Graduate Studies Bylaws

Credit Hour System

Faculty of Engineering, Alexandria University
2011

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With amendments 2013

Contents

Introduction

The role of engineers has become more important in our currently vastly developing societies. Engineers need to reach a significant caliber. This is due to their role in industrial units, organizations and companies and their need to cope with rapid successive technological developments.
In order to keep up with the progress and sustainability of scientific and research experiences to match global developments, the Faculty of Engineering, Alexandria University has developed an upgraded curriculum for Graduate Studies and Research enhancement based on the credit hour system, through providing advanced academic programs to match developments in different fields and to improve scientific and research experience in order to support the rapid pace of development worldwide.

Vision

The Faculty of Engineering, Alexandria University aims to be a pioneer in engineering sciences on both the Middle Eastern and the African levels in education, scientific research and community service through the distinction of its faculty members and the availability of education and research programs and the exceptional resources related to the surrounding environment, specially the desert and the sea.

Mission

Preparing outstanding cadres of specialists that are creative, innovative and capable of working cooperatively through education, learning, teaching, scientific research and knowledge exchange according to the best academic and professional standards in order to serve the needs of the local, national, and international societies and to encourage scientific and technical publishing while contributing in developing the knowledge capabilities of individuals and organizations and providing continuous education.

Goals

1-Prepare graduates with a command of modern basic sciences, humanities and engineering sciences.
2-Produce the most comprehensively prepared graduates to deal with modern technologies capable of applying the state-of-art in information technology.
3-Prepare multidisciplinary graduates capable of interacting effectively with challenges and problem solving.

4-Provide students with the linguistic capabilities to benefit from immensely growing global knowledge.
5-Prepare distinguished graduates capable of presenting their ideas and interacting with the surrounding community.
6-Prepare creative graduates capable of competing in the labor market in view of new and rapid developments.
7-Prepare talented graduates capable of applying scientific, engineering methodology, analysis and deduction, and having the desire and capabilities for continuous education.
8-Prepare scientific cadres of the highest academic and professional standards to conduct academic and applied research relevant to the different engineering disciplines.
9-Participation in community services and environmental development by involvement in setting strategies and visionary initiatives needed for the continuing development of the surrounding society especially the sea and desert environments.

History of the Faculty of Engineering and its Scientific Departments

1941 The Faculty of Engineering – Cairo University establishes its branch in Alexandria
1942 The issuance of law decree No. 32 for the year 1942 for founding Alexandria University.
1942 The inception of the education in the preparatory year and the first year (Architecture, Civil Engineering, Electrical Engineering and Mechanical Engineering)
1946 Establishing the Department of Sanitary Engineering and Municipalities
1953 Establishing the Department of Chemical Engineering
1960 Establishing the Departments of Mechanical Power Engineering and Weaving & Textile Engineering
1961 Establishing the Department of Naval Architecture and Marine Engineering
1963 Establishing the Department of Production Engineering
1964 Establishing the Department of Nuclear Engineering
1974 Establishing the Department of Computer Engineering and Automatic control

Scientific Departments

- Architectural Engineering
- Structural Engineering
- Irrigation Engineering and Hydraulics
- Transportation Engineering

- Sanitary Engineering
- Mechanical Engineering
- Production Engineering
- Naval Architecture and Marine Engineering
- Textile Engineering
- Electrical Engineering
- Computer and Systems Engineering
- Nuclear and Radiation Engineering
- Chemical Engineering
- Engineering Mathematics and Physics

Chapter (1)

General Regulations

Article (1) Alexandria University offers the following degrees upon the approval of the Faculty Council:

- Professional Diploma.
- Specialized Graduate Diploma.
- The Master of Engineering.
- The Master of Science in Engineering.
- The Doctor of Philosophy in Engineering.

Article (2) <u>Semesters of Study:</u>

- Fall Semester: starts on the third Saturday of September and lasts for 15 weeks including exams.
- Spring Semester (second semester): starts on the second Saturday of February and lasts for 15 weeks including exams.
- Summer Semester (third semester): starts on the first Saturday of July and lasts for 8 weeks including exams.

Article (3) <u>System of Study:</u>

The student is allowed to register 12 credit hours per regular semester and 9 credit hours in the summer semester, thesis or dissertation registration credit hours not included.

Article (4) <u>The Credit Hour:</u>

The credit hour is the measurement that defines the weight of each course relative to other courses. It is equivalent to one lecture that has a duration of one hour per week, an applied tutorial or laboratory session with a duration of two hours per week or applied field training with a duration of four hours per week throughout the semester.

Article (5) <u>General Admission Regulations:</u>

1-Applicants should have a B.Sc. in Engineering or equivalent, from any University recognized by the Supreme Council of Egyptian Universities and should satisfy the acceptance requirements of that program.

2- Fulfillment of the special requirements of the department (if any) and the approval of the Department Council and Faculty Council are required.

3- The student has to provide all the required documents and forms specified by the graduate studies administration.

4- A student has to pay all study expenses before the beginning of the semester or according to the date announced by the Faculty.

5- Registration is mandatory and is made by paying study expenses and fulfilling the registration rules in order to be allowed to attend courses and get courses credited.

6- A student who does not register before the registration deadline (the end of the second week of the regular semester) and (the first week in the summer semester) is not allowed to attend lectures or attend exams.

Article (6) <u>Course Study Regulations:</u>

- The Faculty Council decides the minimum number of students to offer a course.
- The student has the right to remove/add any course before the end of the second week of the beginning of the semester (fall- spring) or the end of the first week of the summer semester after filling out a form deletion, addition, and getting the academic advisor's approval. This course will not be shown on the student transcript.
- A student is allowed to withdraw from a course after registration before the end of the 12^{th} week (the sixth week in the summer semester). In such case, the hours of this course will not be credited and the course will appear in his/her transcript as (W- Withdrawal).
- A student is not allowed to attend the final exam of a course unless he/she has attended at least 75% of the study hours of the course. In this case, the student will be considered as "Forced Withdrawn" and the course will appear in his/her transcript as (FW).
- A student who could not attend the final exam of a course or fulfill its requirement due to unforeseen reasons accepted by the Department Council and who has attended and accomplished more than 75% of the study hours will be considered as (I- Incomplete) and will have to sit for the exam the first two weeks in the next semester, otherwise he/she will get (FW- Forced Withdrawal).
- Courses with grades "FW", "W" or "I" will not be accounted for as credit hours and will not be counted in the student's CGPA.
- A student is allowed to repeat any course in order to improve his/her grade.
- If a student repeats a course, his/her higher grade will appear in his/her transcript and will be counted in calculating his CGPA.
- A student is allowed to register in any course outside the Department, the Faculty or the University that is after the approval of the Faculty Council upon the recommendation of the Department Council. Such courses will be considered in his/her final CGPA.

- For a student who gets a grade below "C" in a certain course, such a course will not be counted in the hours required to complete the degree. This course must be repeated if it is a compulsory course. However, such a course will be considered in his/her CGPA.
- Credited courses are only valid for five years for all degrees except for the Ph.D. degree, the validity of its courses is seven years. These invalid courses will not be included in the fulfillment of the requirements for that degree.
- The final Grade Point Average GPA, as well as, the semester GPA is calculated according to the equation

GPA = sum of points of credit hours in all courses /sum of number of credit hours of all courses within this semester.

- The CGPA is the sum of the points of credit hours of all courses divided by the sum of number of credit hours of all courses.
- A student is allowed to attend any course as an auditor. In such case, he/she will not be required to pass course exams or fulfill its requirements. Students who attend more than 75% of the course, will get an "L" grade in their certificate.
- A student is not allowed to register in any course before fulfilling the prerequisites of that course if any.
- The student is allowed to withdraw from the course after registration when called to perform military service and withdraws for military service, will get a Military Withdrawal (MW) in his/her academic record.
- Credit hours for a thesis or dissertation will appear in the transcript as “IP”(in progress), "S" (satisfactory) or "U" (unsatisfactory) but these will not be considered in calculating the CGPA.

Article (7) <u>Course Grading Regulations:</u>

A course is graded according to the following table considering that each credit hour is equivalent to four points.

- **Point Calculation System:**

Performance fors	Grade	Points
High Performance	**A**	**4.000**
	A^-	**3.666**
	B^+	**3.333**
Satisfactory Performance	**B**	**3.000**
	B^-	**2.666**
	C^+	**2.333**
	C	**2.000**

Less than Expected Performance	**C$^-$**	**1.666**
Unsatisfactory Performance	**D$^+$**	**1.333**
	D	**1.000**
Fail	**F**	**0.000**
Withdrawal	**W**	**---**
Forced Withdrawal	**FW**	**---**
Incomplete	**I**	**---**
Military Withdrawal	**MW**	**---**
Listener	**L**	**---**
In Progress	**IP**	**---**
Satisfactory	**S**	**---**
Unsatisfactory	**U**	**---**
Transfer	**Tr**	**---**

Article (8) Tuition Fees for Graduate Programs:
Fees are determined at the beginning of each academic year and approved by the university president with the consent of the University Council.

Article (9) The Academic Advisor:
Each Department will assign an Academic Advisor for each student, from its faculty members in the same field of specialization in order to advise the student and to help him/her select the necessary courses required to obtain the degree, as well as, additional courses when needed. The Academic Advisor will be replaced by the Principal Supervisor when registering the M.Eng. report. For the M.Sc. and Ph.D. programs the Principal Supervisor must be assigned before registering in the program and will act as the Academic Advisor.

Article (10) Course Transfer:
- After the approval of the Faculty Council upon the prosed approval of the Department Council, a student may be allowed to transfer a number of courses that he/she has studied in another university or another faculty on the condition that such course(s) are required for obtaining the degree and that the student has received a grade not below "C" or its equivalent. The total number of credit hours for these transferred courses must not be more than 30% of the required credit hours for the degree and must not have been counted towards fulfilling the requirements of earning another degree. Credit hours earned from the same University or any other University more than five years prior to the student being awarded the degree will not be considered for transfer for all degrees, except for the Ph.D. degree where this period is extended to seven years. The transferred

courses are not included in calculating the CGPA but are shown in the transcript with the grade Tr.

- A student may be allowed to transfer courses he/she has passed with a minimum "C" grade, that were studied in a Continuous Education Program in Alexandria University or in an incomplete program if these courses are needed for fulfilling the requirements of his/her degree.

Chapter 2

Graduate Programs

Article (11) Alexandria University awards the following diplomas and degrees based on the proposal of the Faculty of Engineering:

First: Professional Diploma in:
Landscape Architecture
Multimedia Applications in Architecture
Transportation Engineering.
Sanitary Engineering
Ship Maintenance and Repair
Pollution Protection and Environmental Engineering
Petroleum Refining and Petrochemicals

Second: Specialized Graduate Studies Diploma:
Architectural Design and Urban Design
Structural Engineering
Construction and Project Management
Irrigation Structures
Water Resources Engineering
Transportation Engineering
Sanitary Engineering
Mechanical Engineering
Manufacturing Engineering
Ship Design
Offshore Engineering
Spinning Engineering
Weaving Engineering
Electrical Power and Machines Engineering
Nuclear Power Plants
Nuclear Radiation and Environment
Chemical Engineering

Third: Master of Engineering (M.Eng.) in:
Architectural Engineering
Structural Engineering
Construction and Project Management

Irrigation Engineering and Hydraulics
Transportation Engineering
Sanitary Engineering
Mechanical Engineering
Manufacturing Engineering
Marine Engineering
Offshore Engineering
Textile Engineering
Electrical Engineering *(Electronics and Communications)*
Electrical Engineering *(Electrical Power and Machines)*
Chemical Engineering
Engineering Mathematics
Engineering Physics

Fourth: The Master of Science (M.Sc.) in:
Architectural Engineering
Structural Engineering
Construction and Project Management
Irrigation Engineering and Hydraulics
Transportation Engineering:
(Highway - Rail - Surveying – Harbor and Marine Structures - Transportation Planning and Traffic Engineering)
Sanitary Engineering
Mechanical Engineering
Industrial Engineering
Manufacturing Engineering
Naval Architecture and Marine Engineering
Textile Engineering
Electrical Engineering *(Electronics and Communications)*
Electrical Engineering *(Electrical Power and Machines)*
Computer and Systems Engineering
Nuclear and Radiation Engineering
Nuclear Science and Technology *(from the ministerial decree No. 278 dated 09.02.2010*
Chemical Engineering
Engineering Mathematics
Engineering Physics

Fifth: Ph.D. in:
Architectural Engineering

Structural Engineering
Construction and Project Management
Irrigation Engineering and Hydraulics
Transportation Engineering:
(Highway - Rail - Surveying – Harbor and Marine Structures - Transportation Planning and Traffic Engineering)
Sanitary Engineering
Mechanical Engineering
Industrial Engineering
Manufacturing Engineering
Marine engineering and ship building
Textile Engineering
Electrical Engineering *(Electronics and Communications)*
Electrical Engineering *(Electrical Power and Machines)*
Computer and Systems Engineering
Nuclear and Radiation Engineering
Chemical Engineering
Engineering Mathematics
Engineering Physics

Chapter 3

Regulations for the Graduate Diploma

Article (12) <u>Admission Requirements:</u>

In addition to the conditions contained in Article (5), it is required of the applicant to:

1 - Have a Bachelor of Science degree in Engineering from one of the universities / institutions recognized by the Supreme Council of Egyptian Universities.

2 - The Faculty council may approve the recommendation of the Department Council to accept a student having a bachelor's degree in a different specialization after passing a number of supplementary courses determined by the Department Council. The supplementary courses should not be more than four courses and should not be pre-requisites for graduate courses. In case more than four courses are needed, the student must spend a preliminary year and pass all supplementary courses in order to register for the diploma. Such courses will not be counted towards the program credit hours.

Article (13) <u>Hours of Study for the Graduate Diploma:</u>

In order to receive a diploma the student must complete a number of credit hours as follows:

- 24 credit hours for professional diploma.
- 30 hours for the specialized graduate diploma.

The final grade (CGPA) is shown in the Diploma Certificate.

Chapter (4)

Regulations for the Master Degree

Article (14) <u>Admission Requirements:</u>

In addition to the conditions contained in Article (5), it is required of the applicant to:

1. Have a B.Sc. degree in the same specialization in Engineering or a related Engineering field with a minimum grade of "GOOD", (CGPA= 2.333), or equivalent.

   The Faculty council may approve the recommendation of the Department Council to accept the admission of a student having a bachelor's degree in a different specialization after passing a number of supplementary courses determined by the Department Council. The supplementary courses should not be more than four courses and should not be pre-requisites for graduate courses. The student must obtain a cumulative average not less than 2.000 in the supplementary courses before joining the program. Such courses will not be counted towards the program credit hours.
2. Students having a B.Sc. with a "PASS" grade, (2.000), or equivalent may be admitted to the M.Sc. program in the same field if they have a specialized graduate diploma in the field with a minimum (2.333) grade point.
3. The student must successfully pass the courses with a CGPA of at least (2.333); otherwise, the student must register in additional courses or repeat some courses to improve his CGPA:

   A – In the case of Master of Engineering (without thesis), the student submits a request to the head of the department to register the scientific report and determine the report supervisor(s). The department council then approves the registration.

   B - In the case of Master of Science in Engineering (with thesis), the principal supervisor must determine the thesis main subject, the research plan, and the supervision committee. The department council approves the registration after the student presents his research plan before the council.

1. Obtaining the ICDL and proving acceptable level in the English language are two requirements for the Master's degree that should be satisfied prior to the discussion and defense of the scientific report or thesis and in accordance with the resolutions of the University Council and the Faculty Council. (The condition to obtain the ICDL was cancelled by the University Council on 22.03.2012)
2. After the completion of students of all course requirements with a CGPA of at least 2.333 and also the completion of the thesis or the scientific report, the principal supervisor submits a validity report to the Department Council including the proposed Defense Committee.

3. The M.Sc. degree is awarded to students who pass their thesis defense before the Defense Committee. The CGPA is not recorded in the final awarded certificate. Master of Engineering students are awarded the degree after defending their scientific report before the Defense Committee. The CGPA and all course records including the scientific report grade will be shown on the M.Eng. certificate with the condition that all these record grades be not less than 2.333.

Article (15) Hours of Study for the Master Degree:

In order to receive a Master degree, the student must complete a number of credit hours as follows:

- 30 credit hours + 3 credit hours for the scientific report in the case of Master of Engineering.
- 24 credit hours + 8 credit hours for the thesis in the case of Master of Science in Engineering

Article (16) Supervision:

1. The Faculty Council appoints based on the Department Council's recommendation a supervising committee from among professors or associate professors. It is possible to appoint lecturers (assistant professors) in supervising committees, however, the supervising committee should not exceed four members who are resident in Egypt. The principal supervisor must be from the Faculty of Engineering- Alexandria University.
2. If the student conducts his research outside the university, the supervising committee may contain a specialist or doctoral degree holder with experience in the area of research specialization; this must be approved by the Faculty Council.
3. In the event of any of the supervisors traveling before one year has passed since the approval of the supervising committee, his/her name will be removed from the committee with a recommendation from the Department Council and the approval of the Faculty Council.
4. In the event of any of supervisors traveling after one year since the approval of the supervising committee, he/she must provide a report signed by the supervising committee on the student's progress in research during the period of supervision. This supervisor keeps his right to publish the results of the thesis but his signature is not required on the validity report.
5. The Supervising Committee must submit a periodical progress report every six months on the student progress in his research signed by all the members of the Supervising Committee. In the case of different opinions of the Supervising Committee members, the Department Council and the Faculty's Graduate Studies Committee make the appropriate decision. The students are notified by the Graduate Studies Administration office of the decision in the progress report

being one of the following three: the continuation of the student's registration, warning or cancellation.

6. The student Registration in the program is canceled if the student has three progress reports stating that his performance is unsatisfactory and after he/she has received three warnings.

Article (17) <u>Defense Committee:</u>

First: Master of Science (with thesis) - Defense Committee

1. After completely the preparation of the thesis, the Principal Supervisor of the thesis presents to the concerned Department Council, the following:-
   - A validity report stating the adequacy of the thesis for discussion and determining its scientific and research standard, and the scientific contribution and additions the research has accomplished. This report must be signed by the Supervising Committee. If one of the supervisors is abroad, the head of the department should contact him/her for approval of the validity report by mail, fax, or e-mail. In case no reply is received within three weeks implicit acceptance of the report is assumed.
   - Proposed Defense Committee for the thesis.
   - Specific title of the thesis.
2. Based on the department council's recommendation, the faculty council approves the Defense Committee formed consisting of three members, one of which is the principal supervisor. The other two members are professors, associate professors, and/ or equivalent specialists, of which at least one is from outside the Faculty. The head of this committee is the senior member. More than one supervisor may be members of the committee; in this case all supervisors will have one vote. The University's Vice President for Graduate Studies and Research approves this formation.
3. The thesis defense may be conducted with the presence of one member of the supervising committee, even if the other supervising committee members are absent.
4. If the thesis is not defended during the three months from the date of university approval to form the Defense Committee, re-approval of the committee with the same members is a must. The second time a new committee must to be formed.
5. The Defense Committee may return the thesis to the student in order to correct the deficiencies after which a collective report is submitted to the department council recommending that the student be given six months from the date of the defense to make necessary corrections and completions. The Defense Committee or one of its members is selected to give the final approval of the thesis.

Second: <u>The Master of Engineering (without thesis) - Defense Committee:</u>

1. After completely preparing the scientific report, the Principal Supervisor of the scientific report presents to the concerned Department Council, the following:-
    a. Validity Report for the scientific report.
    b. Proposed Defense Committee for the scientific report.
    c. Specific title of the scientific report.
2. The Department Council forms a Defense Committee of three members, one of whom is the Principal Supervisor. The other two members should be university professors or associate professors, current or previous; or equivalent specialists. The head of this committee is the senior member. All the members may be from the Faculty of Engineering, Alexandria University.
3. Each member of the Defense Committee presents an individual report in a sealed envelope to the Head of the Committee containing a summary of the scientific report and evaluation.
4. The Department Council determines a date for the scientific report defense at the request of the Principal Supervisor with the approval of the Defense Committee at the end of one of the semesters, Fall or Spring.
5. After the defense the Head of the Defense Committee announces the Committee's decision after the signing of the collective report by all the members of the Committee. The report should include the average score of the scientific report (60% of the total), the average score for the defense (40% of the total) and the final grade of the scientific report (the report grade should be at least C+ and should include the recommendation to grant the degree of Master of Engineering. The Committee may recommend postponing granting the degree of Master of Engineering. The student will then re-defend the modified scientific report before the same committee with maximum time till the end of the semester after the one when the first defense was held.
6. Pre-determined forms must be filled for the individual and collective evaluation and the final grade and recommendation. These forms should be approved by the Faculty Council.

