses can be selected from the list below according to the recommendation of the academic advisor and department council. Each course weights 3 credit hours.

IEM 450 Introduction to Industrial Engineering

Fundamentals of Industrial Engineering; concepts, analysis, and design - Simple operations research applications - systems analysis - types of industries and types of manufacturing processes - human factors - facility design - supply chain and value chains operations - quality management - operations operation.

IEM 451 Engineering Economics

Principles of Economy - Economical Analysis - Time value of money – Interest rates Comparison between alternatives- Depreciation –Taxes – Inflation- Introduction to Engineering cost analysis and budgeting.

IEM 452 Operations Research (1)

Introduction to operations research – linear programming – graphical methods – analytical methods – application of linear programming – transportation – transshipment - assignment – goal programming – introduction to queuing theory.

IEM 453 Facilities design and Material Handling

Facilities design cycle – sources of information for the facility design - process design – schedule design – Flow analysis – work station design – Auxiliary services - Employees services – material handling – layout – location problem – selling the layout.

IEM 454 Operations Management

Overview of Production and Operations Strategy – Forecasting- Aggregate Planning - Inventory Control - Materials Requirements Planning - Supply Chain Modeling –Scheduling - Line balancing - Recent Advances.

5- MATERIALS SCIENCES AND ENGINEERING

MSE 501 - Chemical Change and Materials Properties: This is an introductory module designed to bring students from different background to a common understanding of materials science, its terminology and concepts. In addition, this course takes students through different topics which will be discussed through the master core courses and shows them how it is related and derived from the basic science and engineering concepts they have encountered in their first degree. The course includes chemical, physical, mechanical, electrical and magnetic properties of materials.

MSE 502 - Phase Equilibrium and Transformation: The aim of this course is to present a general view on the phase transformation and the growth theory of metals and alloys. The applications of this theory in the field of steel and its alloys and effect of heat treatment on the properties will be applied

MSE 503 - Crystallography and Diffraction: The aim of this course is to study the relation between crystalline materials and their modern applications. Moreover, knowledge of crystallography opens the door to a better and clearer understanding of so many other topics in physics and chemistry, earth, materials and textile science, and microscopy. The subject of diffraction flows naturally from that of crystallography because by its means are the structures of materials revealed. Hence, in discussing diffraction, the common aspects of the phenomena with respect to light, X-rays and electrons will be emphasized.

MSE504 - Defects and Microscopic Studies: The goal of this course is to provide the students with the differences between perfect and imperfect solids and the different types of imperfections such as point, line and surface defects in crystalline solids. The basic concepts of microscopic characterization using Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM), Atomic Force Microscopy (AFM) and Scanning Tunneling Microscope (STM) will be given. This course will provide an understanding and mathematical description of microscopic defects in crystalline solids. Certain concepts for understanding the behavior of engineering materials by emphasizing important relationships between the internal structure and properties will be carried out.

MSE 505 - Electronic and Photonic Properties of Materials: This course aims at presenting the fundamentals of electronic and optical properties of metals, semiconductors, and insulators. The concept of the band structure.Electronic and lattice conductivity. Type I and Type II superconductivity. Optical engineering using photonic band gap crystals in one-, two-, and three-dimensions

MSE 506 - Polymers Engineering: The aim of this course is to present polymer processing techniques, plastic technology, design considerations and commercial considerations. In addition, the processing of polymer blend and composite will be introduced

MSE 507 - Refractory Materials: This course aims at conveying the theoretical structure of raw refractories into final products through both heat

and chemical treatments. It describes the application procedure of a raw material into final refractory products.

MSE 508 - Advanced Deformation processes - This course presents the consistent phenomena demonstrated in deformation processing of metals, ceramics, and polymers. The development of laminated or "sandwiched" structures consisting of polymers and metals, mechanically-assisted high temperature powder densification, and predictive models for crystallographic texture effects during hot working are but a few of the many examples wherein deformation processing can overlap the boundary between the traditionally distinct topics of metal forming and fluid flow. Topics include: crystal plasticity, viscous flow (Newtonian and non-Newtonian), microstructural origins of deformation behavior, isotropic and anisotropic yield criteria, upper bound analysis, an introduction to slip line fields, dislocation theory, rolling, drawing, extrusion, tape casting, superplastic forming, roll bonding, texture development, and assessment.

MSE 509 - Recycling and Processing of Engineering Materials:

The use of recyclable materials has been continuously rising worldwide due to the economic and technological developments. Without recycling these materials, they will get degraded or corroded, and then completely destroyed by the nature, which will be a waste of resources and huge environmental damage. In order to increase the academic and public attentions to recycling this course is designed. The lectures focus on basic characterization and separation techniques of recyclable materials, recycled products, environmental concerns, as well as potential commercial applications. Throughout the lectures, students are expected to gain an understanding of recycling concepts and processing techniques. In this course student is expected to acquire the following knowledge: Understand the fundamental principles for the characterization of recyclable materials, Apply modern analytical techniques, Apply fundamental principles to the separation of recyclable materials.