Chapter (5)

Regulations for the Ph.D. Degree

Article (18) <u>Admission Requirements:</u>

In addition to the conditions contained in Article (5), it is required of the applicant to:

1. Have a M.Sc. degree in the same specialization in Engineering or a related field from one of the institutes accredited by the Supreme Council of Egyptian Universities.
2. The Faculty Council may approve the recommendation of the Department Council to accept a student having a Master of Science degree in a different specialization after passing a number of supplementary courses determined by the Department Council. The supplementary courses should not be more than four and should not be pre-requisites for graduate courses. The student must obtain a cumulative average not less than 2.000 in the supplementary courses before joining the program. Such courses will not be counted towards the program credit hours.
3. The student must successfully pass the courses with a CGPA of at least (2.333); otherwise, the student must register in additional courses or repeat some courses to improve his CGPA. The academic adviser applies to the Department Council requesting that the student be given an oral Comprehensive Exam proposing an Exam committee made up of three or five members from different specializations. The Comprehensive aims at measuring the student's in-depth and comprehensive ability, the assimilation of the major topics in the specialization and subspecialties and to measure the student's methodic ability for contemplation, analysis, deduction and suitable solving of problems presented by the exam committee. Comprehensive exam procedures approved by the Faculty Council and consistent with the University Council in this regard should be followed. (Procedures approved on 8/5/2012)
4. After succeeding in the Comprehensive Exam, the academic adviser (principal supervisor) submits to the department council a request for registration of the dissertation proposing the supervising committee
5. Obtaining the ICDL and proving acceptable level in the English language are two requirements for the Ph.D. degree that should be satisfied prior to the discussion and defense of the dissertation and in accordance with the resolutions of the University Council and Faculty Council. (The condition to obtain the ICDL was cancelled by the University Council on 22.03.2012)
6. After the success of the student in all courses with a CGPA of at least 2.333 and also the completion of the dissertation, the Principal Supervisor submits a validity

report to the Department Council including a proposal for the Defense Committee.

7. The Ph.D. degree is awarded to students who pass their dissertation defense before the Defense Committee. The CGPA is not recorded in the final awarded certificate.

Article (19) Hours of Study for the Ph.D. Degree:

In order to receive a Ph.D. degree, the student must complete a number of credit hours as follows:

• 18 credit hours of courses + 24 credit hours for the dissertation

Article (20) Supervision:

1. The Faculty Council appoints upon the Department Council's recommendation a supervisor from among the professors or associate professors. It is possible to appoint lecturers (assistant professors) in supervising committees; however, the supervising committee should not exceed four members who are resident in Egypt. The principal supervisor must be from the Faculty of Engineering-Alexandria University.
2. If the student conducts his research outside the university, the supervising committee may contain a specialist or doctoral degree holder with experience in the area of research specialization; this must be approved by the Faculty Council.
3. In the event of any of the supervisors traveling before one year has passed from the date after the supervising committee has been sanctioned, that supervisor will be removed from the committee upon the recommendation of the Department Council and the approval of the Faculty council.
4. In the event of any of supervisors traveling after one year has passed from the date after the supervising committee has been sanctioned, he must provide a progress report on the student's progress in research during the period of supervision signed by the supervising committee. This supervisor keeps his right to publish the results of the thesis but his signature is not required in the validity report.
5. The Supervising Committee must submit a periodical progress report every six months on the student progress in his research signed by all the members of the Supervising Committee. In the case of different opinions of the Supervising Committee members, the Department Council and the Faculty's Graduate Studies Committee make the appropriate decision. The students are notified by the Graduate Studies Administration office of the decision in the progress report, being one of the following three: the continuation of the student's registration, warning or cancellation.

6. The student registration in the program is canceled if three of the student's progress reports state that his performance is unsatisfactory and after the student has received three warnings.

Article (21) <u>Defense Committee:</u>

1. After completely preparing the dissertation, The Principal Supervisor of the dissertation presents to the concerned Department Council, the following:-
   - A Validity Report on the adequacy of the dissertation for discussion revealing its scientific and research merit, and the scientific contribution and additions the research has accomplished. This report must be signed by the Supervising Committee inside the country. If one of the supervisors is abroad, the head of the department should contact him/her for approval of the validity report by mail, fax, or e-mail. In case no reply is received within three weeks implicit acceptance of the report is assumed.
   - Proposed Defense Committee for the dissertation.
2. Based on the department council's recommendation, the faculty council approves the Defense Committee formed consisting of three members, one of which is the principal supervisor. The other two members are professors, associate professors, and/ or equivalent specialists, of which at least one is from outside the Faculty. The head of this committee is the senior member. More than one supervisor may be members of the committee; in this case all supervisors will have one vote. The University's Vice President for Graduate Studies and Research approves this formation.
3. The thesis defense may be conducted with the presence of one member of the supervising committee, even if the other supervising committee members are absent.
4. If the thesis is not defended during the three months (or four months in case one of the members is a foreign examiner) from the date of the university approval to form the Defense Committee, re-approval of the committee with the same members must be obtained. In the case no defense is held, a new committee is to be formed.
5. The Defense Committee may return the dissertation to the student in order to correct the deficiencies after which a collective report is submitted to the department council recommending that the student be given six months from the date of the defense to make necessary corrections and completions. The Defense Committee or one of its members is selected to give the final approval of the dissertation.
6. There should be at least one research paper published in a recognized International Journal or international conference (peer reviewed) in the field of specialization.

Chapter (6)

Continuing Education

Article (22) <u>Continuing Education:</u>

1. A student may register in a postgraduate degree course through the continuing education program after the approval of the Department Council and the Faculty Council. The University is then notified of the accepted students' names before the end of the third week of the start of classes.
2. A signed statement will be issued to the student after completing a course successfully.
3. A student may transfer continuing education courses to one of the postgraduate studies programs if he satisfies the acceptance criteria of that program on the condition that not more than five years have passed since taking the courses for diploma and master's courses and seven years for Ph.D. courses.

Chapter (7)

General Rules

Article (23) <u>Joint and Dual Degree Programs with Other Universities:</u>
The University may grant scientific degrees in cooperation with other universities such as **dual** degrees or **joint** degrees.

Article (24) <u>Exchange Programs:</u>

1. The Faculty Council may upon the recommendation of the concerned Department Council and the approval of the university allow graduate students to study some graduate courses in foreign universities having mutual agreements with Alexandria University. These courses are counted as part of the degree requirements. A student may transfer a number of courses in which he/she has passed with a grade of C at least or its equivalent to any graduate program he wishes to join on the condition that theses course be part of the requirements for the program. The grades for these courses are taken into account in calculating the cumulative grade point average CGPA as long as not more than five years have passed since the courses were completed, before registration.
2. The Faculty Council may upon the recommendation of the concerned Department Council allow foreign students registered in foreign universities to study some postgraduate courses in the Faculty of Engineering. A signed statement will be issued in case the student completes the course successfully.
3. The Faculty Council may upon the recommendation of the concerned Department Council allow professors from distinguished foreign universities to teach some postgraduate courses.

Article (25) <u>Distance Learning:</u>
The university may allow Egyptian and Foreign graduate students upon the recommendation of the concerned Department Council to join graduate programs through distance learning or electronic learning in foreign universities having an agreement with Alexandria University.

Article (26)
The Faculty reserves the right to offer new specialized programs for the diploma, master and doctorate degrees after the approval of the Faculty Council, University Council and the concerned authorities in the Ministry of Higher Education.

Article (27)
These bylaws are to be applied the first Fall semester after final approval.

Chapter (8)

Programs of Study, Courses and Course Contents

Course Codes:

Course Code Number: AA BB N1 N2 N3
AA is the code for the Faculty of Engineering= 07
BB is the code of the department offering the course as follows:

Code BB	Scientific Department	Program
01	Department of Architectural Engineering	Architectural Engineering (Landscape)
02		Architecture and Urban Planning
03		Architectural Engineering (Housing)
04	Department of Structural Engineering	Structural Engineering
05	Department of Irrigation Engineering and Hydraulics	Irrigation Engineering and Hydraulics
06	Department of Transportation Engineering	Transportation Engineering
07	Department of Sanitary Engineering	Sanitary Engineering
08	Department of Mechanical Engineering	Mechanical Engineering
09	Department of Production Engineering	Manufacturing Engineering
10		Industrial Engineering
11	Department of Naval Architecture and Marine Engineering	Naval Architecture and Marine Engineering
12		Offshore Engineering
13	Department of Textile Engineering	Textile Engineering
14	Department of Electrical Engineering	Electrical Engineering (Electronics and Communications)
15		Electrical Engineering (Electrical Power and Machines)
16	Department of Computer and Systems Engineering	Computer and Systems Engineering
17	Department of Nuclear and Radiation Engineering	Nuclear and Radiation Engineering
18	Department of Chemical Engineering	Chemical Engineering
19	Department of Engineering Mathematics and Physics	Engineering Mathematics and Physics

N1 **Number denoting course level**
N2 **Number denoting course specialty group**
N3 **Number denoting course sequence within a specialty group at a certain academic level or the field of the scientific report, thesis or dissertation in the scientific department**

In case of diploma project	**N2= 0**	**and**	**N3= 1-4**
In case of scientific report (M.Eng.)	**N2= 0**	**and**	**N3= 1-4**
In case of M.Sc. thesis	**N2= 0**	**and**	**N3= 5-9**
In case of Ph.D. dissertation	**N2= 0**	**and**	**N3= 1-4**

Department of Architectural Engineering

The department of Architectural Engineering offers the following programs:

1. Graduate Diplomas

1.1 Professional Diploma in Landscape Architecture

The student must complete 24 credit hours.
Compulsory courses: The student must pass six courses with a total of 18 credit hours from course numbers (07 01 611 to 07 01 616).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.2 Professional Diploma of Multimedia Applications in Architecture

The student must complete 24 credit hours.
Compulsory courses: The student must pass six courses with a total of 18 credit hours from course numbers (07 01 620 to 07 01 625)
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.3 Specialized Graduate Diploma in Architectural Design and Urban Design

The student must complete 30 credit hours.
Compulsory courses: The student must pass three courses with a total of 9 credit hours with course numbers (07 01 618, 07 01 626,07 02 613).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

2. Master Degrees

2.1 Master of Engineering in Architectural Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass five courses with a sum of 15 credit hours with course numbers (07 01 711, 07 01 714, 07 01 720, 07 01 723, 07 02 711).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Architectural Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must pass three courses with a sum of 9 credit hours with course numbers (07 01 714, 07 01 720, 07 01 721).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Architectural Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

The student must choose three courses from those specified as “Doctorate courses”. The student has the right to choose another three courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit Hours	Exam Duration
1	07 01 611	Theories and History of Landscape	3	3
2	07 01 612	Landscape Architecture	3	3
3	07 01 613	Water and Environment in Landscape	3	3
4	07 01 614	Applications in Landscape (1)	3	3
5	07 01 615	Applications in Landscape (2)	3	3
6	07 01 616	Environmental Design for Buildings	3	3
7	07 01 617	Computer Aided Architectural Design	3	3
8	07 01 618	Architectural Design Applications (1)	3	3
9	07 01 619	Architectural Design Applications (2)	3	3
10	07 01 620	Digital Design	3	3
11	07 01 621	Virtual Architecture	3	3
12	07 01 622	3-D Models and Real Image	3	3
13	07 01 623	Digital Multimedia	3	3
14	07 01 624	Applications in Virtual Architecture (1)	3	3
15	07 01 625	Applications in Virtual Architecture (2)	3	3
16	07 01 626	Construction and Building Systems	3	3
17	07 01 627	Site and Project Management	3	3
18	07 02 611	Sustainable Urban Design	3	3
19	07 02 612	Urban Coordination	3	3
20	07 02 613	Applications in Urban Design (1)	3	3
21	07 02 614	Applications in Urban Design (2)	3	3
22	07 01 711	Environmental Techniques in Buildings	3	3
23	07 01 712	Methods of Environmental Analysis	3	3
24	07 01 713	Built Environment and Energy Conservation	3	3
25	07 01 714	Design Methodology and Analysis	3	3
26	07 01 715	Sustainable Architecture	3	3
27	07 01 716	Rehabilitation of Buildings	3	3
28	07 01 717	Introduction to Construction Economics	3	3
29	07 01 718	Feasibility Studies	3	3
30	07 01 719	Special Studies in Architectural Design	3	3
31	07 01 720	Special Studies in History and Theory of Architecture	3	3
32	07 01 721	Architectural and Urban Criticism	3	3

33	07 01 722	Conservation of Architectural Heritage	3	3
34	07 01 723	Special Studies in Building Technologies	3	3
35	07 02 711	Special Studies in Urban Design	3	3
36	07 02 712	Development of Urban Environment	3	3
37	07 02 713	Policies of Land Use	3	3
38	07 02 714	Transportation and Land Use	3	3
39	07 02 715	Introduction to Geographical Information Systems	3	3
40	07 02 716	Introduction to Remote Sensing	3	3
41	07 02 717	Basics of Environmental Sciences	3	3
42	07 02 718	Applications of Geographical Information Systems and Remote Sensing in Environmental Indicators	3	3
43	07 02 719	Theories and Methodologies of Urban Planning	3	3
44	07 02 720	Research Methods	3	3
45	07 01 811	Selected Topics in Architectural Design and Renewable Energy	3	3
46	07 01 812	Selected Topics in Computer Applications in Architecture	3	3
47	07 01 813	Selected Topics in Building Technologies and Materials	3	3
48	07 02 811	Selected Topics in Urban Development	3	3
49	07 02 812	Selected Topics in Urban Communities	3	3
50	07 02 813	Selected Topics in City Problems	3	3
51	07 03 811	Selected Topics in Rural Housing	3	3
52	07 03 812	Selected Topics in Informal Housing	3	3
53	07 03 813	Selected Topics in Urban Housing	3	3
54	07 01 601	Diploma Project in Landscape	3	Presentation
55	07 01 602	Diploma Project in Multimedia Applications in Architecture	3	Presentation
56	07 01 603	Diploma Project in Architectural Engineering and Urban Design	3	Discussion
57	07 01 701	Scientific Report of Master of Engineering in Architectural Engineering	3	Defense

58	07 01 705	Master of Science Thesis in Architectural Engineering	8	Defense
59	07 01 801	Doctor of Philosophy Dissertation in Architectural Engineering	24	Defense

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 01 611 Theories and History of Landscape
Study the theories that control landscape regarding the historical background of landscape to gain experiences in landscape heritage from historical gardens in different eras.

07 01 612 Landscape Architecture
Study the theoretical bases of in landscape architecture and used material and basics of selection of whether plants or finishing materials.

07 01 613 Water and Environment in Landscape
Study water as a one of the major elements in landscape and its impacts on the general image and perception of the place is the major point in that course taking into consideration the surrounding environment and its climatic and physical conditions. Study the practical techniques which participate in saving water in places with rare sources of water.

07 01 614 Applications in Landscape (1)
Apply theoretical bases of landscape through the projects of like public and private gardens, parks, forests, and recreational areas in a comprehensive which promote the experiences of students.

07 01 615 Applications in Landscape (2)
Study the new techniques in landscape such as irrigation and drainage systems as well as develop and upgrade existing projects and generate and evaluate alternatives with paying attention toward climatic and physical changes regarding the landscape elements.

07 01 616 Environmental Design for Buildings
Study methods of architectural design that respect the usage of available or suitable construction materials for climatic situation of the surrounding environment or the suitable, which guarantee is for what it is designed for.

07 01 617 Computer Aided Architectural Design
Study the possibility of the usage of the computer as an assisting tool to facilitate the

design process in generating and evaluating alternatives, when variables and inputs are inconsistent and the design is hard for the designer to imagine drawing.

07 01 618 Architectural Design Applications (1)
Study more architectural applications that are more complicated to innovate than the student use to do in the undergraduate design studios to promote his or her experiences in the field of architectural thoughts and visions to solve the architectural problem after defining the input variables in a deeper way in design processes.

07 01 619 Architectural Design Applications (2)
Use the computer software packages in an extensive way through software development to generate and evaluate alternatives to let the computer not only an assisting drawing tool but also as a designing tool with paying attention to criticism and analysis methods of architectural projects. 07 01 618 is a prerequisite.

07 01 620 Digital Design
Study the theories and applications of digital architecture in the field of architectural and urban design. Study digital architecture techniques and processes beside models and methodologies in the field of architectural design and digital design.

07 01 621 Virtual Architecture
Study how to make virtual architecture to overcome the learning problem and professional practice to guarantee high quality in the final product where corrections or changes are difficult. The course uses the cave technology as a direct application for virtual architecture to evaluate projects in the design phase.

07 01 622 3-D Models and Real Image
Study theoretical and practical computer applications to create 3-D models with detailed elements simulating the reality of architectural design, which help to compose a real image of the building to assist in criticizing the architectural design.

07 01 623 Digital Multimedia
Study the applicability of multimedia technology in the fields of architecture like architectural design, building technology, history of architecture, theory of architecture, and as such through presentations for architectural concept, learning material or in the world wide web.

07 01 624 Applications in Virtual Architecture (1)
Study theoretical and practical basics of virtual reality application in the field of architectural and executive design to enable the student to avoid the architectural mistakes and shortcomings to ensure high quality after operation for optimum performance. To go

over virtual reality available software packages.

07 01 625 Applications in Virtual Architecture (2)
Study the creation and treatment of organic shapes, which always was the main obstacle in the face of computer aided design software packages, which reduces the designer ability to produce what he feels, it also allow the special abilities for the designer that are not available in the convention work. In them meanwhile, the ability to interact with the model and correct it from inside. 07 01 624 is a prerequisite.

07 01 626 Construction and Building Systems
Advanced study for used in building and construction process, but in a more multifaceted way than has been studied in the bachelor programs, this is through paying attention the variable related to different construction process phases regarding developed and developing countries experience.

07 01 627 Site and Project Management
Study theoretical and practical basics that followed in management of construction projects as a special case of projects with a unique character. Expose to the used software packages in project management and different inside phases. Study utilized methods in providing, storing, and using construction materials within the construction sites. Labor size, and instruments and work arrangement to reach the optimum site management to achieve the construction process in a safe and fast way.

07 02 611 Sustainable Urban Design
Follow methods and basics of sustainable in the field of urban design in material selection, and methods and strategies of saving resources through the urban design applications.

07 02 612 Urban Coordination
Study methods of urban image coordination in cities, which suffers from visual opposition between urban designs expressions with the study of effects of each urban design elements and the impact of that on the image of the city generally.

07 02 613 Applications in Urban Design (1)
Study of urban design applications that is more advanced and creative than applications has been studied in the bachelor degree in different field to raise the student experience in solving urban design problems with a deeper vision after defining input variables in urban design process.

07 02 614 Applications in Urban Design (2)
Applications in this course focus on thoughtful points like employing urban design in solving specific problem such as criminal prevention and social complications. The

applications also focus on key differences in urban spaces varieties and types of activities and the extent of this effect positively or negatively on the surrounding urban fabrics. Renewable and clean energy applications in urban spaces are studied. 07 02 613 is a prerequisite.

07 01 711 Environmental Techniques in Buildings
Study the surrounding environment of buildings, which can provide several techniques that is proper for every community financially, environmentally, and socially to offer good living standards. This is to create cleaner and healthier environment to let the architectural space plays its role. Study these available techniques in several diverse environments.

07 01 712 Methods of Environmental Analysis
Analyze the environmental circumstances around our buildings, which need several scientific curriculums on the bases that architect analyze this environment.

07 01 713 Built Environment and Energy Conservation
Study what is needed for built environment from energy and study of architectural methods from techniques, materials, and studied, which help saving energy as a main source of sustainable energy environmental resources.

07 01 714 Design Methodology and Analysis
Study theoretical and practical methods that should be followed architects during architectural design process with defining the separate variables or related to design elements in different applications.

07 01 715 Sustainable Architecture
Study theoretical and practical basics of sustainability and how it could be applied in different architectural design phases to guarantee special nature architecture to protect sustainability of resources of future generations.

07 01 716 Rehabilitation of Buildings
Study the physical, capacity, and historical capability of the building for the possibility of rehabilitation whether in the same activity or in new other activity. Study the capability of the site, which is one of the important variables in building rehabilitation. The course exposes to theoretical and strategic basics and practical application techniques followed in developed and developing countries in building rehabilitation.

07 01 717 Introduction to Construction Economics
Definitions in engineering economy with the study of analysis mechanisms, methodologies, economical thinking methods through direct applications on building industry generally and specifically.

07 01 718 Feasibility Studies
Study types of different projects and how to make different types of feasibility studies like marketing, economical, technical, and environmental with focus on technical feasibility of projects.

07 01 719 Special Studies in Architectural Design
Seminars focus on special specific vital topics in architectural design and the student is asked to select a research point, which is proper with this to gain more experiences as well as learning other experiences.

07 01 720 Special Studies in History and Theory of Architecture

Seminars focus on special specific vital topics in history and theories of architecture and the student is asked to select a research point, which is proper with the course name.

07 01 721 Architectural and Urban Criticism
Study the architectural and artistic schools movements with relation to architecture and criticize these schools in an objective way, which help to gain the student the sense of evaluating the architectural with comprehensive vision.

07 01 722 Conservation of Architectural Heritage
Study theoretical and practical basics in a wide range, which should be accompanied by historical building conservation, strategies, and techniques in each type of buildings in a specific way.

07 01 723 Special Studies in Building Technologies
Seminars focus on special defined subjects, which are significant in building technologies. Students select one of research point, which are suitable for course title.

07 02 711 Special Studies in Urban Design
Seminars focus on special defined subjects, which are significant in urban studies. Students select one of research point, which are suitable for course title.

07 02 712 Development of Urban Environment
Study theoretical basics of urban environment from shelter, local economy, urban basic services, infrastructure, and services, and how to develop these major areas with into consideration the cross cutting areas from environment, vulnerable groups, gender, and governance to this environment.

07 02 713 Policies of Land Use

Study theoretical and practical basics that are governed in policies of land uses and examples of experiences followed in that field. How to establish strategies for land use plans, which guarantee a proper distribution of society's needs to ensure availability of its demands with saving the environment.

07 02 714 Transportation and Land Use

Study the interaction relationship between land use and transportation systems in the urban fabric. Study the interaction models from the real international experiences.

07 02 715 Introduction to Geographical Information Systems

Study theoretical and practical basics that are followed in geographic information system about the possibility of dealing with different information as a decision support system tool in several planning and urban applications to give the possibility to deal with geographic information system technology individually at any valid field.

07 02 716 Introduction to Remote Sensing

Study theoretical and practical basics that are followed in remote sensing as a decision support system tool in several planning and urban applications to give the possibility to deal with remote sensing technology at any valid field.

07 02 717 Basics of Environmental Sciences

Understand the general trends in environmental sciences problems, definitions, and methodologies with the possibility to use geographic information system and remote sensing to express environmental problems as a decision support system tool in that matter. Evaluate the positive or negative effects of projects on the surrounding environment and the effect of that on the feasibility of projects. Applications in that course take into consideration the architectural application.

07 02 718 Applications of Geographical Information Systems and Remote Sensing in Environmental Indicators

Intense study in geographic information system and remote sensing to give the student the chance for theoretical and practical study to solve the problems. Examples with major differences are studied and analyzed to convey multiple experiences. The course needs a previous experience in geographic information system and remote sensing.

07 02 719 Theories and Methodologies of Urban Planning

One of the application to geographic information system and remote sensing to impart the student the experiences and enough skills in the field of followed methodologies in urban planning equally in developed and developing countries. The course needs a previous experience in geographic information system and remote sensing.

07 02 720 Research Methods

The course introduces the methodologies of academic research and its techniques, so as to enable students to adequately conduct research work, in addition to presenting procedures of academic writing so as to produce rational, thorough, and complete research documents fulfilling essential scientific requisites. The course also reviews the commonly applied research methods along with simple statistics that develop the students' ability to devise inquiries, take samples, analyze data, and induce statements and conclusions.

07 01 811 Selected Topics in Architectural Design and Renewable Energy

Seminars concentrate on special defined topics with significance in architectural design. The student selects a research point corresponding to gained experiences taking into consideration sources of renewable energies and their applications.

07 01 812 Selected Topics in Computer Applications in Architecture

Seminars focus on specific special topics with the necessary in computer architectural applications. The student is obligated to select a research point that is suitable to get experience in comparison to other experiences.

07 01 813 Selected Topics in Building Technologies and Materials

Study the enormous progress in building methods, techniques, and available possibilities, in addition, to what the scientists create from materials valid for architecture use. The Ph. D. specialized candidate should be exposed to modern techniques and materials. The candidate studies success existing interface between architectural sciences and available techniques and how they could be applied in architectural design and projects to gain more experiences.

07 02 811 Selected Topics in Urban Development

Seminars focus on special defined significant topics in studying theoretical basics of urban development with respect to shelter, local economy, urban basic services, services, and

governance. Negative and positive from pollution, poverty and welfare of existing effects on these developments and their habitants are discussed.

07 02 812 Selected Topics in Urban Communities
Seminars focus on special defined significant topics in studying theoretical basics of urban communities with respect to shelter, local economy, urban basic services, and services. Negative and positive from pollution, poverty and welfare of existing effects on these communities and their habitants are discussed.

07 02 813 Selected Topics in City Problems
Study the existing problems in cities of developed or developing countries and their roots, and causes, which are different or similar and making comparative studies among cities.

07 03 811 Selected Topics in Rural Housing
Seminars focus around specific and special subjects significant in studying rural housing. Students are asked to select a research point that is proper with the topic of this course. Study the development of rural housing types in developed and developing countries and the policies of these countries to provide, and upgrade their prototypes, and the negative and positive aspects of other system on rural housing.

07 03 812 Selected Topics in Informal Housing
Seminars focus around specific and special subjects significant in studying informal housing. Students are asked to select a research point that is proper with the topic of this course. Study the development of informal housing types in developed and developing countries and the policies of these countries to provide, and upgrade their prototypes, and the negative and positive aspects of other system on informal housing.

07 03 813 Selected Topics in Urban Housing
Seminars focus around specific and special subjects significant in studying urban housing. Students are asked to select a research point that is proper with the topic of this course. Study the development of urban housing types in developed and developing countries and the policies of these countries to provide, and upgrade their prototypes, and the negative and positive aspects of other system on urban housing.

07 01 601 Diploma Project in Landscape

07 01 602 Diploma Project in Multimedia Applications in Architecture

07 01 603 Diploma Project in Architectural Engineering and Urban Design

07 01 701 Scientific Report of Master of Engineering in Architectural Engineering

07 01 705 Master of Science Thesis in Architectural Engineering

07 01 801 Doctor of Philosophy Dissertation in Architectural Engineering

Department of Structural Engineering

The department of Structural Engineering offers the following programs:

1. Graduate Diploma

1.1 Specialized Graduate Diploma in Structural Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must complete the following 6 courses equivalent to 18 credit hours.
(0704 610 – 07 04 620- 07 04 630-07 04 641- 07 04 660, 07 04 650)
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.2 Specialized Graduate Diploma in Construction and Project Management

The student must complete 30 credit hours.
Compulsory courses: The student must complete the following 6 courses equivalent to 18 credit hours.
(07 04 610- 07 04 663- 07 04 643- 07 04 660- 07 04 661- 07 04 662)
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

2. Master Degrees

2.1 Master of Engineering in Structural Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must select a number of courses from the available course list in the required structural engineering stream option. The department council specifies the M.Eng. degree specialization in structural engineering according to the courses to be studied.
The student is allowed to choose 2 courses from another major.

2.2 Master of Engineering in Construction and Project Management

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must select a number of courses from the available course list in the required construction and project management stream option. The department council specifies the

M.Eng. degree specialization in construction and project management according to the courses to be studied.
The student is allowed to choose 2 courses from another major.

2.3 Master of Science in Structural Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must select a number of courses from the available course list in the required structural Engineering stream option. The department council specifies the M.Sc. degree specialization in construction and project management according to the courses to be studied.
The student is allowed to choose 2 courses from another major.

2.3 Master of Science in Construction and Project Management

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must select a number of courses from the available course list in the required construction and project management stream option. The department council specifies the M.Sc. degree specialization in construction and project management according to the courses to be studied.
The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Structural Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must select a number of courses from the available course list in the required structural engineering stream option. The student is allowed to choose 3 courses from another major.

3.1 Doctor of Philosophy in Construction and Project Management

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must select a number of courses from the available course list in the required construction and project management stream option. The student is allowed to choose 3 courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit Hours	Exam Duration
1	07 04 610	Advanced Structural Analysis and Computer Applications	3	3
2	07 04 611	Advanced Structural Systems and Applications	3	3
3	07 04 620	Soil Mechanics and Advanced Foundations	3	3
4	07 04 621	Site Exploration – Field and Laboratory Investigations	3	3
5	07 04 622	Rock Mechanics and Tunneling Engineering	3	3
6	07 04 630	Ultimate Design of Metallic Structures	3	3
7	07 04 631	Design of Composite Beams	3	3
8	07 04 632	Stability of Metallic Structures	3	3
9	07 04 633	Design of Special Metallic Structures	3	3
10	07 04 640	Properties and Testing of Materials.	3	3
11	07 04 641	Specifications of Construction Materials	3	3
12	07 04 642	Special Types of Concrete	3	3
13	07 04 643	Inspection, Quality Assurance and Control	3	3
14	07 04 650	Design of Reinforced Concrete Structures – 1	3	3
15	07 04 651	Pre-stressed Concrete -1	3	3
16	07 04 652	Shell and Space Structures	3	3
17	07 04 653	Design of RC Structures for Earthquake Resistance	3	3
18	07 04 654	Inspection, Assessment, Repair and Strengthening of Reinforced Concrete Structures	3	3
19	07 04 660	Conditions of Contracts for Works of Civil Engineering Construction (FIDIC)	3	3
20	07 04 661	Productivity Improvement in Construction Projects	3	3
21	07 04 662	Computer Applications in Construction Management	3	3
22	07 04 663	Construction Engineering	3	3
23	07 04 664	Management of Construction Companies	3	3
24	07 04 710	Stability of Structures I	3	3
25	07 04 711	Theory of Elasticity	3	3

26	07 04 712	Plastic Analysis of Structures	3	3
27	07 04 713	Structures Analysis of Plates & Shells	3	3
28	07 04 714	Structural Dynamics I	3	3
29	07 04 715	Structural Dynamics II	3	3
30	07 04 716	Analysis of Composite Structures	3	3
31	07 04 717	Finite Element I	3	3
32	07 04 718	Nonlinear Analysis of Structures I	3	3
33	07 04 720	Geo-environmental Engineering	3	3
34	07 04 721	Buried Structures and tunnels	3	3
35	07 04 722	Numerical Methods for Solving Soil Problems	3	3
36	07 04 723	Soil Dynamics	3	3
37	07 04 730	Stability of Structures -2	3	3
38	07 04 731	Metallic Space Structures	3	3
39	07 04 732	Metallic Tall Buildings	3	3
40	07 04 733	Optimum Design of Steel Structure	3	3
41	07 04 734	Cold Formed Structures	3	3
42	07 04 740	Time Dependent Properties and Failure of Hardened Concrete	3	3
43	07 04 741	Concrete Technology	3	3
44	07 04 742	Deterioration of Construction Materials and Materials of Repair	3	3
45	07 04 743	Non-Destructive Testing and Experimental Stress Analysis	3	3
46	07 04 744	Corrosion Theories of Metallic Materials.	3	3
47	07 04 745	Durability of Concrete	3	3
48	07 04 746	Introduction to Fracture Mechanics	3	3
49	07 04 750	Design of Reinforced Concrete -2	3	3
50	07 04 751	Pre-stressed Concrete -2	3	3
51	07 04 752	Analysis and Design of Tall Concrete Structure		
52	07 04 753	Mechanics of Concrete Structures	3	3

53	07 04 760	Linear Application Program in Civil Engineering	3	3
54	07 04 761	Risk Management, Insurance and Licensing	3	3
55	07 04 762	Quality Control in the Construction Process	3	3
56	07 04 763	Shallow Foundations	3	3
57	07 04 764	Claims, Liability and Dispute Resolution	3	3
58	07 04 810	Analysis of Space and Non-conventional Structures	3	3
59	07 04 811	Inelastic Seismic Performance and Damage Evaluation of Building Structures	3	3
60	07 04 812	Wind Engineering	3	3
61	07 04 813	Seismic Analysis of Structures	3	3
62	07 04 820	Limit Analysis of Soil Problem	3	3
63	07 04 821	Geotechnical Earthquake Engineering	3	3
64	07 04 830	Metallic Suspension Structures	3	3
65	07 04 831	Pre-stressed Metallic Structures	3	3
66	07 04 840	Value Engineering in the Construction Industry	3	3
67	07 04 850	Self-Compacting Concrete and High Performance Concrete	3	3
68	07 04 601	Diploma Project in Structural Engineering	3	Presentation
69	07 04 602	Diploma Project in Construction and Project Management	3	Presentation
70	07 04 701	Master of Engineering Report in Structural Engineering	3	Defense
71	07 04 702	Master of Engineering Report in Construction and Project Management	3	Defense
72	07 04 705	Master of Science Thesis in Structural Engineering	8	Defense

73	07 04 706	Master of Science Thesis in Construction and Project Management	8	Defense
74	07 04 801	Doctor of Philosophy Dissertation in Structural Engineering	24	Defense
75	07 04 802	Doctor of Philosophy Dissertation in Construction and Project Management	24	Defense

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 04 610 Advanced Structural Analysis and Computer Application
Matrix analysis of structures. Stiffness method for analyzing trussed and framed structures. Approximate methods for structural analysis. Computer applications.

07 04 611 Advanced Structural Systems and Applications
Advanced lateral load resisting systems: special moment resisting frames, concentrically braced frames, eccentrically braced frames, dual systems and special truss moment resisting frames. Composite structures; space single layer and double layer lattice domes; double layer space trusses; cable net structures; membrane and fabric structures; air-supporting structures; deployable structures. Applications using structural-analysis computer programs.

0704612 Introduction to Theory of Elasticity
Definition of stress and strain; principal stresses and strains; stress deviation tensor and its invariants; octahedral stresses; Mohr's circles; equations of equilibrium; equations of compatibility; Hook's law; plane stress and strain case; principle of virtual work; Stress function; polar coordinates.

0704613 Introduction to Dynamics of Structures
Types of dynamic loads; equation of motion; free and forced vibration of single-degrees of freedom (SDF) systems; introduction to multi-degrees of freedom (MDF) systems.

0704614 Numerical Methods in Structural Analysis
Matrix analysis of structures; Stiffness method for analyzing trussed and framed structures; Approximate methods for structural analysis; Computer applications.

704615 Elasto-Plastic Analysis of Structures
Definition of plastic hinge; formation of plastic hinge in structures; The curvature and rotational ductility of plastic hinges; inelastic analysis of frames subjected to lateral static

loading; evaluating the inelastic seismic performance of frames designed according to the Egyptian code.

0704616 Introduction to Nonlinear Analysis
Definition of nonlinearity and its sources; methods of equilibrium check; solution of nonlinear problems: incremental and iterative solution techniques; tracing of equilibrium path beyond limit and bifurcation critical points; automation of load increments; convergence criteria.

07 04 620 Advanced Soil Mechanics and Foundations
Pile foundations: piles under vertical loads, piles under horizontal loads and analysis of pile groups. Machine foundations: soil dynamics, theory of vibrations, design of foundations for machines. Underground structures: types, geological investigations, earth/rock pressure on underground structures, specifications, and design and construction methods. A.R.E specifications of deep foundations.

07 04 621 Site Exploration – Field and Laboratory Investigation
Program for site investigation. Various methods of site investigation. Laboratory tests. Field tests. Field equipment for measuring soil displacements. Chemical analysis for soils and ground water.

07 04 622 Rock Mechanics and Tunneling Engineering
Definition. Rock formation. Physical properties and laboratory tests. Mechanical properties and their measurements. Field tests. Stress under surface loading. Lateral rock pressure. Stability of cuts. Site investigations. Foundation resting on rock. Types of tunnels. Geological investigations. Earth/rock pressure on tunnels. Planning of tunnels. Specifications and design construction methods.

07 04 630 Ultimate Design of Metallic Structures
Comparative study for the methods of design in metallic structures. Design of trusses using the ultimate strength method. Design of beams and frames .Design of connections.

07 04 631 Design of Composite Beams
Theory of composite structures. Design of simple and continuous girders .Effect of secondary stresses .Shear connectors. Methods of construction

07 04 632 Stability of Metallic Structures
Fundamentals and conditions of equilibrium. Types of loads .Types of bodies. Different methods for the critical load .Mathematical model for the stability of equilibrium. Critical loads of columns and beam-columns. Stability of frames. Torsion and torsional buckling. Lateral buckling. Buckling of plates .

07 04 633 Design of Special Metallic Structures
Design of tanks. Elevated tanks. Bunker and Silos. Design of guyed towers and self-supporting towers .Transmission towers. Space and long span roofs.

07 04 634 Design of Thin Walled Steel Structures
Classification of elements; properties of sections, allowable design stresses, effective width of compression elements, design of axially loaded members, beams and beam-columns, design of connections.

07 04 640 Properties and Testing of Materials
Concrete aggregates, properties, selection, optimization and durability of Cement, hydration, heat evolution, special types of cement, chemical and mineral admixtures, classification, physical properties, performance, cost and mechanical properties, Wood, types, properties and testing. Waterproof and heat insulation materials, introduction to polymer.

07 04 641 Specifications of Construction Materials
Egyptian standard specifications. ASTM. B.S.S. comparison between different specifications. Compositions of construction materials.

07 04 642 Special Types of Concrete
Properties and strength of light weight concrete. Fibrous concrete. Massive concrete. Pre-stressed concrete. Pre-cast concrete and heavy weight concrete.

07 04 643 Inspection, Quality Assurance and Control
Test procedures. Sampling methods. Data collection and statistical data distributions. Quality control charts. Development of quality assurance. Specifications and acceptance plans. Examples using data from actual field of construction and laboratory experiments collected by destructive and non-destructive methods. Inspection and testing of construction materials. Inspection before, during, and after construction.

07 04 644 Production of Engineering Materials - Fatigue of Metallic Materials and Welding Techniques
Ferrous materials; Raw material of iron, High furnace, Production of raw cast iron, Transforms,- Production of sponge iron by direct reduction, Processes of continuous casting,- Rolling process, Extraction and forging- Non-ferrous materials; Raw materials for aluminum, Processes of electrical analysis, melting, aluminum continuous casting, Rolling processes, Raw material for lead, Extraction of lead- Alloys; Extraction processes- Plastics- Examples of other metals.

Types of repeated and cyclic loading - Welding techniques and monitoring - Fatigue limits for common types of welding- Residual stresses and its monitoring. Brittle fracture of steel weld elements- Failure of metals and weld elements under repeated loading- Damage theories for welded and un welded metals- Applications and selection of design parameters- Testing of welds; Welding techniques, methods and non-destructive tests of welds, Residual stresses and its measurements.

07 04 645 Non-Destructive Testing and Experimental Stress Analysis

Non-destructive tests of concrete and metals; hardness testing, steel dedication and others- Visual test; pressure and leak test, liquid penetration test, test by radiography, test by magnetic methods, test by ultrasonic methods and test by eddy current methods - Experimental stresses analysis, structure model analysis, Analogy - Stress analysis by brittle coatings and brittle models and grid methods- Photo elasticity.

07 04 650 Design of Reinforced Concrete Structures – 1

Limit States Method – Strength of concrete under combined stresses – Analysis and design of reinforced concrete members subjected to flexure – Eccentric compression – Shear and Torsion – Bond and anchorage – Serviceability limit state: deflection and crack control – Yield Line analysis of slabs.

07 04 651 Pre-stressed Concrete – 1

Methods of pre-stressed. Properties of materials used in pre-stressed concrete. Pre-stress losses .Analysis and Design of sections subjected to bending moment and shear forces cracking and Ultimate loads. Composite beams.

07 04 652 Space and Shell Structures

Introduction, Loading, Membrane theory for surfaces of revolution
Cylindrical Shells: membrane theory, bending theory for closed circular cylindrical surfaces subjected to ax symmetrical loading, bending theory for open circular cylindrical surfaces .Circular cylindrical shell roofs continuous in the transverse direction - Circular cylindrical shell roofs continuous in the longitudinal direction .Applications on different shell problems.

07 04 653 Design of RC Structures for Earthquake Resistance

Introduction, Ground Conditions and Seismic Action. Characteristics of Earthquake resistant buildings. Structural Analysis, Specific Rules for Concrete Buildings: Design concepts, Design according to Egyptian Code, Provisions for anchorage and splices Concrete Foundation Elements.

07 04 654 Inspection, Assessment, Repair and Strengthening of Reinforced Concrete Structures

Defects, Methods of inspection, Assessment of Reinforced concrete Structures, Reasons for Repair and/or Strengthening, Methods of repair or Strengthening of RC structures .Non-Conventional Methods of repair or strengthening, Analysis of RC sections after strengthening.

0704655 Introduction to reinforced concrete tall buildings

Introduction – analysis and design of tall buildings containing symmetrically and unsymmetrically placed shear walls – design of shear walls with openings – design of box structures – evaluation of the different systems used in tall buildings.

07 04 660 Conditions of Contracts for Works of Civil Engineering Construction (FIDIC)

General conditions. Definitions and interpretation. Engineer and engineer's representative. Assignment and subcontracting. Contract documents. General obligations. Labor. Materials, plant and workmanship. Suspension. Commencement and delays. Defects liability. Alterations, additions and omissions. Procedure for claims. Contractor's equipment, temporary works and materials. Measurement. Provisional sums. Nominated subcontractors. Certificates and payment. Remedies. Special risks. Release from performance. Settlement of disputes. Notices. Default of employer. Changes in cost and legislation. Currency and rates of exchange.

07 04 661 Productivity Improvement in Construction Projects

Production process improvement. Work task analysis. Recording techniques. Work measurement. Field count. Theory of activity sampling. Estimating and tendering. Parties involved in estimating and tendering. The estimates process. Tendering adjustments. Submitting the tender. Workforce motivation. Cost control. Allocation of cost. Materials control. Subcontractors.

07 04 662 Computer Applications in Construction Management

Primavera Project Planner (P3). Creating projects and layouts. Working with activities and relationships. Activity and resource calendars. Defining project dictionaries. Calculating and adjusting the schedule. Targets and progress. Resource management. Project groups. Project tools. Customizing views. Grouping, sorting, filtering, and summarizing data. Printing layouts, reports, and graphics.