MSE 510 - Semiconductor technology: The aims of this course are to introduce the different techniques used to fabricate semiconductor materials

and devices. The student will be familiar with different characterization techniques used for semiconductor materials and devices.

MSE 601 - Surface science and corrosion: The objectives of this course are present fundamentals of corrosion, forms and mechanisms of corrosion, identification and analysis of corrosion problems, and methods for corrosion control.

MSE 602 - Composite materials and fiber science: The goal of this course is to present fiber, textile, and composite materials. The reinforcement of polymeric materials with different types of fiber fabrication techniques will be given.

MSE 603 - Building materials and ceramics: The objective of this course is to teach types of building materials, ceramic composite, chemical composition of cement and additives. In addition the physical and mechanical properties of building materials and creep will be given.

MSE 604 - Solid-state and thin-film reaction kinetics: The objectives of this course is introduce thin film deposition technology, thickness measurement and analytical techniques, nucleation and kinetic growth and structure of thin films.

MSE 605 - Nanomaterials and technology: The aim of this course is to depict applications of nanotechnology, novel physics and chemistry associated with the nanoscale, manufacturing techniques, characterization and nanoscale probes.

MSE 606 - Biomaterials: This course will cover biomaterials and biomimetic materials. Metal, ceramic, and polymer biomaterials will be discussed. Emphasis will be on the structure-property relationships, biocompatibility/degradation issues and tissue/material interactions. Synthesis and mechanical testing of biomimetic materials will also be discussed.

MSE 607 - Magnetic and Superconducting Materials: Magnetism is a familiar concept in our everyday lives and has been exploited for thousands of years. Superconducting materials are a distinct class of magnetic materials

whose industrial applications have rapidly developed since the 1960s. Consequently the study of materials that exhibit magnetic and superconducting properties is an important part of Materials Science. The development of an understanding of magnetism (and its relation to electricity) was a tour de force of 19th century physics. The study of magnetism is a staple component of physical science courses (and increasingly some biological subjects) at every level. As Material Scientists, however, our interest is primarily in how the properties of materials give rise to magnetic effects. The course will equip you to understand how the magnetic and superconducting properties of materials arise and how they can be control.

MSE 608 - Materials for Photovoltaic devices: Fundamentals of solar energy harvesting. Properties of sunlight, interaction of light with matter. Introduction to semiconductors for solar cell applications, fabrication routes and working principles. Theory of conventional pn junction and excitonic solar cells. Material issues and effect of nanostructures in silicon based, thin film, tandem, dye-sensitized and organic solar cells, including emerging solar cell concepts such as intermediate band and bio-inspired solar cells.

MSE 701 - Project Based Learning in Materials Development and Integration in Engineering Systems.

MSE 702 - Advanced Research Seminar on Materials Science and Engineering.

MSE 703 - Research Seminar on Recent Topics in Materials Science and Engineering.

MSE 704 - Research Seminar on Research Progress in Materials Science and Engineering.

MSE 801 - M.Sc. Thesis

MSE 802 - Ph.D. Thesis

M.Sc. Prequalifying Courses:

MSE 450- Materials Properties and Testing: This course will cover the topics: Engineering materials (general properties, testing and specifications),

Mechanical behaviour (stress-strain diagram), Causes and types of failure (i.e. fatigue, creep, buckling, etc.), Statistical evaluation and data presentation, properties of bricks and plastics. Specifications and standard specifications of engineering materials and products, testing machines and its calibration, Strain gages. Main properties of engineering materials (physical, chemical, mechanical, etc).

MSE 451- Composite Materials: This lecture course will contributes primarily to the students' knowledge of engineering topics including overview of composites & types of composite system, elastic constants of long fiber composites, short fiber and particulate composites, the fiber-matrix interface, strength of composites, toughness of composites, compressive loading of fiber composites, thermal expansion of composites and thermal residual stresses, surface coatings as composite systems, and cellulosic and biological composite systems.

MSE 452 - Principle of Plastic Deformation: This lecture course will cover: Fundamentals of plasticity theory including elastic, viscoelastic, and elastic-plastic constitutive models: plastic deformation on the macroscopic and microscopic levels; stress-strain relations in the plastic regime; strain hardening; limit analysis; numerical procedures.

MSE 453 - Introduction to Crystallography: This course is aiming at giving concise explanation of the logical development of basic crystallographic concepts. Extensive discussion of crystals and lattices, symmetry, crystal systems and geometry, x-ray diffraction, determination of atomic positions, and more.

6- ENERGY RESOURCES AND ENVIRONMENTAL ENGINEERING

ERE 501- Energy Resources and Engineering: Overview of Energy Resources (Fossil fuel: oil, gas, coal, nuclear (fission, fusion). Renewables: wind, wave, tidal, solar, geothermal and hydropower. Principles of energy production.

Energy Usage (Egypt energy usage.Energy use in Egypt and current infrastructure to meet the demand).Electricity Generation (Conventional methods of generation - oil, gas, coal, nuclear.Historical, current and future practice.Environmental and financial aspects of traditional technologies).Environmental impact and Public perception.Solar Energy Resource issues. Photovoltaic technologies: grid connected and standalone systems. Practical demonstration of PV and CPV systems.Solar Thermal Power Generation Technology and Applications. Geothermal Energy

ERE 502- Advanced Topics on Water Resources and Environmental Engineering: Computer simulation technology and advanced monitoring technology. Advanced theories and contemporary issues in society. Advanced Technology for Water Resources Planning-Water Resources Management and Irrigation- Aquatic Chemistry for Water Treatment-Integrated Watershed and Coastal Zone Management. Theory and application of biological processes.Engineered treatment of waste streams.Municipal and industrial wastewaters and biosolids. Foundational principles to treatment processes, including bioreactor configurations and design considerations. Aspect of Environmental science.Air pollution control technology- Energy and air pollution.Fundamentals of fossil fuel combustion and related air pollution.Post-combustion air pollution control.Industrial air pollution control.Control of particulate matter. Control of VOC's, Sox, and NOx.

ERE503- Atmospheric Chemistry: Measures of atmospheric composition, Atmospheric pressure, Simple models, Atmospheric transport, Geochemical cycles, Chemical forcing of climate, Stratospheric chemistry, Tropospheric chemistry, Ozone pollution, Acid rain, Aerosols, photophysics with dynamics and relaxation of molecules.

ERE 504- Solar Energy: The course includes passive solar heating in buildings as well as designing PV and hybrid systems. In essence understanding the energy use and thermal energy balance of different types of buildings and the potential for energy savings. Other topics are passive solar techniques for both heating and cooling and the roll of building design and orientation, day-lighting, natural ventilation, and the integration of active elements for both thermal and photovoltaic applications. Combined heat and power generation from the sun is also studied, including different types of systems and general design concepts, and economic analysis of the systems.

ERE 505-Fuels and Processes: Sources, Extraction, separation and treatment. Transportation of petroleum, Natural Gas pipelines and underground storage. Basic principles of liquefaction, Liquefaction of Natural gas LNG.

ERE 506- Industrial Ecology: Sustainable combination of environment, economy and technology. Analysis of material and energy flow in industrial systems to enhance eco-efficiency and sustainability. Methods: life cycle assessment, quantifies energy, waste, emissions (greenhouse gases) for materials production, manufacturing, product use, recovery. Life cycle designs integrate environmental, performance, economic, and regulatory objectives.

ERE 507- Transport Phenomena: Introduction to transport phenomena, Molecular transport mechanisms, heat transfer, mass transfer, momentum transfer. The general property balance; the three dimensional balance equations. Molecular transport and the general property balance. Transport with a net convective flux. Unsteady state transport.Boundary layer theory.

ERE 508- Introduction to Computational Fluid Dynamics: Classification of partial differential equations - Emphasis on finite-volume and finite-difference techniques for numerical solution of elliptic, parabolic and hyperbolic partial differential equations - Stability analysis - Applications to heat transfer, and internal and external flow problems.

ERE 509 - Thermal Hydraulics in Power Technology: Emphasis on thermo-fluid dynamic phenomena and analysis methods for conventional and nuclear

power stations. Kinematics and dynamics of two-phase flows.Steam separation.Boiling, instabilities, and critical conditions.Single-channel transient analysis. Loop analysis including single and two-phase natural circulation. Sub-channel analysis.

ERE 510- Electrochemical Energy Conversion and Storage: Fundamental concepts, tools, and applications in electrochemical science and engineering. Introduces thermodynamics, kinetics and transport of electrochemical reactions. Describes how materials structure and properties affect electrochemical behavior of particular applications, for instance in lithium rechargeable batteries, electrochemical capacitors, fuel cells, photo electrochemical cells, and electrolytic cells. Discusses state-of-the-art electrochemical energy technologies for portable electronic devices, hybrid and plug-in vehicles, electrical vehicles.Theoretical and experimental exploration of electrochemical measurement techniques in cell testing, and in bulk and interfacial transport measurements (electronic and ionic resistivity and charge transfer cross the electrode-electrolyte interface).

ERE 511- Thermal and Cogeneration Systems: Thermal and energy systems, heat exchangers, co-generation, etc. Second law of thermodynamics and concept of entropy generation and thermo-economics. Environmental issues and pollution control. Renewable energy system. Cogeneration design, heat exchanger design, energy storage systems. Optimization process

ERE512- Climate Change: An introduction to the Earth's climate system and climatic zones as basis for human activity and settlements - An introduction to climate science looking at historical and recent observations, climate modeling and climate change predictions - An introduction to energy systems in buildings and on community scale looking at principles, function and applications.

The assessment of global and regional climate change implications and associated mitigation / adaptation strategies.