07 04 663 Construction Engineering

Overview of the construction industry. Earthmoving machinery and properties. Excavation and lifting. Loading and hauling. Compaction and finishing. Concrete construction. Concrete form design.

07 04 664 Management of Construction Companies

Company organization. Market planning and business development. The business development strategy. The business forecast. Company strengths and weaknesses, international construction logistics. Information resources. Process involved in construction business, management of contractor' information resources. Financial management. Capital sources. The company accounts. Analysis of the balance sheet. Inflation accounting.

07 04 665 Linear programming principals in construction projects

A two-variable model and its graphical solution, linear programming (LP) formulations, additional linear programming formulations, overall idea of the simplex method, development of the simplex method, primal simplex method, dual simplex method, special cases in simplex method application, interpreting the simplex tableau: sensitivity analysis, mathematical foundations, revised (primal) simplex method, definition of the dual problem, solution of the dual problem, economic interpretation of the dual problem, complementary slackness, post-optimal or sensitivity analysis, parametric linear programming, definition and application of the transportation model, solution of the transportation problem.

07 04 666 Introduction to equipment and construction methods.

Fixed-position excavation machines, methods of transportation materials, specialized excavation machines, simple lifting mechanisms, cranes, truck, tower cranes, fork-lift truck, monorail, concrete pump, aggregate production, concrete production, pre-stressed concrete, flexible pavement construction, bituminous based materials for flexible pavements, concrete pavement construction, soil-stabilized pavement construction, welding technology, bridge construction methods.

07 04 667 Economic Feasibility study of construction projects.

Interest calculations, simple interest, cash flow diagrams, compound interest, nominal and effective interest rates, present worth, uniform series of payments, equivalence, uniform gradient series, economic feasibility, traditional methods of appraisal, the equivalent annual cost method, the present worth method, capitalized costs, internal rate of return method, influences on economic analysis.

07 04 668 Introduction to Stability of Structures

Introduction and terminology; mathematical models; Stability of columns in elastic and plastic domains; Beam-columns; Stability functions; torsional buckling, flexural-torsional buckling; lateral buckling of beams.

07 04 710 Stability of Structures -1

Introduction and scientific terms, mathematical models, stability of column in elastic and plastic state, stability function, torsional buckling, later buckling of beams.

07 04 711 Theory of Elasticity

Stress and strain tensor; principal stresses and invariants of stress tensor; stress deviation tensor and its invariants; octahedral stresses. Mohr's circles for three dimensional stress system; equations of equilibrium; equations of compatibility. Linear elastic isotropic stress-strain relation (hook's law); plane stress case; plane strain case; principle of virtual work. Stress function; applications: effect of circular holes on stress distribution in plates, Saint Venant problems, two dimensional

07 04 712 Plastic Analysis of Structures

Basic concept of plastic analysis; plastic hinge formation; collapse mechanism. Step-by-step method; load-displacement relationship. Static, kinematics, and uniqueness theorems; partial, complete and over-complete collapse mechanisms; method of combining mechanisms; deflection at collapse. Cyclic loading and shake-down theorem; analysis of rectangular and circular plates.

07 04 713 Structural Analysis of Plates & Shells

Assumptions; formulation of governing equations for rectangular plates subjected to normal and in-plane loads. Solutions of rectangular plates with different edge conditions; continuous rectangular plates; plates of various shapes. Thermal stresses in plates; large deflection and buckling of thin plates. Various types of shell structures; assumptions; stress-strain relations; strain-displacement relations. Internal actions; fundamental membrane theory of thin shells; boundary conditions; analysis of cylindrical shells; shells of double curvature; edge disturbance.

07 04 714 Structural Dynamics I

Types of dynamic loads and formulation of the equation of motion. Free and forced vibration of single-degrees of freedom (SDF) systems. Free vibration of multi-degrees of freedom (MDF) systems. Forced vibration of MDF systems. Response of MDF systems to gusting wind and earthquakes.

07 04 715 Structural Dynamics II

Non-classical modal analysis. Fourier analysis. Random vibration; response of single-degree of freedom systems to random load. Distributed random loads. Response of multi-degrees of freedom systems to random loads. Nonlinear vibration.

07 04 716 Analysis of Composite Structures

Analysis of composite sections. Analysis of composite beam-columns under long term loading. Analysis of simple and continuous composite beams. Partial interaction theory

of simple and continuous composite beams. Effect of slip and uplift at the interface of concrete slab steel beams. Types of composite connections and their analysis.

07 04 717 Finite Element I

Matrix algebra; finite difference method. Weighted residual methods; fundamental concepts of finite element method. Structure idealization and discretization; selection of approximating (shape) functions. Deriving the element equation: direct approach and variation approach. Higher order finite element; mapping and numerical integration. Formulation of two and three dimensional problems. Plane stress and plane strain problems; axi-symmetrical problems. System equation; boundary conditions; solving techniques. Computer applications on different structures.

07 04 718 Nonlinear Analysis of Structures I

Sources of nonlinearity; levels of structural analysis; coordinate systems. Equilibrium check; Lagrangian and Eulerian approaches. Solution of nonlinear problems: incremental and iterative solution techniques. Tracing of equilibrium path beyond limit and bifurcation critical points. Automation of load increments. Convergence criteria.

07 04 719 Inelastic Seismic Performance and Damage Evaluation of Building Structures

Modeling various structural systems; Evaluating global strength and ductility of various structural systems under pushover static loading; Assessing the local performance of individual structural elements and determining the effect of the geometric nonlinearity; Evaluating local damage of individual elements and of global damage of whole structural system using damage indices.

07 04 720 Geo-environmental Engineering

Geo-technical practice for waste disposal. New disposal Facilities: landfills, clay liners, geo-membrane liners , collection, and removal system, stability of landfills. Remediation Technologies: strategies for remediation, geophysical techniques for subsurface site. Soil exploration at contaminated sites, vertical cutoff walls, cover system, Recovery well system, in situ bioremediation of ground water, soil washing. Monitoring Wells vadose Zone Monitoring.

07 04 721 Buried Structures and Tunnels

Calculation of loads acting on buried structures of different shapes and flexibility due to own weight of soil, live, and moving loads. Design loads. Method of construction and excavation. Effect of construction method on the adjacent buildings.

07 04 723 Soil Dynamics

Theory of vibration. Wave propagation in systems of an elastic homogeneous isotropic medium. Elastic waves in layers. Propagation of waves in saturated soil. Behavior of dynamically loaded soil. Theory of vibration of foundations.

07 04 724 Earth Retaining Structures
Introduction - Materials and manufacture - Hydraulic design loads and stresses - Design considerations - Durability considerations - Design for sulfide control - Standards and testing - Slurry walls - Reinforced earth.

07 04 725 Deep Foundations
Elastic behavior of axially and laterally loaded piles and piers - Ultimate bearing capacity of single piles and pile groups subjected to axial loading - lateral loading and inclined loading - Driving stresses and formula - Inspection and testing of piles after installation - Deep foundation in difficult subsoil conditions.

07 04 726 Theoretical Soil Mechanics
Stress – Strain behavior of soil. Stress path concept - Critical state of soil mechanics. Shear strength of soil - Flow of water through soil**.**

07 04 727 Soil Instrumentation and Field Testing
Theory of wells - Construction of wells - Observation wells and pumping wells – Inclinometers - Plate loading test - Penetrometers: static and dynamic – Piezocone – Pressuremeter.

07 04 728 Rock Mechanics and Tunneling Engineering – 2
Definition - Rock formation - Physical properties and laboratory tests - Mechanical properties and their measurements - Field `tests - Stress under surface loading - Lateral rock pressure - Stability of cuts - Site investigations - Foundation resting on rock - Types of tunnels - Geological investigations - Earth/rock pressure on tunnels - Planning of tunnels - Specifications and design construction methods.

0 7 04 730 Stability of Structures II
Buckling of columns on elastic foundations. Stability of frames; stability of plates in elastic and plastic domains. Stability of arches and rings; stability of shells.

07 04 731 Metallic Space Structures
Analysis of space structures. Types of loads acting on space structures. Design of sections and connections of space structures. Methods of construction.

07 04 732 Metallic Tall Buildings

Construction methods of tall buildings. Types of loads acting on tall buildings. Structural systems of tall buildings. Approximate methods of analysis for tall buildings. Behavior of buildings under the effect of vertical and horizontal loads. Design of connections and wind bracing systems.

07 04 733 Optimum Design of Steel Structures

General formulation of optimal design. Approaches to structural design optimization . Optimality criteria method . Linear, nonlinear, and dynamic programming. Applications in the optimization of steel structures.

07 04 734 Cold Formed Structures

Theory of thin walled sections. Design of sections subjected to axial and combined axial and bending forces. Design of connections and bracing. Methods of construction.

07 04 735 Ultimate Strength Design of Metallic Structures

Design of trusses using the ultimate strength method - Design of beams and frames - Design of connections - Comparative study for the methods of design in metallic structures.

07 04 736 Design of Special Metallic Structures-2

Design of tanks - Elevated tanks - Bunker and Silos - Design of guyed towers and self-supporting towers.

07 04 737 Analysis and Design of Steel Towers

Shapes: guyed, transmission towers - Loadings: vertical loading, wind loading and wire loading - Temperature effects; mast; guys; fasteners; foundation - Linear analysis; nonlinear analysis; buckling strength; design formula - Fabrication; erection.

07 04 738 Advanced Structural Analysis and computer applications-2

Analysis of structures in three dimensions - stiffness method for analyzing 3D structures - methods of dynamic analysis - computer applications.

07 04 739 Analysis and Stability of Suspended Structures-1

Introduction; definitions; shapes of suspended structures; structural behavior of cables; static analysis; introduction to Nonlinear analysis and stability; introduction to Performance under wind and earthquake loading; methods of design and erection.

07 04 740 Time Dependent Properties and Failure of Hardened Concrete

Concrete behavior under uniaxial, biaxial, and triaxial stresses in tension and compression. Shrinkage of concrete, creep of concrete, creep of prestressed concrete, relaxation of steel stress in prestressed concrete.

07 04 741 Concrete Technology
Hot weather concreting. Massive concrete. Effect of volume change on cracks of massive concrete. Concrete testing in existing structures. Design of mixes for normal, and heavy weight concrete. Admixtures for concrete. Evaluation of strength test results of concrete. Selection and use of aggregates for concrete. Structural Composite materials. Refractory concrete materials.

07 04 742 Deterioration of Construction Materials and Materials of Repair
Durability of concrete. Corrosion of steel. External influences on concrete. Chemical attacks. Assessing concrete damage. Diagnosis of building. Methods of repair (dry-pack method, concrete replacement method, mortar, use of epoxy). Protection of steel reinforcement against corrosion. Case study for the use of repairing materials.

07 04 743 Non-Destructive Testing and Experimental Stress Analysis
Non-destructive tests of concrete and metals hardness testing, steel dedication and others. Visual test. Pressure and leak test. Liquid penetration test. Test by radiography. Test by magnetic methods. Test by ultrasonic methods. Test by eddy current methods. Experimental stresses analysis: structure model analysis. Analogy. Stress analysis by brittle coatings and brittle models. Grid methods. Photo elasticity

07 04 744 Corrosion Theories of Metallic Materials
Theory of galvanic cells. Properties of corroded metals. Fatigue corrosion and creep stresses. Crack diffusion in metals subjected to corrosive media. Design limit of metals in corrosive cells. Application: pressure vessels, chemical settlers, reinforced steel bars. Protection and prevention method. Cathodic protection concept. Corrosion tests and monitoring.

07 04 745 Durability of Concrete
Design of concrete mixes for durability. Permeability of concrete and factors affecting it. Determination of permeability coefficient: organic and inorganic acid attack. Effect of sulfates on concrete. Effect of chlorides on the durability of concrete. Effect of sea water on concrete. Corrosion of steel reinforcement and its protection. Choice of aggregate and type of cement for durability under severe conditions. Freezing and thawing of concrete in cold weather, Alkali reaction of aggregate.

07 04 746 Introduction to Fracture Mechanics
Cohesive strength, plasticity, Fracture mechanics in relation to structure steel, Stress intensity, Fracture toughness, Energy release rate, LEFM , COD, J- integral , R-curve, fatigue, compressive fracture of concrete, , Masonry and rocks; cracking patterns , fracture theories, damaged models, test methods and effects.

07 04 747 Construction Technology

Concrete casting; of high-rise building, in moving water- Formwork: Concrete pressure, ACI equation, tunnel formworks, slip-form and design- Construction methods; pre-stressed concrete, pre-cast concrete and steel construction – welding.

07 04 748 Inspection and Quality Control-2

Definition of quality and quality assurance according to Egyptian code- Variables and attributes - Different charts of quality control - Quality control of building materials.

07 04 749 Self Compacting Concrete and High Performance Concrete-1

Self-compacting concrete; Definitions, Materials, Admixtures, Tests, properties and design of concrete mixes - High performance concrete - Mineral admixtures; Properties, Applications.

07 04 750 Design of Reinforced Concrete Structures -2

Limit States Method – Strength of concrete under combined stresses – Analysis and design of reinforced concrete members subjected to flexure – Eccentric compression – Shear and Torsion – Bond and anchorage – Serviceability limit state: deflection and crack control – Yield Line analysis of slabs.

07 04 751 Pre-stressed Concrete -2

Methods of pre-stressing – Properties of materials used in prestressed concrete – Pre-stressing losses – Analysis and Design of sections subjected to bending moment and shear forces – Cracking and Ultimate loads – Composite beams – Study of end anchorage zone – Statically indeterminate structures.

07 04 752 Analysis and Design of Tall Concrete Buildings

Introduction – Analysis and design of tall buildings containing symmetrical and asymmetrically distributed shear walls. Design of shear walls containing openings, Design of tubular structures, Evaluation of these methods.

07 04 753 Mechanics of Concrete Structures

Modes of failure under multi-axial stresses. Nature of bond and distribution of stresses between cracks. Representation of concrete structures by the finite element. Methods to study the behavior of reinforced concrete members Elastic and plastic buckling for element subjected to concentric and Eccentric loads.

07 04 754 Reinforced concrete shell structures – 2

Introduction – loads – membrane theory – cylindrical shells: membrane theory, bending theory for axi-symmetrically loaded closed cylindrical surfaces and bending theory for

open cylindrical surfaces – cylindrical shells continuous in the transverse direction - cylindrical shells continuous in the longitudinal direction – examples

07 04 755 Seismic design of reinforced concrete structures -2
Introduction – movement of tectonic plates and nature of earthquakes – specifications of earthquake resisting structures – Structural analysis – reinforced concrete tall buildings: design principals, design according to Egyptian code – splices and curtailment of reinforcement - foundations

07 04 756 Inspection, evaluation, repair and strengthening of reinforced concrete structures-2
Introduction – faults and damage – inspection methods – evaluation methods for reinforced concrete structures – aims of repair and strengthening – methods of repair and strengthening of reinforced concrete structures – modern methods for repair and strengthening – analysis of strengthened reinforced concrete sections

07 04 757 Introduction to Seismic Analysis of structures
Definitions; General characteristics of earthquake ground motion; earthquake risk; seismic design principles; Deterministic analysis of earthquake response; governing equations, linear elastic and inelastic response; introduction to design response spectra; parameters affecting seismic behavior of structures; Introduction to probability theory and Fourier analysis; Non-deterministic earthquake analysis.

07 04 758 Introduction to Analysis of Space and Non Conventional Structures
Definitions; Introduction to different methods for analyzing space structures to calculate imternal forces; Loads on space structures; design of sections and connections of space structures.

07 04 760 Linear Application Program in Civil Engineering
Definition of linear program, graphic solution and simplex method, application of linear program in structural engineering and project management. Methods of solution and application.

07 04 761 Risk Management, Insurance and Licensing
General introduction in law. Laws for labor in Egypt. Insurance laws for building. Taxation laws concerning contracting companies and consulting services. Building regulations. Legal responsibilities for building construction. Principles of accounting. Applications to construction industry. The bidding process and bidding requirements. Principles and basics of construction contracting. Types of construction contracts. Selection of construction contracts. Contracts documents. Project delivery systems.

Introduction to building and construction law. Legal aspects associated with construction projects.

07 04 762 Quality Control in the Construction Process
Introduction to quality. Quality improvement techniques. Fundamentals of statistics and probabilities. Control charts for variables and attributes. Lot-by-lot acceptance sampling by attributes. Acceptance sampling systems. Reliability. Cost of poor quality. Total quality management. Computers and quality control.

07 04 763 Shallow Foundations
Beams on elastic foundations. Plates and rafts on elastic foundations. Beams and plates resting on non-homogeneous soil. Shallow foundations in difficult sub-soil conditions.

07 04 764 Claims, Liability and Dispute Resolution
Contract changes. Major claim categories. Design changes, additions and deletions. Changed site condition. Delay claims. Acceleration effect on claims. Pricing delay claims. Pricing acceleration, impact and effect, and ripple effect claims. Alternative dispute resolution. Text of the contract guidelines for the disputes resolution clause.

07 04 765 Construction Productivity.
Introduction, techniques for measuring, human factors and productivity improvement, management issues

07 04 766 Time delay disputes in construction contracts.
Definitions – causes – types - methods description and implementation - analysis evaluation - professional methodology.

07 04 767 Computer Applications in Civil Engineering Projects.
Using Primavera Enterprise (P6) - Creating projects and layouts - Working with activities and relationships - Activity and resource calendars - Defining project dictionaries - Calculating and adjusting the schedule - Targets and progress - Resource management - Project groups - Project tools - Customizing views - Grouping, sorting, filtering, and summarizing data - Printing layouts, reports, and graphics.

07 04 768 Construction Management.
Integration – Scope, time, cost, quality, human resources, communication, risk, procurement and stakeholder.

07 04 769 Management Techniques of Construction Companies.
Company organization - Market planning and business development - The business development strategy - The business forecast - Company strengths and weaknesses -

international construction logistics - Information resources - Process involved in construction business - Management of contractor' information resources - Financial management - Capital sources - The company accounts - Analysis of the balance sheet - - *Inflation accounting.

07 04 770 Value Engineering in the Construction Industry.
The value concept: history, definitions, application to the construction industry, incentive provisions in construction contracts, factors to be considered, application to design. Value engineering methodology: information phase, speculative phase, analytical phase, proposal phase, and final report phase. Value engineering study procedures: objective, selecting the input required, required documentation, life cycle cost methodology including weighted evaluation.

07 04 771 Construction Equipment and Methods.
Calculation of equipment cost - Predicting equipment productivity - Fixed-position excavation machines - Methods of transportation materials - Specialized excavation machines - Simple lifting mechanisms – Cranes, truck, tower cranes, fork-lift truck, monorail, concrete pump - Aggregate production - Concrete production - Pre-stressed concrete - Flexible pavement construction - Bituminous based materials for flexible pavements - Concrete pavement construction - Soil-stabilized pavement construction - Welding technology - Bridge construction methods.

07 04 772 Feasibility study of civil engineering projects.
Technical study - Economical study and Financial study - Simple interest - Cash flow diagrams - Compound interest - Nominal and effective interest rates - Present worth - Uniform series of payments – Equivalence - Uniform gradient series - Economic feasibility - Traditional methods of appraisal - The equivalent annual cost method - The present worth method - Capitalized costs - Internal rate of return method - Influences on economic analysis.

07 04 810 Analysis of Space and Non-conventional Structures
Introduction; shapes; economy; materials; cables systems. Structural behavior; element stiffness matrices; transformation matrices. Suspension bridges; cable-stayed bridges; continuous suspension bridges. Lattice shells and lattice domes; air-supporting structures. Deployable structures; fabric and cable net structures. Applications using structural-analysis computer programs.

07 04 811 Inelastic Seismic Performance and Damage Evaluation of Building Structures
Modeling various structural systems including; moment-resisting steel frames, concentrically and eccentrically braced steel frame, moment-resisting RC frames and RC

shear walls using computer programs of inelastic dynamic analysis. Evaluating global strength and ductility of various structural systems under pushover static loading and real earthquake records. Assessing the local performance of individual structural elements and determining the effect of the geometric nonlinearity (P-Δ). Evaluating local damage of individual elements and of global damage of whole structural system using damage indices. Applications on capacity-design and seismic rehabilitation.

07 04 812 Wind Engineering

Nature of wind; wind measurements. Characteristics of the atmospheric boundary layer; variation of mean wind speed with height. Turbulence characteristics; turbulence intensity. Power spectrum of strong winds; probability analysis of extreme wind; design wind speed in Egypt. Wind response of structures; stochastic approach; time domain approach; design implications; gust factor; code requirements. Fundamentals of aeroelasticity; wind effects on bridges (divergence, vortex shedding); flutter and galloping.

07 04 813 Seismic Analysis of Structures

General characteristics of earthquake ground motion; characteristics of some typical strong earthquakes; earthquake risk in Egypt; seismic design principles. Deterministic analysis of earthquake response: governing equations, linear elastic response, inelastic response, design response spectra. Code requirements; parameters affecting seismic behavior of buildings. Introduction to probability theory and Fourier analysis. Non-deterministic earthquake analysis; stochastic modeling of strong ground motions; analysis of linear systems; spectral analysis in time domain and frequency domain. Multi component effects of earthquakes.