ERE513- Water Quality and Environmental Analysis: Introduction to measurement systems, fate of contaminants, solute and particle transport on

multiple scales. Introduction to water quality, effluent, chemical elements, salinity. Physical, chemical and biological treatment processes for drinking, industrial and wastewater

ERE514- Biological Processes For Wastewater Treatment: Specialized biological wastewater treatment processes for removal of impurities not effectively removed by conventional secondary wastewater treatment systems, such as nutrients (e.g. nitrogen and phosphorus), residual organics, residual solids, bacteria and viruses. Wetlands. Activated sludge modeling. Biological nutrient removal. Sludge management. Disinfection

ERE515- Fires and Explosion: This course covers the safety aspects of combustion including ignition, flammability, safe design practice, oscillating combustion, combustion noise.

ERE516- Oil and Gas Utilization: The current and future technology for the oil and gas industry. Hydrogen and the fuel cell provide the focus for the first part of the course. The technologies available to move towards a “hydrogen economy” are examined as are the different types of fuel cell technology. The origins of oil and gas exploration and production Burner and combustion calculations.

ERE 517- Arid Land Hydrology and Water Management: Fundamentals of surface hydrology, the hydrologic cycle, hydrologic processes, and water management with an emphasis on arid lands

ERE518- Groundwater Hydrology: Groundwater hydrology, subsurface flow, geological considerations, aquifers and wells

ERE 519- Advanced Hydraulics: Flow processes, unsteady flow. Introduction to Navier-Stokes equations, Introduction to numerical modeling, river routing models, sediment transport models, Reservoir routing models, groundwater flow, Erosion hydraulics.

ERE 520- Remote Sensing and GIS in Energy and Water Resources: Remote Sensing technique, GIS data and databases, GIS Operations and management, GIS in Water Resources, GIS in Energy Resources, Application

of remote sensing data and GIS models, Applications on different Energy and Water Resources projects.

ERE 521 Water Pollution Control Processes: Fundamentals of biochemical processes, aerobic growth in a single CSTR, multiple events in complex systems, and techniques for evaluating kinetic parameters; unit processes of activated sludge system, attached growth systems, stabilization and aerated lagoon systems, biosolids digestion and disposal, nutrient removal, and anaerobic treatment systems.

MTH 523Advanced Mathematics and Statistics I

ERE 601- Environmental Systems and Processes: An introduction to the analysis, characterization, and modeling of environmental processes; physical, chemical, discussion of economic and legislative constraints and requirements. Concepts of environmental systems and principles of related transport and transformation phenomena and processes; development of fundamental models for expression of relevant process dynamics; system and process scaling factors and methods; extension of process models to ideal and non-ideal natural and engineered homogeneous environmental systems.Waste minimization; pollution prevention; hazardous waste management; wastewater management; air pollution control; solid waste technologies; wetlands management, design and construction; groundwater contamination modeling;

ERE 602- Sustainable Energy Utilization: The Engine of Sustainable Development- Estimation and Evaluation of Energy Resources- Technical Performance: Allowability, Efficiency, Production Rates- Local, Regional, and Global Environmental Effects of Energy- Project Economic Evaluation- Energy Systems and Sustainability Metrics- Fossil Fuels and Fossil Energy- Nuclear Power- Renewable Energy in Context- Biomass Energy- Geothermal Energy- Hydropower- Solar Energy- Ocean Waves, Tide, and Thermal Energy Conversion- Wind Energy-Storage, Transportation, and Distribution of Energy- Electric Power Sector-Transportation Services- Industrial Energy Usage- Commercial and Residential Buildings- Synergistic Complex Systems- Choosing Among Options- Conversion Factors

ERE 603-Turbulence: Introduction to the topic of turbulence with special emphasis on physical processes; characterization of fundamental turbulent flows such as shear layers, wakes, jets, plumes, and thermals; effect of stratification on turbulence; forcing and control of turbulence by acceleration and pulsation. Tturbulence Models.Integral Methods of analysis (Rayleigh method- Buckingham method). Transport in ducts, heat and mass transfer in duct flow. Transport past immersed bodies. Analysis of submerged turbulent buoyant jets; scaling relations; consideration of ambient effects including density stratification, ambient currents; numerical models for buoyant jet mixing; hydraulics of two-layer stratified flow and control on mixing processes.

ERE 604 - Advanced Computational Fluid Dynamics: Introduction to the methods and analysis techniques used in computational solutions of fluid mechanics and heat transfer problems. Model problems are used to study the interaction of physical processes and numerical techniques. Contemporary methods for boundary layers, incompressible viscous flows, and inviscid compressible flows are studied. Finite differences and finite volume techniques are emphasized. Grid generation techniques are discussed.

ERE 605- Refrigeration and Indoor Environmental Control: Different refrigeration processes, refrigeration machinery and plant design are considered. New refrigerants, as well as advanced refrigeration processes are discussed. Optimizing insulation thickness and different mechanical components are analyzed. Design and optimization of heat pump plants with safety standards, are considered in detail. Mobile refrigeration and air conditioning systems, Absorption processes, low-temperature processes, and air separation processes are covered. In addition topics related to ventilation and heating are studied, in particular how they affect thermal comfort and air quality indoors, and how this, in turn, reflects on energy management in the built environment. Gaseous and particulate indoor air pollutants are discussed with regard to acceptable concentrations, health effects and existing regulations/standards.

ERE 606- Turbomachinery: The course aims at giving an overview of dedicated aspects in thermal turbomachinery. It will focus on applications in the energy sector (steam and gas turbines for power generation).Starting from

simple 1d analysis of turbomachine components the view is extended to 2D and 3D aspects. Dedicated aspects such as gas turbine cooling technology, mechanical integrity, materials and system behavior are elucidated and brought into context.

ERE 607- Energy Management: Importance of energy management. Energy auditing: methodology, analysis of past trends plant data), closing the energy balance, laws of thermodynamics, measurements, portable and on line instruments. - Energy economics - discount rate, payback period, internal rate of return, life cycle costing. Steam Systems: Boiler -efficiency testing, excess air control, Steam distribution, & use- steam traps, condensate recovery, flash steam utilization.Thermal Insulation. - Electrical Systems: Demand control, power factor correction, load scheduling/shifting, Motor drives- motor efficiency testing, energy efficient motors, motor speed control. - Lighting-lighting levels, efficient options, fixtures, daylighting, timers, Energy efficient windows. - Energy conservation in Pumps, Fans (flow control), Compressed Air Systems, Refrigeration & air conditioning systems. Waste heat recovery: recuperators, heat wheels, heat pipes, heat pumps. - Cogeneration - concept, options (steam/gas turbines/diesel engine based), selection criteria, control strategy. Heat exchanger networking- concept of pinch, target setting, problem table approach, composite curves. Demand side management. Financing energy conservation

ERE 608- Alternative Energy Systems: Energy demand forecasting, Depletion of traditional fuel, Review of renewable technologies. Solar Energy: Characteristics of solar radiation, Wind Power: Actuator disc theory, effect of wake rotation, blade element theory. Rotor types, vertical and horizontal machines. Power and drag coefficients. Rated power and load factor. OTEC: Ocean temperature difference, the open or Claude cycle, Modifications of the open OTEC cycle. Recent OTEC development.Wave Power: Wave structure and characteristics, Maximum energy recovered from waves, wave distribution, wave power devices and characteristics. Geothermal Energy: Types, operational and environmental problems. Vapor dominated and liquid dominated systems. Hybrid systems.

ERE 609- Transportation Systems Analysis: Introduces transportation systems analysis, stressing demand and economic aspects. Covers the key principles governing transportation planning, investment, operations and maintenance.Introduces the microeconomic concepts central to transportation systems. Topics covered include economic theories of the firm, the consumer and the market, demand models, discrete choice analysis, cost models and production functions, and pricing theory. Application to transportation systems include congestion pricing, technological change, resource allocation, market structure and regulation, and project evaluation; covering passenger and freight, aviation and intelligent transportation systems.

ERE 610- Advanced Topics in Fuel and Energy: The aim of this module is to introduce the fundamental aspects of combustion and fuel technology to the students. Topics covered in the course include Combustion chemistry & Thermodynamics, Burners, Flames and Flame properties, Solid, liquid and gaseous fuels, Boilers, District heating/CHP units, Atmospheric pollution, Renewable energy.

ERE 611- Earth Observation for the Environment: An introduction to environmental earth observation systems in particular to satellite platforms. New technique for fusing multi-dimensional datasets (i.e. multi-spectral, multi-temporal, multi-resolution, and point-source ground data in particular). Carbon sequestration modeling; advanced techniques for estimating biophysical variables that are integral parts in various environmental models; modeling of natural hazard; and modeling of climatic influence on forested and polar ecosystems, among others.

ERE 612- Seawater and Brackish Water Desalination: Theoretical and practical aspects of seawater/brackish water desalination technologies, including thermal-based (MSF, MED, VC) and membrane-based (RO, NF, ED/EDR) desalination processes; process design and system performance; fouling, scaling (including bio-fouling) and cleaning; product water quality and post-treatment

ERE 613- Hazardous Waste Management: Legal and technological approaches to control and management of hazardous wastes and

contaminated sites to protect human health and the environment: fate and transport of contaminants; physical, chemical and biological treatment; environmental monitoring systems; medical waste and treatment options; toxicology; storage tanks; landfills

ERE 614 Environmental Physical-Chemical Processes: Fundamental concepts of physical-chemical processes that affect water quality in natural and engineered environmental systems. Focus is on developing a qualitative understanding of mechanisms as well as quantitative tools to describe, predict, and control the behavior of physical-chemical processes. Topics include reactor hydraulics and reaction kinetics, gas transfer, adsorption, particle characteristics, flocculation, gravitational separations, filtration, membranes, and disinfection. Principles and design of physical-chemical unit processes; including screening, coagulation, flocculation, chemical precipitation, sedimentation, filtration, lime softening and stabilization, oxidation, adsorption, membrane processes, ion exchange and disinfection; recovery of resources from residuals and sludges; laboratory exercises and demonstrations; case studies in mineral processing and secondary industries. Advanced course on water chemistry- physical chemical principles and geochemical processes controlling the chemical composition of natural waters, soil- and sediment-water interactions. Emphasizes behavior of inorganic contaminants in natural waters, engineered systems, and dissolved natural organic matter.