07 04 814 Analysis and Stability of Suspended Structures-2

Advanced systems in suspended structures; Advanced materials used in suspended structures field; structural behavior of cables and its types; static analysis; stability and non linear analysis; performance under wind and seismic loads.

07 04 820 Limit Analysis of Soil Problem

Upper bound method. Lower bound method. Slip line method. Theory of punching. Progressive failure. Applications of limit analysis in soil problems: earth pressure, stability of slopes, and bearing capacity of footing – soil system.

07 04 821 Geotechnical Earthquake Engineering

Elements of structural dynamics. An outline of the nature and characteristics of earthquake. Strength and deformations of structural materials and elements under loads similar to seismic loads. Effect of some previous created earthquakes. Determination of seismic loads. Probability theory methods in problems of seismic resistance.

07 04 822 Advanced Numerical Methods for Solving Soil Problems
Method of finite element: seepage problems, two-dimensional and three-dimensional elasticity problems, elasto-plastic problems - Application of boundary element and finite element in soil problems.

07 04 823 Advanced theoretical soil mechanics
Application of the theory of elasticity in soil problems: stresses in soil, consolidation in two and three dimensions. Settlement analysis and sand drains. Application of the theory of plasticity in soil problems: stability of slopes, bearing capacity of foundations, and earth pressure on retaining structures.

07 04 824 Soil Structures Interaction
Soil foundation interaction: static and dynamic problems of soil structure interaction.

07 04 825 Application of Numerical Methods in Geotechnical Engineering
Introduction to numerical method techniques - Formulation of field differential equations in solving geotechnical problems - Finite difference method and applications - Finite element method and applications - Boundary element method and applications.

07 04 830 Metallic Suspension Structures
Methods of analysis of suspension structures and bridges. Types of loads acting on suspension structures and bridges. Design procedure of suspension structures and bridges. Methods of construction.

07 04 831 Pre-stressed Metallic Structures
Theory of pre-stressed structures. Design of pre-stresses trusses, beams ,and frames. Applications of pre-stressing in metallic structures. Methods of construction.

07 04 832 Plastic Design of Metallic Structures
Plasticity in metallic structures - Plasticity criteria and limits - Applications on the optimum design of steel structures - Design of connections in plastic state.

07 04 833 Design of Special Structures-3
Offshore and moving metallic structures - Types of drilling steel platforms - Supply structures and piers - Methods of construction of drilling platforms - Types of direct and indirect loading acting on offshore and moving structures - Stability of shells and composite connections in offshore structure.

07 04 834 Stability of Structures-3

Buckling of columns on elastic foundations - Stability of frames; stability of plates in elastic and plastic domains - Stability of arches and rings; stability of shells - Lateral buckling of beams.

07 04 840 Value Engineering in the Construction Industry

The value concept: history, definitions, application to the construction industry, incentive provisions in construction contracts, factors to be considered, application to design. Value engineering methodology: information phase, speculative phase, analytical phase, proposal phase, and final report phase. Value engineering study procedures: objective, selecting the input required, required documentation, life cycle cost methodology including weighted evaluation.

07 04 841 Fracture Mechanics

Stress concentration –Transition behavior of different metallic materials - Ductile and brittle fracture – Non-linear fracture mechanics – Material selection for components subjected to cyclic loading – Fatigue damage and cycle counting analysis- Crack growth rate and fatigue life prediction.

07 04 842 Refractory Concrete and Fire Resistance of construction

Over view of structural fire engineering- Fire behavior; heat transfer and structural response of buildings – Major events of structure fire- Comparison of structural fire design approaches in different codes (E.S.S, ACI - British and Euro codes) - Introduction to fire protection engineering; Methods of insulation- Refractory concrete; Materials , properties and usages.

07 04 843 Micro mechanics of Materials

Basic theories - Analysis techniques and mathematical foundations of micromechanics - Physical micromechanics: mathematical theory of dislocation, and cohesive fracture models - Micro-elasticity: Eshelby's eigenstrain theory - Comparison variation principles, and mico-crack/mico-cavity based and damage theory - Theoretical composite material that includes the main methodologies in evaluating overall material properties - Meso-plasticity that includes meso-damage theory, and the crystal plasticity - Homogenization theory for materials with periodic structures.

07 04 850 Design of reinforced concrete structures-3

Strength of concrete subjected to combined stresses – eccentric compression – shear and torsion – bond – deflection and crack control – analysis of slabs using the yield line theory – steel/concrete composite structures – strut and tie model.

07 04 851 Seismic design of reinforced concrete structures -3

Introduction – movement of tectonic plates and nature of earthquakes – specifications of earthquake resisting structures – Structural analysis – reinforced concrete tall buildings: design principals, design according to Egyptian code – splices and curtailment of reinforcement – foundations.

07 04 852 Analysis and design of reinforced concrete tall buildings-2
Introduction – analysis and design of tall buildings containing symmetrically and unsymmetrically placed shear walls – design of shear walls with openings – design of box structures – evaluation of the different systems used in tall buildings.

07 04 853 Mechanics of concrete structures
Failure modes for concrete subjected to multi-axial stresses – nature of bond and stress distribution between cracks – modeling of concrete structures using the finite element method for studying the behavior of reinforced concrete elements – elastic and plastic buckling of members subjected to axial and eccentric loads.

07 04 861 Advanced Computer Applications in Construction Management.
Advanced use of Primavera Enterprise (P6) - Creating projects and layouts - Working with activities and relationships - Activity and resource calendars - Defining project dictionaries - Calculating and adjusting the schedule - Targets and progress - Resource management - Project groups - Project tools - Customizing views - Grouping, sorting, filtering, and summarizing data - Printing layouts, reports, and graphics.

07 04 862 Local and International Contracts in Civil Engineering
General conditions - Definitions and interpretation - Engineer and engineer's representative - Assignment and subcontracting - Contract documents - General obligations – Labor, materials, plant and workmanship – Suspension - Commencement and delays - Defects liability – Alterations, additions and omissions - Procedure for claims - Contractor's equipment, temporary works and materials – Measurement - Provisional sums - Nominated subcontractors - Certificates and payment – Remedies - Special risks - Release from performance - Settlement of disputes – Notices - Default of employer - Changes in cost and legislation - Currency and rates of exchange.

07 04 863 Advanced Construction Engineering and Management.
Advanced overview of the construction industry - earthmoving machinery and properties - excavation and lifting - loading and hauling - compaction and finishing - concrete construction - concrete form design - Quality control - Different construction techniques.

07 04 864 Advanced Mathematical Modeling
Queuing theory, inventory, linear and nonlinear modeling - A two-variable model and its graphical solution - Linear programming (LP) formulations - Additional linear

programming formulations - Overall idea of the simplex method - Development of the simplex method - Primal simplex method - Dual simplex method - Special cases in simplex method application - Interpreting the simplex tableau: sensitivity analysis - Mathematical foundations - Revised (primal) simplex method - Definition of the dual problem - Solution of the dual problem - Economic interpretation of the dual problem - Complementary slackness - Post-optimal or sensitivity analysis - Parametric linear programming - Definition and application of bid strategy - Elements of dynamic programming (DP) model- Definition of the state - Examples of dynamic programming models and computations - Problem of dimensionality in dynamic programming - Solution of linear programs by dynamic programming.

07 04 865 Quality Control Affects in Construction Projects.
Introduction to quality - Quality improvement techniques - Fundamentals of statistics and probabilities - Control charts for variables and attributes - Lot-by-lot acceptance sampling by attributes - Acceptance sampling systems – Reliability - Cost of poor quality - Total quality management - Computers and quality control.

07 04 866 Risk management and uncertainty theories.
overview of risk and uncertainty - Process of risk management (Risk identification) - Risk analysis (qualitative and quantitative) - Risk response planning - Risk monitoring and control - Utility concepts - Statistical decision theory - Development of modern statistical decision theory and risk analysis - Tools and techniques (Modeling of non-deterministic problems - Modeling and analysis of uncertainties.

07 04 867 Knowledge-Based Systems uses in Construction Management.
Modeling and problem solving - The role of computation in engineering - Knowledge-based systems defined - Knowledge-based systems in engineering - Formulation and representation of problems - State space search - Directed search - Forward and backward chaining - Writing and organizing rules - Architecture of a rule-based system - Semantic nets, frames, and object-oriented programming.

07 04 601 Diploma Project in Structural Engineering

07 04 602 Diploma Project in Construction and Project Management

07 04 701 Master of Engineering Report in Structural Engineering

07 04 702 Master of Engineering Report in Construction and Project Management

07 04 705 Master of Science Thesis in Structural Engineering

07 04 706 Master of Science Thesis in Construction and Project Management

07 04 801 Doctor of Philosophy Dissertation in Structural Engineering

07 04 802 Doctor of Philosophy Dissertation in Construction and Project Management

Department of Irrigation Engineering and Hydraulics

The department of Irrigation Engineering and Hydraulics offers the following programs:

1. Graduate Diploma

1.1 Specialized Graduate Diploma in Irrigation Structures

The student must complete 30 credit hours.
Compulsory courses: The student must complete the following 7 courses equivalent to 21 credit hours.
(07 05 611 to 07 05 616 and 07 05 601)
Elective courses: The student can choose the remaining 3 courses (9 credit hours) from courses: (07 05 621 to 07 05 627).

1.2 Specialized Graduate Diploma in Water Resources Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must complete the following 6 courses equivalent to 18 credit hours.
(07 05 611 to 07 05 616 and 07 05 602)

Elective courses: The student can choose the remaining 3 courses (9 credit hours) from courses: (07 05 631 to 07 05 636).

2. Master Degrees

2.1 Master of Engineering in Irrigation Engineering and Hydraulics

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must complete the following 6 courses equivalent to 18 credit hours from the following:
(07 05 711 to 07 05 716)

Elective courses: The student can choose the remaining 4 courses (12 credit hours) from courses: (07 05 721 to 07 05 730).
The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Irrigation Engineering and Hydraulics

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must complete the following 4 courses equivalent to 12 credit hours from the following:
(07 05 731 to 07 05 734)

Elective courses: The student can choose the remaining 4 courses (12 credit hours) from courses: (07 05 741 to 07 05 753).

The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Irrigation Engineering and Hydraulics

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

Compulsory courses: The student must complete the following 3 courses equivalent to 9 credit hours from the following:
(07 05 811 to 07 05 813)

Elective courses: The student can choose the remaining 3 courses (9 credit hours) from courses: (07 05 821 to 07 05 827).

The student is allowed to choose 2 courses from another major.

For both M.Sc. and Ph.D. programs, two seminars are to be held by the student:

i- First seminar (3-6 months after finishing course requirements). Suggested topic of the research, literature review and general outlines of the study should be presented.

ii- Second seminar (2-3 months before selection of the examination committee). Final details of the study should be presented.

List of Diploma, Master and Ph.D. courses

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
	Diploma Courses			
07 05 611	Engineering Hydrology	3	3	
07 05 612	Hydraulic, Hydrological and Environmental Measurements	3	3	
07 05 613	Design of Small Dams	3	3	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
07 05 614	Planning and Construction of Irrigation and Drainage Projects	3	3	
07 05 615	Crop Water Requirements and Water Budget in Egypt	3	3	
07 05 616	Applied Hydraulics	3	3	
07 05 621	Design of Irrigation Structures for Small Canals	3	3	
07 05 622	Water Control Structures	3	3	
07 05 623	Pump Stations	3	3	
07 05 624	Scour Downstream Hydraulic Structures and Energy Dissipation Methods	3	3	
07 05 625	Computer Applications in the Design of Water Structures	3	3	
07 05 626	Canals and Drains Escapes	3	3	
07 05 627	Energy Dissipation behind Hydraulic Structures	3	3	
07 05 631	Analysis of Water Resources Systems	3	3	
07 05 632	Water Resources Pollution	3	3	
07 05 633	Environmental Impact of Irrigation and Drainage Projects	3	3	
07 05 634	Conservation and Optimization of Irrigation Water Use	3	3	
07 05 635	Computer Applications in Water Resources Studies	3	3	
07 05 636	Water Storage Projects	3	3	
	Master of Engineering (M.Eng.) Courses			
07 05 711	Flash Flood Hydrology and Protection Methods	3	3	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
07 05 712	Canal Falls Structures	3	3	
07 05 713	Improvement of Irrigation Water Control and Management Systems	3	3	
07 05 714	Design and Execution of Agricultural Drainage Networks	3	3	
07 05 715	Shore Engineering and Protection	3	3	
07 05 716	Water Hammer (WH) in Pipelines and Protection Methods	3	3	
07 05 721	Water Environment Engineering	3	3	
07 05 722	Hydrological and Hydraulic Study of the River Nile	3	3	
07 05 723	Integrated Management (IM) and Sustainable Development (SD) of Irrigation Water Resources	3	3	
07 05 724	Design and Construction of Canal Lining	3	3	
07 05 725	Use of Pipe Systems For Irrigation Networks	3	3	
07 05 726	Dewatering Systems for irrigation and Drainage structures	3	3	
07 05 727	Stability of Canals and Drains Embankments	3	3	
07 05 728	Groundwater Hydrology	3	3	
07 05 729	Hydraulics of Wells	3	3	
07 05 730	Improved Irrigation Structures	3	3	
	Master of Science (M.Sc.) Courses			
07 05 731	Fluid Mechanics	3	3	
07 05 732	River Engineering and Sediment transport	3	3	
07 05 733	Statistical Analysis in Water Resources Engineering	3	3	
07 05 734	Computational Hydraulics	3	3	
07 05 741	Finite Element Method in Water Structures	3	3	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
07 05 742	Unsteady Flow in open Channels	3	3	
07 05 743	Pipe Network Systems	3	3	
07 05 744	Design and Maintenance of Wells	3	3	
07 05 745	Wave Hydraulics	3	3	
07 05 746	Advanced Analysis of Irrigation and Drainage Systems	3	3	
07 05 747	Water Resources Pollution (Advanced)	3	3	07 05 632
07 05 748	Special Course	3	3	
07 05 749	Seepage in Hydraulic Structures	3	3	
07 05 750	Local Scour behind Hydraulic Structures	3	3	
07 05 751	Ground Water Modeling	3	3	
07 05 752	Hydraulics of Pumping Stations	3	3	
07 05 753	Hydraulics Measurements and Modeling	3	3	
	Doctor of Philosophy (Ph.D.) Courses			
07 05 811	Advanced Hydraulics	3	3	
07 05 812	Advanced Topics in Water Resources Engineering	3	3	
07 05 813	Water Basin Hydrology of Rivers	3	3	
07 05 821	Estuary Hydraulics	3	3	
07 05 822	Hydro Informatics	3	3	
07 05 823	Pipe Network Systems (advanced)	3	3	07 05 743
07 05 824	Water Management of Coastal Environment	3	3	
07 05 825	Economical, Environmental and Social Studies for Water Projects	3	3	
07 05 826	Statistical Analysis in Water Resources Engineering (Advanced)	3	3	07 05 733
07 05 827	Design of Irrigation Structures (Advanced)	3	3	
07 05 601	Diploma Project (Irrigation Structures)	3	Discussion	
07 05 602	Diploma Project (Water Resources Engineering)	3	Discussion	
07 05 701	Scientific Report (M.Eng.) in Irrigation	3	Defense	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
	Engineering and Hydraulics			
07 05 705	M.Sc. Thesis in Irrigation Engineering and Hydraulics	8	Defense	
07 05 801	Ph.D. Dissertation in Irrigation Engineering and Hydraulics	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 05 611 Engineering Hydrology
Introduction. Hydrologic cycle. Precipitation. Evaporation. Evapo-Transpiration. Surface water. Sub-surface water.

07 05 612 Hydraulic, Hydrological and Environmental Measurements
Equipment and measurement methods of discharge, pressure, velocity and water levels in the laboratory and field. Weirs. Submerged orifice. Hydraulic models. Methods of measuring rainfall, runoff, evaporation and evapo-transpiration. Field measurements of canals cross sections. Ground water measurements.

07 05 613 Design of Small Dams
Types of small dams. Selection of type of dam. Foundations. Construction materials. Design of earth fill dams. Design of rock-fill dams. Design of concrete gravity dams. Spillways. Outlet works. Construction of dams. Operation and Maintenance.

07 05 614 Planning and Construction of Irrigation and Drainage Projects
Job planning and management. Factors affecting the selection of construction equipment. Soil stabilization and compaction equipment. Excavation equipment. Dewatering of the construction site. Pumping equipment. Cofferdams. Concrete mixing. Canal lining equipment. Piles and pile driving equipment. Sheet pilings and their driving equipment.

07 05 615 Crop Water-Requirements and Water Budget in Egypt
Crop-water-soil relationships. Crop water consumption. Leaching requirements. Conveyance, distribution, and field water losses. Irrigation scheduling.
Water resources in Egypt: Present evaluation and future expectations, Development alternatives. Water requirements in Egypt: Present evaluation and future expectations, Conservation alternatives. Summary of present and future water budget.

07 05 616 Applied Hydraulics
Hydraulics and construction of pipe lines. Hydraulic transients in pipe lines. Secondary flow. Channel transitions. Inlets of pump stations.

07 05 621 Design of Irrigation Structures for Small Canals
Conveyance structures. Regulating structures. Protection structures. Measuring structures. Energy dissipaters. Protection against erosion.

07 05 622 Water Control Structures
Hydraulics and analysis of small dams, regulators and weirs. Site preparation. Construction methods.

07 05 623 Pumping Stations
Types of pump Stations. Main components. Dimensioning. Seepage underneath the structure. Design of superstructures. Design of Suction and delivery pools. Design of steel pipes. Effect of vibration on structure. Design of gates. Design of weed barrier. Collection of operational data. Valves and accessories. Main costs. Secondary costs. Depreciation, maintenance and operating costs .

07 05 624 Scour Downstream Hydraulic Structures and Energy Dissipation Methods
Introduction. Phenomenon of local scour downstream hydraulic structures. Experimental modeling. Calculation of local scour. Protection measures. Hydraulics of flow in stepped weirs. Air mixing with flowing water. Design of stepped channels and chutes. Design of stilling basins. Design considerations for hydraulic structures to avoid local scour and tail erosion.

07 05 625 Computer Applications in Design of Water Structures
Programming of the hydraulic and structural design procedure of water retaining structures. Programming of the uplift pressure calculations.

07 05 626 Canals and Drains Escapes
Introduction. Operation methods (self-control, gated flow and combined flow). Separate escape. Combined escape. Intermediate escapes. Tail escapes. Self-control gates for tail escape.

07 05 627 Energy Dissipation behind Hydraulic Structures
Introduction. Classification of energy dissipaters. Type selection. Hydraulic jump characteristics. Hydraulic jump stilling basins. Contracted depth behind weirs and gates.

Hydraulics of flow over stepped weirs. Cavitation and air entrainment. Design of stepped and chute channels. Design of stilling basins. Trajectory buckets – Design considerations.

07 05 631 Analysis of Water Resources Systems
Availability of water – Quantitative and qualitative requirements of water – Application of systems-engineering concepts (linear and dynamic programming, probabilistic methods and simulation methods) in planning, design and operation of water resources systems.

07 05 632 Water Resources Pollution
Sources of pollution of surface and ground water resources– Necessary precautions and structures for preventing pollution – Environment protection laws.

07 05 633 Environmental Impact of Irrigation and Drainage Projects
Impact of storage projects on the environment – Impact of irrigation and drainage projects on the local society.

07 05 634 Conservation and Optimization of Irrigation Water Use
Water budget in Egypt and water deficit problem – Irrigation water losses – Improvement of irrigation efficiencies – Control and management problems – Social issues – Cropping pattern and water productivity optimization – Re-use of drainage water.

07 05 635 Computer Applications in Water Resources
Programming the following topics: Calculation of groundwater quantity and Artisan pressure. Rainfall intensity and surface runoff. Water budget. Analysis of pumping test data.

07 05 636 Water Storage Projects
Site selection. Hydrological studies. Analysis of expected water requirements. Variation of area and volume with elevation. Reservoir components. Reservoir management. Storage losses. Expected sedimentation. Hydraulic and Environmental studies.

07 05 711 Flash Floods Hydrology and Protection Methods
Introduction. Factors affecting flash floods. Studies required for flash floods. Estimation of maximum discharge and resulting volume. Protection methods. Utilization of flash flood water. Environmental impact of flash floods.

07 05 712 Canal Falls Structures

Introduction. Importance of studying canal falls. Land topography. Hydraulics of water falls. Design of different canal falls structures: vertical, notched, stepped, glacis falls, or chute falls. Dissipation of excess water energy and protection against D/S scour.

07 05 713 Improvement of Irrigation Water Control and Management Systems
Urgent need for conservation of irrigation water. Operational problems of the existing system. Improvement objectives and methodology. On-demand irrigation with D/S control. Mathematical modeling for unsteady flow in canals. Canal night storage. Flow-control structures. Design of different elements. Rehabilitation of irrigation network. Use of information technology for irrigation management. Evaluation of the outcome of some improvement projects.

07 05 714 Design and Execution of Agricultural Drainage Networks
Benefits of agricultural drainage. Causes of water logging. High salinity problems in agricultural lands. Preliminary field studies. Drainage duties. Design and maintenance of surface and covered drains networks. Specifications of materials. Efficiency of drainage networks and inspection methods. Hydraulic structures of drainage networks. Vertical drainage using wells. Environmental impacts of agricultural drainage projects.