ERE 615- Industrial Waste Treatment: Introduction to industrial waste treatment. Individual industries, emphasizing constituents of the waste-stream and how best to recycle, recover, or reduce wastes. Cost concerns and regulations. Field trips to various industries to gain first-hand knowledge of processes involved in treatment.

ERE 616- Advanced Irrigation and Drainage: Water for agriculture, Water demand, Water distribution systems, Design of irrigation systems, Advanced drainage systems, Unconventional system, groundwater exploitation, water re-use.

ERE 617- Integrated Water Resources Management: Management concepts in water, sustainable water development, rationale of IWRM, evolution of IWRM, Integrated water resources experiences (community, local, watershed, regional scales), Strategies to achieve IWRM, Water Law and Policy, Capacity and consensus building, Different case of study of IWRM, Evaluation of IWRM and future challenges.

MTH 618 Advanced Mathematics and Statistics II

ERE 701- Project Based Learning On Energy Systems:

ERE 702-Professional Practice Seminar

ERE 801 – M.Sc. Thesis

ERE 802 – Ph.D. Thesis

M.Sc. Prequalifying Courses:

EEE 301- Fluid Mechanics: Introduction and Basic Concepts- Properties of Fluids- Pressure and Fluid Statics- Fluid Kinematics- Bernoulli and Energy Equations- Momentum and Analysis of Flow Systems- Dimensional Analysis and Flow Systems- Flow in Pipes- Differential Analysis of Fluid Flow- Approximations of the Navier-Stokes Equation- Flow Over Bodies: Drag and Lift- Compressible Flow- Open-Channel Flow- Turbomachinery- Introduction to Computational Fluid Dynamics (CFD)

EEE 302- Heat and Mass Transfer: Introduction and Basic Concepts- Heat Conduction Equation- Steady Heat Conduction- Transient Heat Conduction- Numerical Methods in Heat Conduction- Fundamentals of Convection- External Forced Convection- Internal Forced Convection- Natural Convection- Boiling and Condensation- Heat Exchangers- Fundamentals of Thermal Radiation- Radiation Heat Transfer- Mass Transfer- Heating and Cooling of Buildings - Refrigeration and Freezing of Foods

EEE 303 Measurement and Instrumentation- Temperature transducers, Measuring circuits for temperature measurements, Pressure transducers, Measuring circuits for pressure measurements, Level transducers, Flow

transducers (orifice meter, venturimeter, ultrasonic flow meters, electromagnetic flow meter). Strain measurements, Gas analyzers, Weather data measurements, Solar radiation flux meters, direct and diffuse measurements, wind velocity meters, duct meters, Exhaust combustion analyzers. Error analysis, probable error and uncertainties

EEE 304- Thermodynamics: Introduction and Basic Concepts- Energy Conversion and General Energy Analysis- Properties of Pure Substances- Energy Analysis of Closed Systems- Mass and Energy Analysis of Control Volumes- The Second Law of Thermodynamics- Entropy- Energy: A Measure of Work Potential- Gas Power Cycles- Vapor and Combined Power Cycles- Refrigeration Cycles- Thermodynamic Property Relations- Gas Mixtures- Gas Vapor Mixtures and Air-Conditioning- Chemical Reactions- Chemical and Phase Equilibrium- Compressible Flow

EEE 201- Combustion and Air Pollution: Theory of combustion: Heat of reaction, flame temperature and combustion products. Chemical equilibrium and reaction kinetics. Structure of flames and flame transmitting. Explosion and detonation. Flammability limits, ignition and quenching : Flame trap and flame stabilization. Laminar and turbulent gaseous flames.Combustion of liquid and solid fuels.Pollutant formation in combustion.Reduction of emission by modification of combustion parameters.

7- CHEMICAL AND PETROCHEMICALS ENGINEERING

CPE 501- Transport Phenomena: Review of momentum transfer, macroscopic balance (Bernoulli Equation), momentum transport with two independent variables, non-newtonian flow, viscosity and elasticity, linear viscoelasticity, large deformation.

CPE 502- Advanced Unit Operations: Multicomponent diffusion, Stephan-Maxwell equation, extension to multicomponent distillation and adsorption, interphase transport in multi-component system, interphase energy transport, solidification (diffusion and cooling) Mullins-Sekka stability.

CPE 503-Modeling and Simulation of Chemical and Petrochemical Processes: The first part of this course will include revision and completion of the math required in the following topics: numerical methods, linear and nonlinear system analysis, finite element analysis, chaos, Markov chain, Monte Carlo with the use of the a selected software (Matlab, simulink, Berkeley Madonna, Comsol...). The second part will include the Modelling fundamentals in chemical and petrochemicals engineering and formulation of dynamic model with examples in the equations of state, steady and unsteady mass, energy and momentum balances, chemical kinetics, multistage modeling. Project: The student(s) to select a chemical process, and present a model that simulate the process with the aid of computer software with a certain level of complexity that is chosen by the instructor.

CPE 504-Advanced Electrochemistry: Revision on the principles of electrochemistry and application of electrochemical equilibrium, kinetics, and transport processes, technical electrolysis; organic and inorganic synthesis, electrochemical energy conversion, application of electrochemistry in corrosion protection in chemical and petrochemical plants.

CPE 505- Advanced Separation Technologies: Separation processes used for the preparation of raw materials for processing, purification of products and protection of the environment. The course includes examples of the different technologies used in industries as well as the new technologies that are appearing in industries, e.g. adsorption, chromatography, ion exchange,

multicomponent distillation systems, micro-filtration, ultra-filtration, membrane separations, gas separations, oil/water separations, nanoparticle separations

CPE 506-Advanced Process Control: Interaction analysis: Process identifications, relative gain array (RGA), dynamic RGA, internal model control, multi-loop control, multi-variable control, plant wide control, model predictive control, project: modeling and simulation of a multivariable chemical process, design a multivariable control/multi-loop control by Simulink, applications of SCADA systems to petrochemical processes.

CPE 507- Nanotechnology in Chemical and Petrochemical Industries: Preparation of nanomaterials, characteristics of nanomaterials, general applications of nanoscience and nanotechnology in chemical and petrochemicals industries(application in oil and gas refining, nanomembranes, nanoseparators, nanoadsorbent, corrosion inhibitors, nanoadditives for clean fuel, nanomaterials from petrochemicals).

CPE 508-Gas Storage and Transportation: Characterization of natural gas systems, phase behaviour of natural gas systems, separators design and selection, acid gas removal, water-hydrocarbon system-hydrate formation, inhibition dehydration, sweetening equipment sizing, selection and design.Fundamental of gas liquefaction and liquefaction cycles: Joule–Thompson, turbine expansions and external refrigeration, Hydrocarbon recovery units, materials equipment performance and selection, natural gas liquefaction plants and LNG storage.

CPE 509-Surface and Interface Analysis Techniques: Spectroscopic techniques e.g. X-ray photoelectron spectroscopy and Auger analysis, ion beam techniques, in-depth analysis techniques, scanning probe microscopy, transmission electron microscopy, synchrotron-based techniques, quantification of surface and near-surface composition by AES and XPS, adhesion science and technology, problem solving approach in studying surface and interface science.

CPE 510- Conducting Polymers: Introduction, conducting polymers, theory, properties, synthesis and classes of conducting polymers. Characterization of conducting polymers and its nanostrucrured forms. Applications of

conducting polymers (for examples in sensors, fabrics, corrosion protection , artificial muscles, coatings, microwave absorption, membranes and ion exchanger, electronics, devices, electrocatalysis, … etc.

Ph.D. Courses:

CPE 601- Advanced Chemical Reactions and Reactor Design: Review of the fundamental concepts in chemical reaction engineering. experimental and theoretical aspects of chemical reaction kinetics, including transition-state theories, molecular beam scattering, classical techniques, quantum and statistical mechanical estimation of rate constants, pressure-dependence and chemical activation, modeling complex reacting mixtures, and uncertainty/sensitivity analyses. Transport processes in heterogeneous catalysis. Fixed bed catalytic reactor design, fluidized bed reactors, multiphase reactors. multiple reactors. Axial and radial dispersion/temperature variations in tubular reactors.

CPE 602- Advanced Polymerization Engineering: Polymerization Reaction Engineering :mechanisms and kinetics of polymerization, rheology and polymeric systems , unit operations in polymer industries, polymer formulations and additives: polymer assemblies, polymer auxiliaries, processing engineering, specialty and engineering polymers, biopolymers,

CPE 603-Process Optimization: Basic concepts of optimization, unconstrained multivariable optimization (grid search, simplex method, steepest descent search, conjugate gradient method, Newton's method), Lagrange's method of undetermined multipliers , application of unconstrained multivariable optimization (optimal design of unit operation, etc.), linear programming and applications (production planning problem), nonlinear programming (successive linear programming, excel solver), mixed integer programming and application (B&B method, scheduling problem), heuristic search methods (simulated annealing, Tabu search and genetic algorithm).

CPE 604-Catalysis Engineering and Design: Catalytic processes in industry, chemical kinetics of catalyzed reactions, catalytic reactor design, catalyst engineering and synthesis of catalyst.

CPE 605- Particle Science and Handling Engineering: Characterization of particle (average size, distribution), measurement of fine particle distribution (micro/nano), modeling of particle movement (DEM equation), particle simulation :project of particle simulation , agglomeration, dispersion, coalescence, coagulation, unit operation handling particle, filtering, drying, crashing, cyclone , extension to nanoparticle technology,

CPE 606- Biochemical Engineering: Enzyme catalysis, microbial growth, bioreactor design and analysis, transport processes, aeration and agitation, product recovery, microbial interaction, with example in applied & industrial microbiology, fermentation technology, enzymology, biocatalysis and pollution control.