07 05 715 Shore Engineering and Protection
Mechanics of wave motion. Surf zone waves and currents. Water levels and astronomical tides. Coastal sediment process. Shore protection planning and design process. Hydrodynamics of tidal inlets. Engineering analysis. Case study.

07 05 716 Water Hammer (WH) in Pipelines and Protection Methods
Causes. WH due to instantaneous change in velocity. Continuity and Momentum equations for general conditions. Boundary conditions. Numerical solutions. WH resulting from operation of pumps. Transient cavitation and column-separation. Methods of controlling WH. Computer applications.

07 05 721 Water Environment Engineering
Surface and ground water standard specifications. Pollution point source and distributed sources. Dissolved oxygen and pathogens. Sediment oxygen demand. Pollution of surface. Pollution of ground water. Protection from pollution and governing laws. Sea water intrusion. Reuse of drainage water. Environmental studies for irrigation and drainage projects. Sea level rise

07 05 722 Hydrological and Hydraulic Studies of the River Nile
A) Hydrological study of the Nile basins and its tributaries:
The southern basin. The eastern basin. The western basin. Victoria Nile. El-Gabal and El-Zaraf rivers. The White Nile. The Blue Nile. The Main Nile in Sudan and Egypt.

B) Hydraulic Study:
Hydraulic sections and slopes. Discharge regime equations. Erosion and sedimentation.
C) Flow control and hydro-power generation projects.

07 05 723 Integrated Management (IM) and Sustainable Development (SD) of Irrigation Water Resources

(IM) and (SD) concepts, principles and objectives. Evaluation of available water resources for irrigation. Demand management. Engineering and environmental studies. Economical ,social and organizational studies. Field monitoring and building a data base. Case studies for application of IM and SD of irrigation water in Egypt (North Delta, Oases, North coast and Sinai, newly reclaimed lands, irrigation water conservation in the Delta and Wady). Applications in other countries.

07 05 724 Design and Construction of Canal Lining

Types of canal lining: Concrete, membrane, rocks, gabions, or earth lining. Preliminary field investigations. Design of lined canals. Reducing ground water pressure on lining. Lining construction. Seepage losses from lining. Economics of lining. Maintenance of lining. Practical applications and field visits.

07 05 725 Use of Pipe Systems for Irrigation Networks

Comparison between pipe systems and open channels for conveyance and distribution of irrigation water. Design guidelines to account for varying requirements and management method of irrigation water. Hydraulic design and water hammer protection. Design specifications for low-pressure concrete and plastic pipes. Pipe materials and specifications. Structures for transition from open channel to pipeline or vice versa. Economic and environmental study.

07 05 726 Dewatering Systems for Irrigation and Drainage Structures

Sources of shallow and deep groundwater. Different systems for lowering water table. Estimating design discharge. Design of shallow well systems. Design of deep well systems. Economics of different systems.

07 05 727 Stability of Canals and Drains Embankments

General features of earth embankments. Field investigations. Seepage control. Embankment design and stability analysis. Constructions methods of earth embankments. Field measurements and maintenance.

07 05 728 Groundwater Hydrology

Introduction. Fundamentals of groundwater hydrology. Well flow systems. Measurements of aquifer parameters. Groundwater flow system analysis and models. Groundwater quality. Groundwater contamination. Groundwater in Egypt.

07 05 729 Hydraulics of Wells
Introduction. Properties of groundwater aquifers. Abstraction of groundwater. Water wells. Steady radial flow to wells. Unsteady radial flow to wells. Leaky aquifers.

07 05 730 Improved Irrigation Structures
Introduction. Continuous flow. Intermittent (rotational) flow. Upstream control structures. Downstream control structures. Head regulators. Distribution structures. Control structures. Tail escape. Design and stability of improved canals sections. Design of conveyance structures.

07 05 731 Fluid Mechanics
Equations of motion for ideal fluids. Complex potential and complex velocity. Vortex motion. Fluid thrust. Flow through porous medium: Governing equations, Images concept for flow fields, seepage under dams.
Turbulent flow and boundary layer. General forms of continuity, energy and momentum equations for real fluids. Laminar, turbulent and transitional flows. Diffusion process in lakes and estuaries.

07 05 732 River Engineering and Sediment Transport
Sediment characteristics. Incipient motion of sediment particles. Flow regimes. Resistance to flow and velocity distribution in alluvial streams. Total load transport. Stream bed variation in alluvial streams. Lateral migration and sediment transport of alluvial streams. River training and bank protection. River morphology.

07 05 733 Statistical Methods in Hydraulics and Hydrology
Fundamentals of engineering statistical and frequency analyses. Statistical applications to the analysis of hydrological and hydraulic data and experimental results.

07 05 734 Computational Hydraulics
Finite difference method. Finite element method. Introduction to FORTRAN language. Mathematical formulation of physical processes. Solution techniques and their evaluations. Seepage through saturated and unsaturated soils. Flow simulation in natural rivers. Model calibration. Modeling of flow regulation in irrigation canals and power cascades. Movable bed models. Pollutant transport models. Seepage underneath hydraulic structures models.

07 05 741 Finite Element Method in Hydraulic Structures

Review of mathematical background. Variational formulations and applications. Local and global finite element equations. Application of boundary conditions. Computer applications.

07 05 742 Unsteady Flow in Open Channels
Introduction. Basic equations. Method of characteristics. Propagation of simple waves, kinetic wave and diffusion wave problems. Application to dam break wave. Numerical modeling.

07 05 743 Pipe Network Systems
Economical design of discharge and gravity pipe lines. Pump selection for simple and complex networks. Cavitation. Different valves for pipe lines. Water hammer in pipelines. Protection from water hammer hazards.

07 05 744 Design and Maintenance of Wells
Groundwater aquifers. Groundwater exploration. Ideal design of wells. Wells screen and depth. Drilling methods. Well development. Corrosion and incrustation. Well maintenance.

07 05 745 Wave Hydraulics
Linear wave theory. Wave properties. Higher order theories. Deep water waves. Shallow water transportation. Surf zone dynamics. Coastal sediment transport. Wave modeling. Wave effects on shores and protection structures.

07 05 746 Advanced Analysis of Irrigation and Drainage Systems
Estimation of crop-water requirements. Storage of water for irrigation. Irrigation wells. Surface, sprinkler and trickle irrigation systems. Conveyance and pumping irrigation and drainage water. Optimization of irrigation water use. Agricultural drainage. Salinity problems. Water hammer problems in irrigation pipes. Economic studies of irrigation and drainage projects

07 05 747 Water Resources Pollution (Advanced)
Types and sources of pollutants. Variation of pollutants nature and concentration due to diffusion, dispersion and convection. Pollution of rivers and lakes. Pollution of wells and ground water. Pollution of reservoirs. Engineering solutions for water pollution problems. Analysis of existing systems for water quality management. Study of the Nile river pollution problem.

07 05 748 Special Course
Selected topics which enrich student's thesis research, based on his/her supervisor's advice.

07 05 749 Seepage in Hydraulic Structures
Introduction. Different kinds of seepage. Seepage characteristics. Effect of seepage on hydraulic structures. Methods of analysis (analytical, approximate, empirical, experimental, and numerical). Design of gravity hydraulic structures against seepage effects. Design of earth embankments against seepage effects.

07 05 750 Local Scour behind Hydraulic Structures
Introduction. Phenomenon of local scour downstream hydraulic structures. Experimental modeling of local scour. Calculation of local scour. Measures for local scour protection. Design of hydraulic structures for local scour and tail erosion.

07 05 751 Ground Water Modeling
Types of groundwater aquifers. Aquifer characteristics and measurement methods. Groundwater exploration. Flow systems to wells. Mathematical modeling. Governing equations. Numerical modeling. Groundwater code.

07 05 752 Hydraulics of Pumping Stations
Types of pump stations. Hydraulic design of pumps. Hydraulics of suction and delivery pools. Hydraulics of different pipes. Seepage underneath and around the structure. Hydraulics of related and protection structures.

07 05 753 Hydraulics Measurements and Modeling
Methods of measuring and computing. Discharge، pressure، velocity and different water levels in the laboratory and in the field. Means of measuring hydraulic properties behind hydraulic structures. Hydraulic models in the laboratory. Numerical and mathematical hydraulic models.

07 05 811 Advanced Hydraulics
Equations of conservation of mass and energy. Introduction to mixing and dispersion in natural waterways. Turbulent shear flow. Basic theory of diffusion. Advective diffusion. Turbulent dispersion and mixing in natural systems. Mixing in estuaries. Unsteady flow in open channel. Interaction between flowing water and its surroundings. Analytical and numerical models. Initial and boundary conditions. Programming of some hydraulic applications. Application of some commercial software.

07 05 812 Advanced Topics in Water Resources Engineering
Critic review and summary of update scientific researches and papers, dealing with one or more topics, in co-ordination with the supervisor. A seminar presentation evaluated by the department faculty is required.

07 05 813 Water Basin Hydrology of Rivers
Climate parameters affecting precipitation. Stochastic analysis. Catchment boundaries. Study of soil and vegetative cover. Estimation of evaporation and seepage losses. Marshes losses. Estimation of surface runoff and runoff coefficient. Water budget for lakes. Measurement methods and expected errors. Schemes to increase annual water supply.

07 05 821 Estuary Hydraulics
Estuary classifications. Estuary hydrodynamics. Turbulent mixing and dispersion in estuaries. Effect of engineering works on salinity intrusion. Physics of estuary pollution. The use computer in estuaries hydraulic modeling.

07 05 822 Hydro Informatics
Data driven investigations in hydrology. Managing and accessing large datasets. Data communication. Data processing and analysis. Computer Analysis.

07 05 823 Pipe Network Systems (Advanced)
Field studies and planning. Statistical studies. Selection of pipe type. Hydraulic and economic analyses using computer software. Valves and accessories for pipelines. Protection of pipes against corrosion and water hammer. Construction execution methods. Application study.

07 05 824 Water Management of Coastal Environment
Climate parameters. Rainfall analysis. Surface and ground water sources. Water desalination. Wells characteristics and distribution. Storage of water. Sea water intrusion. Soil and water salinity problems. Pollution of coastal lakes. Water budget. Economic study.

07 05 825 Economical, Environmental and Social Studies for Water Projects
Monetary funding for water projects. Annual funding and inflation rate. Cost sharing between government and investors. Expected annual return. Effect of natural, local and international changes. Environmental impact of the project. Social study. Evaluation of different alternatives of the project.

07 05 826 Statistical Analysis in Water Resources Engineering (Advanced)
Introduction. Time series. Basic concepts of probability curves. Mathematical models of probability. Length of records. Selection of design event. Determination of permissible risk. Flood frequency. Probability and stochastic analyses.

07 05 827 Design of Irrigation Structures (Advanced)

Site planning. Basic economical concepts. Different methods of structural analysis. Use of commercial software in the design of irrigation structures. Applications.

07 05 601 Diploma Project (Irrigation Structures)

07 05 602 Diploma Project (Water Resources Engineering)

07 05 701 M.Eng. Scientific Report in Irrigation Engineering and Hydraulics

For the scientific report, three alternatives are suggested:

First Alternative:

A theoretical study of a scientific problem in the field of irrigation and hydraulics is to be carried out. The report should include:

i- An introduction which outlines the suggested problem and its importance in field applications,

ii- A literature review for published papers dealing with this problem,

iii- A proposal for the study outlines and suggested theoretical or experimental solution,

iv- Computer applications for some similar problems.

Second Alternative:

"State of the Art" report about a selected topic of realistic significance in the field of irrigation and hydraulics is to be prepared. It should contain student's comments, comparisons and expected return under local conditions. The student should get copies of main references of his report, with minimum of (15) reviewed papers.

Third Alternative:

It is generally similar to the first alternative but its main objective is "Study and analysis of field data related to the problem". Scientific background of the problem should be clearly identified.

07 05 705 M.Sc. Thesis in Irrigation Engineering and Hydraulics

07 05 801 Ph.D. Dissertation in Irrigation Engineering and Hydraulics

Department of Transportation Engineering

The department of Transportation Engineering offers the following programs:

1. Graduate Diplomas

1.1 Professional Diploma in Transportation Engineering

The student must complete 24 credit hours.
The student must choose at least one course from each specialization group in the course list at the diploma level.

1.2 Specialized Graduate Diploma in Transportation Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass three courses with a total of 9 credit hours (07 06 661, 07 06 662 and 07 06 663).
Elective courses: The student can choose the remaining 21 credit hours from the diploma courses in the course list.

2. Master Degrees

2.1 Master of Engineering in Transportation Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must complete 5 courses equivalent to 15 credit hours with at least one course from each specialization group in the course list at the Master level.
Elective courses: The student can choose the remaining 5 courses (15 credit hours) from the remaining courses in the Master's course list.
The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Transportation Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
Compulsory courses: The student must complete 4 courses equivalent to 12 credit hours from the same specialization group in the course list at the Master level.
Elective courses: The student can choose the remaining 4 courses (12 credit hours) from the remaining courses in the Master's course list.

The student is allowed to choose 2 courses from another major.

Specializations for the Master of Science in Transportation Engineering:

- Highway
- Railroad
- Surveying
- Harbor and marine structures
- Transportation planning and traffic engineering

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Transportation Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

Compulsory courses: The student must complete 3 courses equivalent to 9 credit hours from the same specialization group in the course list at the Ph.D. level.

Elective courses: The student can choose the remaining 3 courses (9 credit hours) from the remaining courses in the Master's course list.

The student is allowed to choose 2 courses from another major.

Specializations for the Ph.D. in Transportation Engineering:

- Highway
- Railroad
- Surveying
- Harbor and marine structures
- Transportation planning and traffic engineering

For both M.Sc. and Ph.D. programs, two seminars are to be held by the student:

i- First seminar (3-6 months after finishing course requirements). Suggested topic of the research, literature review and general outlines of the study should be presented.

ii- Second seminar (2-3 months before selection of the examination committee). Final details of the study should be presented.

List of Diploma, Master and Ph.D. courses

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
Highway Engineering				
07 06 611	Materials Specifications	3	3	
07 06 612	Airport Engineering	3	3	
07 06 613	Road Maintenance	3	3	
07 06 614	Road Construction Equipment	3	3	
07 06 615	Tunnel Engineering	3	3	
07 06 616	Mechanical Properties of Pavement Materials	3	3	
07 06 617	Embankments Construction	3	3	
07 06 661	Computer Applications in Transportation Engineering	3	3	
07 06 662	Operations Research and Numerical Methods in Transportation Engineering	3	3	
07 06 711	Construction & Maintenance of Flexible Pavements	3	3	
07 06 712	Pavement Management Systems	3	3	
07 06 713	Roadway Economics	3	3	
07 06 714	Roadway Planning & Geometric Design	3	3	
07 06 715	Laboratory Applications	3	3	
07 06 716	Superior Performance Asphalt Pavements (Super pave)	3	3	
07 06 811	Rigid Pavement Design	3	3	
07 06 812	Soil Mechanics for Roads & Airports	3	3	
07 06 813	Flexible & Rigid Pavement Design for Airports	3	3	
Engineering Surveying				
07 06 631	Introduction to Astronomy	3	3	
07 06 632	Introduction to Geodesy	3	3	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
07 06 633	Higher Geodesy	3	3	
07 06 634	Analysis & Adjustment of Surveying Measurements	3	3	
07 06 663	Technical Studies in Transportation Engineering	3	3	
07 06 731	Map Projection	3	3	
07 06 732	Adjustment of Geodetic Network	3	3	
07 06 733	Global Positioning System (GPS)	3	3	
07 06 734	Photogrammetry	3	3	
07 06 735	Hydrographic Surveying	3	3	
07 06 736	Introduction to Geomatics	3	3	
07 06 737	Cartography and Digital Mapping Systems	3	3	
07 06 738	Geographic Information System (GIS)	3	3	
07 06 831	Physical Geodesy	3	3	
07 06 832	Photo-Interpretation and remote sensing	3	3	
07 06 833	Spatial Analysis and Modeling in GIS	3	3	
07 06 834	GPS/GIS Integration for Transportation Applications	3	3	
07 06 865	Advanced Topics in Geodetic/Geomatics Surveying	3	3	
07 06 866	Leveling and Quantity Surveying	3	3	
Harbor and Coastal Engineering				
07 06 641	Breakwaters	3	3	
07 06 642	Shore protection structures	3	3	
07 06 643	Stability of shoreline	3	3	
07 06 644	Design and construction of rigid quay-walls	3	3	
07 06 645	Harbor hydraulics	3	3	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
07 06 661	Computers Applications in Transportation Engineering	3	3	
07 06 662	Operations Research and Numerical Methods in Transportation Engineering	3	3	
07 06 741	Coastal Engineering	3	3	
07 06 742	Flexible quay- walls	3	3	
07 06 743	Port planning	3	3	
07 06 744	Marine platforms	3	3	
07 06 745	Soil mechanics for harbor	3	3	
07 06 841	Dynamics of soils and foundations	3	3	
07 06 842	Marine structure	3	3	
07 06 843	Offshore structure	3	3	
Railway Engineering				
07 06 621	Railway Dynamics	3	3	
07 06 622	Geometric Design of Railways	3	3	
07 06 623	Environmental Impacts of Railway Systems	3	3	
07 06 624	Railway Track System	3	3	
07 06 625	Railway Signaling and Interlocking	3	3	
07 06 626	Urban Railways	3	3	
07 06 721	Track Maintenance and Renewal	3	3	
07 06 722	Railway Stations and Yards	3	3	
07 06 723	Track Capacity	3	3	
07 06 724	Railway Transportation Economics	3	3	
07 06 725	Railway Infrastructure Design	3	3	
07 06 821	Railway Operation	3	3	
07 06 822	Railway Freight Transport System	3	3	
07 06 823	Advanced Railway Control Systems	3	3	
07 06 824	Railway Simulation	3	3	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
Transportation Planning and Traffic Engineering				
07 06 651	Public Transport	3	3	
07 06 652	Transport Modeling	3	3	
07 06 653	Transportation Feasibility Studies	3	3	
07 06 751	Freight Transport	3	3	
07 06 752	Traffic Engineering	3	3	
07 06 753	Transport Planning	3	3	
07 06 754	Transportation Facilities	3	3	
07 06 755	Parking Studies	3	3	
07 06 851	Transport Economics	3	3	
07 06 852	Environment and Transport	3	3	
07 06 853	Transportation Logistics	3	3	
07 06 854	Transport and City Planning	3	3	
07 06 855	Intelligent Traffic System (ITS)	3	3	
07 06 856	Transportation Systems and Modes	3	3	
07 06 857	Application of Information Technology in Logistics	3	3	
07 06 601	Diploma Project	3	Presentation	
07 06 701	Scientific Report (M.Eng.) in Transportation Engineering	3	Defense	
07 06 705	M.Sc. Thesis in Highway Engineering	8	Defense	
07 06 706	M.Sc. Thesis in Railway Engineering	8	Defense	
07 06 707	M.Sc. Thesis in Surveying Engineering	8	Defense	
07 06 708	M.Sc. Thesis in Harbor and Coastal Engineering	8	Defense	
07 06 709	M.Sc. Thesis in Transportation Planning and Traffic Engineering	8	Defense	
07 06 801	Ph.D. Dissertation in Highway Engineering	24	Defense	
07 06 802	Ph.D. Dissertation in Railway	24	Defense	

Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
	Engineering			
07 06 803	Ph.D. Dissertation in Surveying Engineering	24	Defense	
07 06 804	Ph.D. Dissertation in Harbor and Coastal Engineering	24	Defense	
07 06 805	Ph.D. Dissertation in Transportation Planning and Traffic Engineering	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 06 611 Materials Specifications
This course discusses the various methods to evaluate the suitability of materials to be used for flexible and rigid pavement layers such as sub-base, base, binder, surfaces layers, and Portland cement concrete road slabs.

07 06 612 Airport Engineering
This course discusses the engineering principals for airport design including airport classifications and the various requirements of airplanes take-off and landing, relating to the planning and design of various airport components. The study includes the detailed design of the runways, taxiways, aprons, structural design of pavement to accommodate the airplane loading conditions, safety zones around the runways, navigation aids for landing and take-off, and finally marking and lighting for airports.

07 06 613 Road Maintenance
This course discusses the main deterioration modes of the roadway pavements, identification of pavement distresses, techniques for pavement maintenance and techniques for strengthening pavement structures. The course applies these techniques to all kind of roads including flexible pavement roadways, rigid pavement roadways, and unpaved roads.

07 06 614 Road Construction Equipment
This course discusses the main equipment used in road construction in terms of properties, productivity, efficiency, etc. This equipment includes graders, bulldozers, finishers, compactors, etc.

07 06 615 Tunnel Engineering
This course discusses the main aspects of the design of tunnels such as alignment, safety and soil mechanics considerations. This includes construction of tunnels below sea level, tunnel construction using explosives, insulation of tunnels, ventilation, capacity and emergency requirements.

07 06 616 Mechanical Properties of Pavement Materials
Design of bituminous mixes (methods of Marshall — modified Hubbared-Hveem, Smith, agg, surface-voids consideration). Asphalt pavement structures (flexible pavement, asphalt macadam, asphalt concrete, surface treatment). Additives used in mixes. Sulphur in asphalt paving materials. Recycling. Specifications.

07 06 617 Embankments Construction
Soil embankments classification. Failure of embankment. Stability of embankment. Treating and protecting the slope of embankment. Compaction of soil embankment. Soil stabilization.

07 06 661 Computer Applications in Transportation Engineering
This course discusses some of the main computer applications used in transportation engineering planning, modeling, and analysis. It focuses on the engineering principles for these models and the practical applications of these applications.

07 06 662 Operations Research and Numerical Methods in Transportation Engineering
This course discusses the statistical analysis in transportation engineering including sampling, statistical tests, principles of operations research and numerical applications in data collection and analysis.

07 06 711 Construction & Maintenance of Flexible Pavements
This course discusses the design of flexible pavements starting with the types of subgrade materials, traffic, wheel loads, stresses in pavement layers, and design methods. It also focuses on the main modes of pavement deterioration and maintenance of difference pavement layers.

07 06 712 Pavement Management Systems
This course discusses the main concepts of road condition evaluation and pavement management systems. This includes pavement condition evaluation, database analysis, periodic evaluation of performance, maintenance and rehabilitation analysis, budget optimization and feedback analysis.

07 06 713 Roadway Economics
This course discusses the main concepts of engineering economics, with particular focus on highway construction and maintenance short term and long term economic impacts. This includes emphasizing the economic aspects of the highway engineering projects, including the concepts of the time value of money, present worth, and equivalent annual worth comparisons, rates of return, inflation, and cost benefit analysis.

07 06 714 Roadway Planning & Geometric Design
This course discusses roadway intersections both at-grade and grade separated. This includes the intersections approaches, safety, and efficiency of the intersection, vertical and horizontal alignment of the intersections.

07 06 715 Laboratory Applications
This course discusses laboratory testing applications concerning all aspects of highway construction and maintenance. This includes the engineering background for each test, the engineering requirements for each tests, and the quality of the engineering materials based on the laboratory testing requirements.

07 06 716 Superior Performance Asphalt Pavements (Super pave)
Consensus properties. Gradation of material. Specification of bitumen. Bitumen classification. Compaction and volumetric design. Super pave gyratory compactor (SGC). Super pave performance tests (permanent- deformation- fatigue cracking, etc.).

07 06 811 Rigid Pavement Design
This course discusses the design of rigid pavements starting with the types of materials, traffic, wheel loads, stresses in pavement layers, and design methods. It also focuses on the main modes of pavement deterioration and maintenance of difference pavement layers and pavement joints.

07 06 812 Soil Mechanics for Roads & Airports
This course discusses main requirements for soil mechanics related to highway engineering including types of subgrade materials, soil classifications, soil compaction, soil strength, and drainage studies.

07 06 813 Flexible & Rigid Pavement Design for Airports
This course discusses the design of flexible rigid pavements for airports including the stress distribution, various methods for design, joints and maintenance.

07 06 631 Introduction to Astronomy
Definitions of Astronomy- Definition and detailed geometry of the celestial sphere- Coordinate systems to determine positions of heavenly bodies on the celestial spheres-

Determination of local time and the error of chronometer- Determination of the true meridian (Azimuth)- Determination of Latitude- Determination of Longitude.

07 06 632 Introduction to Geodesy
History of Geodesy and geodetic measurements – Geodesy relationship with other disciplines- Basic concepts – Geodetic Surveying usage – Surveying branches – Ground surveying history within Egypt.

07 06 633 Higher Geodesy
Earth shape. Geoid. Spheroid. Meridian arcs. Latitude and longitude. Azimuth. Radius of curvature in meridianal plane. Radius of curvature perpendicular to meridian. Latitude and longitude arc lengths. Areas between longitudes and latitudes. Spheroid calculations. Spheroid Curves. Computation of geodetic position on the reference ellipsoid. The Gauss Mid –Latitude formula. Puissant's formula for short lines (direct and inverse problems).

07 06 634 Analysis & Adjustment of Surveying Measurements
Types and sources of error. Error propagation and linearization. Theory of Least Squares. Adjustment using Least Squares. Surveying measurements reanalysis. Least Squares: general form. Applications in plane metric coordinate system. Adjustment using matrices.

07 06 663 Technical Studies in Transportation Engineering
Introduction to the basic concepts in applying GPS and GTS in transportation engineering. Technical studies for site investigation and preparation. Technical studies of projects implementation.

07 06 731 Map Projection
Introduction to mapping. Classification of map projection. Projections of a sphere onto a plane. Theory of distortions. Conformal map projection. Equivalent map projection. Equidistant map projection. Cylindrical map projection. Conical map projection. Azimuthal map projection. Mercator map projection. Transverse Mercator projection. Lambert conformal conical projection. Stereographic projection. Computations on a conformal Map Projection Plane.

07 06 732 Adjustment of Geodetic Network
Types of Geodetic networks. Adjustment Triangulation network. Adjustment of trilateration networks. Adjustment of hybrid networks. Adjustment of precise leveling networks. Adjustment of higher networks. Adjustment of the system traverses of a survey network.

07 06 733 Global Positioning System (GPS)
Introduction-GPS segments - GPS signal structure- GPS errors – Geometric Implications- Dilution of Precision (DOP)- Mask Angle- GPS Positioning (Pseudo ranging – Carrier phase ranging)- Phase differencing Techniques - GPS Modernization- GPS Surveying (single point concept, static, rapid static, pseudo static, kinematics, stop and go) – real time kinematics RTK-
Surveying using GPS- GPS calculations and data processing- GPS applications.

07 06 734 Photogrammetry
Introduction- Basics of optics as applied to photogrammetry- Photogrammetric cameras- Photogrammetric measurements- Stereoscopic view- Control points in Photogrammetry- Aerial mosaic- Flight plan- Tilted photos- Stereoscopic equipment.

07 06 735 Hydrographic Surveying
Introduction – Methods of surveying- Horizontal and vertical control – Distance measurement in the sea – Angle measurement- Shore line survey – Tidal gauges – Datum or mean sea level – Soundings- Methods of location of sounding – Hydrographic charts- Production and predication of tides – Gauging of discharge- Measurements of velocity of flow – Determination of discharge of a stream.

07 06 736 Introduction to Geomatics
Overview of the Geomatics Engineering Technology. Introduction to Field Survey Techniques. Introduction to Digital Image Processing. Introduction to Basic Principles of Geographic Information Technologies. Mapping in Geomatics. Applications of Geomatics Technologies.

07 06 737 Cartography & Digital Mapping Systems
Introduction – Methods of surveying- Horizontal and vertical control – Distance measurement in the sea – Angle measurement- Shore line survey – Tidal gauges – Datum or mean sea level – Soundings- Methods of location of sounding – Hydrographic charts- Production and predication of tides – Gauging of discharge- Measurements of velocity of flow – Determination of discharge of a stream.

07 06 738 Geographic Information System (GIS)
Introduction to GIS- Spatial Information Management systems- Data input quality and verification- Spatial digital data representation- Modeling techniques and their applications in GIS- Data processing and analysis- Introduction to data base management systems- Applications of the data base in digital mapping- Different application of GIS - Data output and presentation- Review of the existing GIS software modules- Review of the current status of digital mapping/GIS in Egypt.

07 06 831 Physical Geodesy
Introduction: concept of physical geodesy- Studies of the latest developments in physical geodesy- Gravitational law- Laplace's equation - Boundary value problems- Gravity field - Normal field and anomalous field of the earth- Gravitational methods in geodesy - The inertial principle- Instruments used in conjunction with these concepts.

07 06 832 Photo-Interpretation and Remote Sensing
Basic characteristic of photo images- Basic elements in photographic interpretation- Determination of photo coordinates- Application of photo interpretation- Idealized Remote Sensing system- Remote Sensing from space- Digital Images- Image classification- Remote Sensing application.

07 06 833 Spatial Analysis & Modeling in GIS
Introduction to GEO-Information system. Spatial information management system. Data input, quality and verification. Spatial digital data representation. Modeling techniques and their applications in GIS. Data processing and analysis. Introduction to spatial database management systems. Application of the spatial database in digital mapping/GIS. Different application of GIS as 3D Modeling. Data output and presentation. Review of the existing GIS software modules. Review of the current status of digital mapping/GIS in Egypt.

07 06 834 GPS-GIS Integration for Transportation Applications
Introduction- GPS. Introduction- GIS, GPS-GIS Integration Principles. Errors and Error Modeling in GPS-GIS Integration. GPS-GIS Integration & Transportation Applications.

07 06 865 Advanced Topics in Geodetic/Geomatics Surveying
Size and Shape of Ellipsoidal Shapes. Equations. Parameters Definitions. Cartesian vs Geodetic Coordinate Systems. Meridian Coordinates. Longitudes in Geodesy. Curvature radius.

07 06 866 Leveling and Quantity Surveying
Datums. Levels. Leveling Calculations. Height of Instrument Method. Rise & Fall Method. 2 Pegs Test. Areas. Trapezoidal Methods. Regular Shapes. Area Using the Coordinates Method. Cross-Section Area Calculations. Contour Lines. Volume Calculations.

07 06 641 Breakwaters
To import a sound understanding of the types and the principles of breakwater as a structure used to solve the problems in Coastal and Port Engineering and introduce the theoretical basics for hydraulic and structural design of the emerged rubble mound breakwaters.

07 06 642 Coastal Defense Structures (A)

To import a sound understanding of the types and the principles of breakwater as a structure used to solve the erosion and accretion problems in Coastal and Port Engineering. And introduce the theoretical basics for hydraulic and structural design of the detached breakwaters, import the knowledge in offshore platforms (Types, construction methods, components behavior and conceptual design) and to provide in details the construction methodology for piles platforms, determination of wave, current and berthing forces acting on piles and deck, studying dynamic behavior for piles and decks, design criteria for plat forms, near shore platforms.

07 06 643 Stability of Shoreline

To provide a good understanding of coastal process, and sediment transport phenomena and its effect on shore line morphology. Introduce the empirical formula to estimate the transported sediment budget, provide the understanding of current induced waves, sediment transport process, shoreline stability, stability of coastal zone, types of coastal protection structures, environmental protection structures.

07 06 644 Design and Construction of Rigid Quay-walls (A)

To provide a good understanding of rigid quay wall types, usage in harbors, and its design criteria's. Introduce and calculate the different design loads and discus with practical examples the design procedures for precast plain concrete blocks quay walls.

07 06 645 Harbor Hydraulics (A)

To import an understanding and appreciation of the principles, theories and concepts of applied Harbor hydraulics, and develop a basic competence in practical applications of the same theories. Derive the governing equations for the wave motions and its transformations in coastal zone and harbors basins according to the Linear Wave Theory (Airy Theory).

To provide the understanding of wave transformation ,wave breaking , energy dissipation, current induced waves, breakwaters and waves interaction, wave diffraction, water circulation in harbors, tidal current, wave surge ,near shore currents, harbor entrance and waves, wave impact and wave forces.

07 06 646 Design and construction of flexible quay walls (A)

To provide a good understanding of flexible quay wall types, usage in harbors, and its design criteria's.Introduce and calculate the different design loads and discus with practical examples the design procedures for cantilever and back anchored sheet piles quay walls.

07 06 647 Port Planning (A)

To provide academic training in Port Planning and managements, and provide the understanding of site selection of harbor position, Coastal surveying, soil investigations.

07 06 648 Waves

To import a good understanding of wave prediction wave characteristics, wave mechanics, wave theories, wave transformation, wave diffraction, wave breaking, energy dissipation, current induced waves, wave statistics and spectrum.

07 06 661 Use of Computer in Transportation Engineering (A)

To acquire knowledge and experience in computer programming in the student's field of specialization

07 06 662 Application of Numerical Methods in Transportation Engineering (A)

Provide a good understanding of using numerical methods to solve problems in the student's field of specialization. Study the Finite Difference Method and its applications in transportation engineering.

07 06 741 Coastal Engineering

To import a sound understanding of the types and the principles of breakwater as a structure used to solve the erosion and accretion problems in Coastal and Port Engineering. And introduce the theoretical basics for hydraulic and structural design of the detached breakwaters, groins and revetments, provide a good understanding of near shore hydrodynamics and the related phenomena like currents and sediment transport. And to review the fundamentals behind all types of offshore structures (fixed or floating) and applications of these principles. Understand the design and construction of offshore platforms. Make the use of current, applicable engineering methods in the design of fixed offshore platforms. Introduce the empirical formula to estimate the transported sediment budget and the methods to predict the impact of this phenomenon on the shoreline stability.

07 06 742 Design and construction of flexible quay walls (B)
To provide a good understanding of flexible quay wall types, usage in harbors, and its design criteria's. Introduce and calculate the different design loads and discus with practical examples the design procedures for cellular sheet pile quay walls.

07 06 743 Port Planning (B)
To introduce proper administrative methods for planning port operations, taking into account the current and futuristic changes for operating seaports, and its reflection on ports situation within regional and international maps. To provide a good understanding of ship repair structures types, usage, hydraulic and structural design of each type including: Dry dock, Slipway, Syncrolift and Floating dock.

07 06 744 Marine Platforms
To review the fundamentals behind all types of offshore structures (fixed or floating) and applications of these principles. Understand the design and construction of offshore platforms. Make the use of current, applicable engineering methods in the design of fixed offshore platforms.

07 06 745 Soil mechanics for Harbor Engineering
To understand the basics of dynamic behavior of soils and foundation and to be able of predicting the response of them due to dynamic loads. To provide the knowledge in earth pressure theories, computing pressures on quay walls, discuss with practical examples for pressure calculations acting on different quay walls with different soil types, selection of quay wall back fill (properties, dimensions and lateral pressure).

07 06 746 Design and construction of rigid quay walls (B)
To provide a good understanding of rigid quay wall types, usage in harbors, and its design criteria's. Introduce and calculate the different design loads and discus with practical examples the design procedures for precast plain concrete blocks quay walls, counterfort quay walls and caissons quay walls.

07 06 747 Harbor Hydraulic (B)
To import an understanding and appreciation of the principles, theories and concepts of applied Harbor hydraulics, and develop a basic competence in practical applications of the same theories. Derive the governing equations for the wave motions and its transformations in coastal zone and harbors basins according to the Non-Linear Wave Theory (Stock's Theory).
To provide the understanding of Current transformation in harbor basin, forces acting on bollards, hydrodynamics of near shore protection.

07 06 748 Use of Computer in Transportation Engineering (B)
To acquire knowledge and experience in computer programming in the student's field of specialization.

07 06 749 Application of Numerical Methods in Transportation Engineering (B)
Provide a good understanding of using numerical methods to solve problems in the student's field of specialization. Study the Finite Element Method (FEM) and its applications in transportation engineering.

07 06 841 Dynamics of Soils and Foundations
To provide a good understanding of soil dynamics theories and its application on marine structures, studying of earth quake types, forces due to earthquakes, bearing capacity due to earthquakes, liquefactions, pore water pressure, Mononobe -Okabe formulation.

07 06 842 Marine Structure
To provide a good understanding of near shore hydrodynamics and the related phenomena like currents and sediment transport. To introduce an overview the general design principles of a breakwater. Determine of boundary conditions for breakwaters, with special attention to the design frequency. Methods to determine the design wave height from wave statistics. Introduce an overview of other boundary conditions (geotechnical and hydraulic). Study materials, quarries and rock properties. Various properties of the different types of breakwaters, like stability of riprap in current and wave conditions, design of armor layer, natural rock and concrete elements. Study the use of caissons for breakwaters. Introduce a computational method to estimate the element size using classical formulae, partial safety coefficients and probabilistic methods. Prepare the Plan and cross section of breakwaters. Introduce practical examples of breakwaters. Execution (marine or land based equipment) of the works. Failure mechanisms and (cost) optimization. To import a sound understanding of the types and the principles of breakwater as a structure used to solve the erosion and accretion problems in Coastal and Port Engineering. And introduce the theoretical basics for hydraulic and structural design of the submerged breakwaters, groins, floating breakwaters and environmentally friendly breakwaters.

07 06 843 Offshore Structures
To introduce to oenological phenomena that may lead to damages of offshore structures or to prevent their normal functioning. Wind and wind data for design of offshore structures. Mathematical formulation of wind generated sea waves and methods for long- and short-term predictions of their extreme values. Describe of sea currents, ice, corrosion and marine fouling and their influence on design of offshore structures.

07 06 844 Harbor Hydraulic (C)
To import an understanding and appreciation of the principles, theories and concepts of applied Harbor hydraulics, and develop a basic competence in practical applications of the same theories. Derive the governing equations for the wave motions and its transformations in coastal zone and harbors basins according to Cnoidal and solitary Wave Theories. Introduce and develop the numerical models to predict the wave transformations according to the different wave theories.

07 06 845 Use of Computer in Transportation Engineering (C)
To acquire knowledge and experience in computer programming in the student's field of specialization.

07 06 846 Application of Numerical Methods in Transportation Engineering (C)
Provide a good understanding of using numerical methods to solve problems in the student's field of specialization. Study the Finite Volume Method (FVM) and its applications in transportation engineering. To provide a good understanding of coastal process, and sediment transport phenomena and its effect on shore line morphology. Introduce the Numerical models to estimate the transported sediment budget and the methods to predict the impact of this phenomenon on the shoreline stability. Introduce and calculate the different design loads for flexible quay walls and discus with practical examples the design procedures for double wall sheet pile quay walls by numerical methods.

07 06 621 Railway Dynamics
Train traction. Forces acting during train motion. Running resistance. Resistance in tunnels. Curve resistance. Acceleration resistance. Gradient resistance. Starting resistance. Train acceleration and deceleration. Train braking. Line scheduling. Coupling of buffers. Tilting trains. Railway simulation.

07 06 622 Geometric Design of Railways
Longitudinal and cross sections. Planning elements. Train movements and horizontal curves. Theoretical and practical values and limits of super-elevation. Combining maximum and minimum speed for super-elevation calculations. Transition curves. Ramps. Compound and reverse curves. Gradients. Vertical curves. Layout design using computer methods. Rail-road crossing and control. Switches and crossing. Manual and automatic switch operation.

07 06 623 Environmental Impacts of Railway Systems
Energy Consumption by railway systems. Air pollution. Prediction Models. Measure to control air pollution. Noise pollution. Sources of railway noise. Factor affecting.

Prediction models. American method. German method. Countermeasure to control railway noise. Noise barrier.

07 06 624 Railway Track System
The track system. Forces generated by train movement. Static and dynamic analysis. Sub-grade. The rail. The sleepers. Fastenings. Ballast. Mechanical behavior of track. Rail welding. Continuous welded rail.

07 06 625 Railway Signaling and Interlocking
Type of signals. Mechanical signaling system. Electro-Mechanical signaling system. Remote control system. Fixed block system. Moving block system. Semi-automatic control system. Automatic system. Centralized traffic control system.

07 06 626 Urban Railways
Introduction to railway transit systems. Railway transit systems (street cars, rapid rail system, regional and subway systems). Planning requirements for different city railway transport systems (cross sections, track alignments, speed, gradient, super-elevation, stations, signaling and control systems). Integration and rationalization of urban transport systems. Example of urban rail transport systems.

07 06 627 Railway Construction, 3 Lec.,
Track technology, Time plan of track construction, Methods of track construction, Track construction machines, Subgrade works, Track drainage, Ballast Works, Tie works, Rail line construction, Correction of track (in horizontal and vertical plan), Rail Welding.

07 06 628 Track Inspection and Maintenance , 3 Lec.,
Parameters influencing track maintenance, Track defects, Track defects recording methods, Limit value of track defects, Progress of track defects, Mechanical equipment for maintenance works, Scheduling of maintenance operations, Technical consideration for track maintenance works, Weed control.

07 06 629 Underground Rail Transport systems, 3 Lec.,
Characteristics of subway transit system, Slab track design, Operation and control systems, Performance characteristics, Rolling stock, Track construction, Track facilities, Operating and Capital costs.

07 06 721 Track Maintenance and Renewal
Classification of maintenance. Daily maintenance. Periodical maintenance. Track inspection. Manual maintenance. Mechanical maintenance. Rehabilitation. Wear of rail. Defects of rail surfaces. Wear of sleepers. Maintenance of rail joints. Insulated track.

Adjustment of track gauge. Manual tamping. Ballast. Checking of rail gaps. Lubrication of rail fastenings bolts. Inspection and maintenance of turnouts and crossings.

07 06 722 Railway Stations and Yards
Type of stations. Planning elements of stations. Wayside. Junction and End stations. Requirements of railway stations for passenger and freight transport. Infrastructure of passenger and freight stations. Passenger and freight yards. Multi-modal container terminal. Marshaling yards. Locomotive yards.

07 06 723 Track Capacity
Introduction. Track capacity. Intersection capacity. Scheduling and timetable. Network analysis. Line and network simulation. Computer applications

07 06 724 Railway Transportation Economics
Railway transit systems. Railway inter-city systems. Railway Transport system components (transit, inter-city). Railway infrastructure.