CPE 607- Pollution control in Chemical and Petrochemical Industries: Introduction to the petrochemical industry, processes and waste streams, management philosophy, air pollution, water pollution, wastewater characteristics, treatment methods, process modification, conservation and treatment, case histories, solid wastes management, types of solid wastes, disposal techniques, disposal of hazardous wastes, energy consideration in pollution control.

CPE 608-Micro-chemistry and Micro-chemical Engineering: Feature of miniaturization, mass and heat transfer in micro channels, micro mixer and effect of mixing on selectivity, micro heat exchanger and effect of temperature control on selectivity, micro reactor and effect of residence time on selectivity, design and operation of micro chemical plant, reaction systems suitable for micro chemical plant .

CPE 609 Petrochemical Industries: Raw materials for petrochemical industries, preparation and manufacture of gas and liquid hydrocarbons, separation methods of hydrocarbons, production of basic petrochemical materials, preparation of methanol, alcohols and ammonia, production of detergents, plastics and synthetic rubber.

CPE 610 Petroleum Refining: Theories of petroleum origin. Crude oils and their main characteristics, treatment of petroleum products, processing of petroleum distillation, hydrogenation, isomerisation, thermal and catalytic refining, thermal and catalytic cracking.

CPE 611 Electrochemical Methods in Chemical and Petrochemical Industries: Revision on thermodynamics of electrochemical cells and electrode kinetics, potential sweep techniques, controlled-current techniques, hydrodynamic methods, impedance Spectroscopy techniques, non-traditional electrochemistry, electrochemical production, electroactive layers and modified electrodes,

CPE 612 Analytical Instrumentation: Introduction, spectrometric instruments, separation instruments, imaging instruments, electrochemical instruments, other instruments. Applications of the analytical instruments in chemical, petrochemical, pharmaceutical and other industries.Applications also in calibrations, testing, and others.

M.Sc. Prequalifying Courses:

CPE 404- Chemical Process Principles: Principles of material balance calculations, degrees of freedom analysis, Batch and continuous, steady flow and unsteady process, reactive and non reactive systems for single unit and multi unit process, process with recycle and by-pass with or without purge material balance, single phase systems, and multiphase systems. Energy balance on closed & open systems and the steady flow energy equation. Energy balance on non reactive processes, energy balance for mixing and dissolution process, energy balance on reactive process, heat of reaction measurements and calculation of heat of reaction, Hess`s law, formation reaction and heat of formation & heat of combustion.

CPE 407- Process Plant Design: Introduction to process design and engineering data. Applications of chemical engineering principles to the design of a chemical plant.Industrial safety basis, site location and plant layout. Detailed design procedure for selected equipment e.g. distillation

columns, reactors, extractors, liquid mixing systems, gravity settlers, pumps and compressors.

Project-Based Learning in Chemical and Petrochemical Engineering

CPE 701-Project-Based Learning in Chemical and Petrochemical Engineering: Students participate in Project-Based Learning activities in new advanced topics related to the field of research, suggested by one or more faculty staff members.

Research Seminar Courses

CPE 702-Seminars on advanced catalysis applications in petrochemical industries: Ph.D. students participate in predetermined series of research seminars based on self-learning and presentations by specialists in different advanced research topics in the fields of catalysis. The student's evaluation is based on his/her understanding of the presented topics.

CPE 703-Seminars on advanced nanotechnology in chemical/petrochemical processes: series of research seminars conducted by Ph.D. students and based on self-learning and presentations of new advanced topics in nanotechnology applications in chemical/petrochemical engineering, selected by professors specialized in those topics. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

CPE 704-Seminars on applied recycling technologies in Petrochemical industries**:** Series of research seminars conducted by Ph.D.students and based on presentations of recent journals papers in advanced research topics in recycling technologies related to students' thesis themes. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

CPE 705 - Seminars on polymeric compounding processes**:** Ph.D. students participate in predetermined series of research seminars based on self-learning and presentations of new advanced topics in specialists in different advanced research topics in the fields of compounding processes. The

student's evaluation is based on his/her understanding of the presented topics.

CPE 706 - Seminars on electrochemistry applications in industry**:** Series of research seminars conducted by Ph.D. students and based on self-learning and presentations of new advanced topics in electrochemistry selected by professors specialized in those topics. The student's evaluation is based on his/her understanding of the presented topics and presentations skills.

CPE 801 – M.Sc. Thesis

CPE 802 – Ph.D. Thesis

Mathematics Courses:

MTH 501 - Advanced Mathematics and Statistics I: Review of the main notions of measure theory, probability theory, and σ-algebras. Types of Markov chains, study of Martingales such as one dimensional random walk with equal probabilities in both directions. Brownian motion.

MTH 601 - Advanced Mathematics and Statistics II: Selected topics in mathematics and statistics and/or probability theory as per the requirements of the academic advisor and recommendation of the supervisors.