07 06 725 Railway Infrastructure Design
Passenger stations. Platform. Stairs. Ramps. Passenger tunnels. Level crossing. Multi-transfer stations. Track junction. Subway infrastructure. Signal planning. Freight stations. Classification yards. Locomotive yards. Container terminals.

07 06 726 Railway Planning Using Micro-Computer, 4 lab.
Site Investigation, Screening contour and surveying maps, Types of railway planning maps, Planning of railway lines and network (contour maps, longitudinal planning, cross sections, fastenings and track junctions, stations and yards, signals and interlocking), Track element quantities, Container terminal, Freight Stations.

07 06 727 Railway Construction Specifications, 3 Lec.,
UIC specification, ENR specification, Subgrade specifications, Ballast specifications, Sleeper specifications, Rail and Fastening specifications, Specifications for Welding and distressing, Signal specifications, Platform and station specifications.

07 06 728 Permanent Way Technique, 4 Lec., E.C.-.
Components of permanent way, Ballasted track, Slab track, Geo-technical analysis of subgrade, Dynamic analysis of subgrade, Curing of subgrade (additives, geotextiles), Geo-technical characteristics of Ballast, Mechanical behavior of ballast, Ballast dimensioning, Laying of track, Mechanical equipment, Sequence of construction of various track works.

07 06 729 Regional Rail and Light rail Transport systems, 3 Lec., E.C. -.

Characteristics of regional rail transit, regional rail permanent-way, Operation and control systems, Performance characteristics, Rolling stock, Track construction, Track facilities, Operating and Capital costs. Characteristics of light rail transit, Light rail permanent-way, Operation of light rail transit and control systems, Performance characteristics, Rolling stock, Light rail construction and operating costs, Light rail transit facilities.

07 06 821 Railway Operation
Railway signals. Operation of signals. Mechanical operations. Electro-mechanical operation. Remote control operation. Train control systems. Traffic safety. Interlocking. Track and intersection capacity. Optimization of train operation at stations. Scheduling and time table. Network analysis. Line and network simulation. Computer applications.

07 06 822 Railway Freight Transport System
Role of freight transport. Types of freight. Transport chain. Type of freight trains. Freight transport planning process. Classification yards. Containerization. ISO container. Container transport. Inland container terminal. Handling systems. Handling equipment. Storage facilities. Just in time freight transport system.

07 06 823 Advanced Railway Control Systems
Types of technology applied for control systems. Centralized traffic control centers. Computerized electronic interlocking. Communication systems for railway. Automatic railway control systems. Subway control systems. Problems of railway control systems. Railway control system in Egypt. Magnetic trains.

07 06 824 Railway Simulation
Objectives of simulations. Model and systems of simulations (model building for economic and technical systems). Statistical evaluation. Application of simulation technique in railway. Movement performance simulation. Track simulation.

07 06 825 Multi-Modal Transport Systems
Freight transport systems, Freight types, Economic transport distances, Iso Container. Transport chain, Handling equipments, Handling systems, Choise of handling systems, Demand prediction, Inland container terminal, planning and design.

07 06 826 Magnetic Train Technology,3 Lec.,
MAGLEV systems, Suspension systems, Propulsion systems, Guidance systems, Overview of system concepts (Transrapid 07, Japanese Maglev), Assessment of MAGLEV technology, The potential for Maglev applications, Comparison of Maglev and high speed rail systems, Option for acquiring Maglev.

07 06 827 Railway Planning for High Speed Systems, 3 Lec.

Track types, slab track, Ballasted track, Curve planning (Planning elements, Theoretical and practical values of super-elevation, Transitions Curves, Ramps, Gradients, Vertical alignment), Track junction specifications, Control systems.

07 06 651 Public Transport
Introduction (role of public transport). Public transport systems (characteristics and planning of bus, tram, rapid transit, regional and inter-regional railways). Planning and operation (data collection and analysis, urban, rural, inter-city public transport planning, network planning, route planning, headway and scheduling, timetable creation). General planning concepts (system economics, system financing, transit fare, environmental consideration, planning policies).

07 06 652 Transport Modeling
Methods of demand forecasting (trends and extrapolation, category analysis, econometric models, land use models, gravity models). Travel demand models. Trip generation models. Trip distribution models. Mode choice models. Trip assignment models. Application of models (intercity, urban, international, regional). Calibration of demand models (multiple regression, error analysis).

07 06 653 Transportation Feasibility Studies
Transport financial analysis (expenditure, revenues, subsidies, taxes). Transport cost analysis (project cost items, capital and maintenance costs, cost allocation). Transport operating costs (distance-related costs, time-related costs, vehicle cost, fuel consumption, motor oil consumption, vehicle maintenance, tire consumption, depreciation, crew, overhead costs). Tariff analysis (price analysis process, discount rate, shadow prices, utility of income, practical and social aspects). Transport economic analysis (net present value, benefit-cost ratio, internal rate of return). Overall evaluation of transportation plans.

07 06 751 Freight Transport
Introduction (role of freight transport, transport chain). Modal characteristics (rail, road, water, air cargo, pipelines, belt conveyors). Handling equipment (classification, characteristics, capacities, planning). Storage facilities (classification, characteristics, planning). Container transport (containerization, classifications, carriers, handling equipment, stacking, system planning and economy, modal interface, container terminal planning). Freight transport planning process (data collection and analysis, transport policies, planning goals, demand forecast, modal split and assignment).

07 06 752 Traffic Engineering
Traffic surveys and analysis (traffic flow between and at intersection, speeds and delays, parking). Traffic characteristics (definitions, capacity, service levels, fundamental

relationships). Design of traffic facilities (predicting demands, route classification, geometric design, facilities at intersection, parking facilities, pedestrian and bicycle facilities, network design). Traffic control systems (signs, signals, cycle time calculations, parking control system, area traffic control, integrated traffic control systems for public transport on public roads). Traffic safety (accidents, accident danger, measures for traffic safety).

07 06 753 Transport Planning
Introduction (transportation problems, trends in transportation planning). Urban transportation planning (elements of transportation planning, transportation planning process, goods movement planning). Forecast of urban transport demand (data collection and analysis, goals and objectives, aggregate sequential demand models). Sketch planning and project planning (generation, analysis and evaluation of alternative plans, risk and uncertainty).

07 06 754 Transportation Facilities
Plan and design of highway facilities (roadway structure, parking, pedestrian and bicycle facilities). Airport facilities (air side area: "runway configuration, geometry and capacity, taxiway layout, guidance signing, lighting, pavement design", land side area: "terminal building, vehicular circulation and parking"). Railway facilities (track structure, passenger and freight stations, marshaling yards, container terminals, operating facilities), Water transport facilities (inland waterways, seaport capacity, wharf structures, fenders, navigation aids, transit sheds, container terminals).

07 06 755 Parking Studies
Introduction. Parking generation and supply needs (parking generation, zoning regulation). Parking studies and characteristics (parking inventories, accumulation and duration). Design aspects of parking facilities (basic parking dimensions, parking modules, separating small and large vehicle areas, parking garages). Parking programs.

07 06 851 Transport Economics
Transport financial analysis (expenditure, revenues, subsidies, taxes). Transport cost analysis (project cost items, capital and maintenance costs, cost allocation). Transport operating costs (distance-related costs, time-related costs, vehicle cost, fuel consumption, motor oil consumption, vehicle maintenance, tire consumption, depreciation, crew, overhead costs). Tariff analysis (price analysis process, discount rate, shadow prices, utility of income, practical and social aspects). Transport economic analysis (net present value, benefit-cost ratio, internal rate of return). Overall evaluation of transportation plans.

07 06 852 Environment and Transport
Introduction (definition of transportation impacts). Environmental direct impacts (air pollution, noise, water pollution, accidents). Environmental indirect impacts (land-use changes, land occupation, cultural and social impacts). Environmental impact assessment and allowable standards. Measures for improving the environmental quality (environment oriented planning, traffic control, traffic calming, land-use changes). Sustainable development of transport systems).

07 06 853 Transportation Logistics
Freight transport (road, rail, sea and air: features, development, technology). Warehousing and material handling (loading and unloading facilities, costs, designs, vehicle design, storage). Distribution strategies (networks, collection-distribution systems). Marketing of transport services (concepts and approach in transport sector, location theory).

07 06 854 Transport and City Planning
Introduction (definitive concepts and ideas). Hypothetical land use/transportation systems. Land use potential and traffic generation. Transportation and land use interaction. Growth and distribution of land use potential. Interactive land use and transportation planning. Concepts of city oriented traffic and traffic oriented city. Developing access. Centralization and decentralization. Traffic facilities in central area. Traffic facilities in residential areas. Feasibility and detailed studies. Management of alternative future. Development of project options.

07 06 855 Intelligent Traffic System ITS
The Range of ITS applications. Actuated Signal control and detection. Network optimization. Sensing traffic using virtual detectors. In-vehicle routing and personal route information. Smart car. Commercial routing and delivery. Electronic toll collection. Smart card. Congestion pricing. Dynamic assignment. Traffic enforcement. Bus transit and para-transit. Emerging issues. Use of GPS.

07 06 856 Transportation Systems and Modes
Introduction. Transportation Systems. Coordinating between transport modes. Road transport (vehicle characteristics, road network, number of lanes and road capacity, parking). Transport stations. Rural and urban transportation planning and management. Rail transport. Air transport. Water transport. Transportation through pipes. Loading/unloading stations and container terminals.

07 06 857 Application of Information Technology in Logistics

Development of trade logistics philosophies. Information technology of trade (electronic commerce. Electronic market. Internet commerce. Electronic data interchange). Transport logistics costs. Organization system. Barriers of trade logistics. Planning of logistics.

07 06 601 Project for the Diploma in Transportation Engineering

07 06 701 Scientific Report for Master of Engineering in Transportation Engineering

07 06 705 Thesis for Master of Science in Transportation Engineering (Highway Engineering)

07 06 706 Thesis for Master of Science in Transportation Engineering (Railway Engineering)

07 06 707 Thesis for Master of Science in Transportation Engineering (Surveying Engineering)

07 06 708 Thesis for Master of Science in Transportation Engineering (Harbor and Coastal Engineering)

07 06 709 Thesis for Master of Science in Transportation Engineering (Transportation Planning and Traffic Engineering)

07 06 801 Dissertation for Ph.D. in Transportation Engineering (Highway Engineering)

07 06 802 Dissertation for Ph.D. in Transportation Engineering (Railway Engineering)

07 06 803 Dissertation for Ph.D. in Transportation Engineering (Surveying Engineering)

07 06 804 Dissertation for Ph.D. in Transportation Engineering (Harbor and Coastal Engineering)

07 06 805 Dissertation for Ph.D. in Transportation Engineering (Transportation Planning and Traffic Engineering)

Department of Sanitary Engineering

The department of Sanitary Engineering offers the following programs:

1. Graduate Diplomas

1.1 Professional Diploma in Sanitary Engineering

The student must complete 24 credit hours. The student must choose his/her courses from the list of courses that are specified as “Diploma courses”.

1.2 Specialized Graduate Diploma in Sanitary Engineering

The student must complete 30 credit hours.
The student must choose his/her courses from the list of courses that are specified as “Diploma courses”.

2. Master Degrees

2.1 Master of Engineering in Sanitary Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must choose his/her courses from the list of courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Sanitary Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must choose his/her courses from the list of courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Sanitary Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student has the right to choose three courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit Hours	Exam Duration
1	0 7 07 611	Operation and Maintenance of Waste Water Treatment Plants	3	3
2	0 7 07 612	Construction and Maintenance of Sewer Systems	3	3
3	0 7 07 613	Waste Water Reuse for Agricultural Irrigation	3	3
4	0 7 07 614	Solid Waste Management	3	3
5	0 7 07 615	Sludge Treatment	3	3
6	0 7 07 616	Design of Wastewater Treatment Plants	3	3
7	0 7 07 617	Advanced Methods of Water Treatment	3	3
8	0 7 07 618	Unit Operation	3	3
9	0 7 07 619	Industrial Wastewater Control	3	3
10	0 7 07 621	Water Purification	3	3
11	0 7 07 622	Potable Water Distribution Systems	3	3
12	0 7 07 623	Wastewater Collection Systems	3	3
13	0 7 07 624	Wastewater Treatment	3	3
14	0 7 07 625	Wastewater Engineering in Rural Areas	3	3
15	0 7 07 626	Unit Operation	3	3
16	0 7 07 627	Economical Methods of Wastewater Treatment	3	3
17	0 7 07 628	Water Bodies Pollution Control	3	3
18	0 7 07 629	Solid Wastes	3	3
19	0 7 07 630	Industrial Wastewater Control	3	3
20	0 7 07 631	Principles of Plumbing	3	3
21	0 7 07 711	Water Purification Engineering	3	3
22	0 7 07 712	Potable Water Distribution and Storage	3	3
23	0 7 07 713	Sewer Systems	3	3
24	0 7 07 714	Wastewater Treatment Processes	3	3
25	0 7 07 715	Rural Sanitation	3	3
26	0 7 07 716	Wastewater Reuse	3	3
27	0 7 07 717	Water and Wastewater Analysis	3	3
28	0 7 07 718	Water Resources Engineering	3	3
29	0 7 07 719	Unit Operation (I)	3	3
30	0 7 07 120	Unit Operation (II)	3	3

31	0 7 07 721	Storm Water Collection	3	3
32	0 7 07 722	Industrial Wastewater Treatment	3	3
33	0 7 07 723	Surface Water Pollution Control	3	3
34	0 7 07 724	Plumbing	3	3
35	0 7 07 725	Solid Wastes Control	3	3
36	0 7 07 726	Economics of Water and Wastewater Projects	3	3
37	0 7 07 727	Waste Recycle Processes	3	3
38	0 7 07 728	Hazard Wastes Control	3	3
39	0 7 07 729	Sanitary Chemistry and Microbiology	3	3
40	0 7 07 811	Potable Water Engineering	3	3
41	0 7 07 812	Wastewater Engineering	3	3
42	0 7 07 813	Economy of Water and Wastewater Projects	3	3
43	0 7 07 814	Safe Reuse of Wastewater	3	3
44	0 7 07 815	Environmental Engineering	3	3
45	0 7 07 816	Sanitary Chemistry	3	3
46	0 7 07 817	Sanitary Microbiology	3	3
47	0 7 07 601	Diploma Project in Sanitary Engineering	3	Presentation
48	0 7 07 701	Master of Engineering Report in Sanitary Engineering	3	Defense
49	0 7 07 705	Master of Science Thesis in Sanitary Engineering	8	Defense
50	0 7 07 801	Doctor of Philosophy Dissertation in Sanitary Engineering	24	Defense

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 07 611 Operation and Maintenance of Wastewater Treatment Plants
Introduction and briefing of physical, chemical and biological wastewater treatment processes, Primary sedimentation facilities, Biological treatment units facilities, Chlorination facility, Sludge treatment, and disposal methods, Operating, maintenance and troubleshooting.

07 07 612 Construction and Maintenance of Sewer System
Sewer materials, Built in place sewers, Excavation techniques, Sheeting and bracing, Pipe laying and joints, Maintenance of sewers, Sewer repairs, Sewer gases, Corrosion of sewers, Construction and maintenance of manholes, street inlets, collection sumps and pump stations, Protection and safety of labors.

07 07 613 Wastewater Reuse for Agricultural Irrigation
Characteristics of wastewater from domestic, irrigation drains and industries, Efficiency of wastewater treatment on physical, chemical, and microbiological characteristics, Effect of wastewater reuse on environment, public health, soil and crops, Methods of irrigation and drainage, Environmental impact assessment.

07 07 614 Solid Wastes Management
Collection of garbage, Transportation, Classification of refuse, Sanitary landfills, Reuse of different constituents, Composting, Environmental impact assessment.

07 07 615 Sludge Treatment
Characteristics and quantities of sludge wasted from wastewater treatment, Sludge pumping, Sludge treatment, Anaerobic sludge digestion, Design, operation and maintenance of digesters, Startup of digesters, Aerobic digestion, Sludge thickening, pressing, vacuum filtration and drying, Land disposal, Incineration.

07 07 716 Design of Wastewater Treatment Plants
Characteristics and flow rates of wastewater, domestic, industrials, and storm water, Preliminary and primary treatment, Biological treatment, Trickling filters, Activated sludge process, Biological towers, Anaerobic biological treatment, sludge treatment and disposal, Advanced wastewater treatment, operation and maintenance of treatment units.

07 07 617 Advanced Methods of Water Treatment
Water characteristics, surface water, ground water and treated wastewater effluent, organic and inorganic contaminants, chemical sedimentation, Iron and manganese removal, Aeration, Filtration, Absorption, Hydro dialysis, Softening, Reverse osmosis.

07 07 618 Unit Operation
Chemical coagulation in water and wastewater treatment, Coagulants, Removal of organic and inorganic contaminants, operation and maintenance of water purification plants and wastewater treatment units, Chemical and microbiological tests needed in water and wastewater processes.

07 07 619 Industrial Wastewater Treatment
Water quality and rates needed for industries, Characteristics of different industrial wastewaters, Physical, Chemical, and biological treatment processes, wastewater recycle Environmental impact assessment of industrial wastewater disposal.

07 07 621 Water Purification

Quality of raw water, Water treatment plants, Plain and chemical sedimentation, Filtration, Disinfections, Advanced treatment processes, Ground water treatment.

07 07 622 Potable Water Distribution Systems
Storage of water, Ground and elevated storage, Equalization between consumption rates and storage, High lift pumps, Distribution networks, Construction and maintenance of distribution networks.

07 07 623 Wastewater Collection Systems
Domestic, storm and industrial wastewater, Design of gravity systems, Sewer appurtenances, Maintenance of sewer systems, Safety, Pumping stations.

07 07 624 Wastewater Treatment
Wastewater characteristics, Aerobic and anaerobic processes, Preliminary treatment, Primary treatment, Secondary treatment, Tertiary treatment, Biological filtration, Activated sludge, Stabilization ponds, Aerated lagoons.

07 07 625 Wastewater Engineering in Rural Areas
Characteristics of wastewater in rural areas, Wastewater treatment methods in rural areas, Disposal and reuse, Biogas.

07 07 626 Unit Operation
Chemical treatment of water and wastewater, Biological treatment of water and wastewater, Sedimentation, Filtration, Adsorption, Reverse osmosis, Distillation.

07 07 627 Economical Methods of Wastewater Treatment
Natural treatment methods, Stabilization ponds, Aerated lagoons, Wetlands, Land treatment.

07 07 628 Water Bodies Pollution Control
Nature of water bodies, Impacts of wastes disposal in water bodies, Treatment and recovery of polluted water bodies, Self-purification.

07 07 629 Solid Wastes
Solid wastes sources, Collection, transportation and classification, Sanitary landfill, Composting, Recycling.

07 07 630 Industrial Wastewater Control
Characteristics of industrial wastewater, Treatment of industrial wastewater from different sources, Recycling and water conservation.

07 07 631 Principles of Plumbing
Water supply pipes and sanitary installations in different buildings, Design of interior water systems, Healing, Interior drainage systems, Vent systems, Fire protection systems in buildings

07 07 711 Water Purification Engineering
Water resources, Potability of water, Drinking water standards, Ground water, Surface water collection works, Low lift units, Sedimentation processes, Water filtration, Water disinfection.

07 07 712 Potable Water Distribution and Storage
Storage of water, Ground and elevated storage, Domestic water tanks, Pumping water systems, Design of distribution network, Network maintenance, Maintenance of storage tanks.

07 07 713 Sewer Systems
Collection methods of domestic sewage, Industrial wastes, Storm water types of collection sewers, Design of storm water sewer system, Design of domestic sewers, Primary studies of collection systems, Pipelines construction, Appurtenances of sewer systems, Collection sumps, Pump stations and rising mains.

07 07 714 Wastewater Treatment Processes
Wastewater characteristics, Organic elements cycle in nature, Aerobic oxidation, Anaerobic oxidation, Wastewater tests, BOD, COD, Domestic sewage sampling, Preliminary treatment, Primary treatment, Chemical sedimentation, Biological treatment, Trickling filters, Activated sludge, Stabilization ponds, Aerated lagoons, Reuse of wastewater.

07 07 715 Rural Sanitation
Wastes collection, Septic tank, Effluent disposal, Small bore sewer system, Night soil collection and disposal, Biogas.

07 07 716 Wastewater Reuse
Collection methods, Simplified and economic treatment methods, Reuse of wastewater, Land treatment, Wastewater reuse applications, Standards.

07 07 717 Water and Wastewater Analysis
Chemical analysis, Microbiological analysis, Advanced chemical methods, Lakes and marine water analysis, Special topics on public health.

07 07 718 Water Resources Engineering
Rain water, Ground water, Surface water, Characteristics of different water resources, Measurement of water discharges of channels and pipelines, Alternative resources of fresh water, Control of losses in water uses in domestic, industrial and irrigation purposes.

07 07 719 Unit Operation (I)
Unit operation, Physical & chemical processes, Sedimentation, Chemical sedimentation, Filtration, Adsorption, Disinfection, Reverse osmosis.

07 07 720 Unit Operation (II)
Biological process, Role of microorganisms, Aerobic oxidation, Anaerobic oxidation, Suspended growth methods, Attached growth methods, Sludge processes.

07 07 721 Storm Water Collection
Measurement of precipitation, Types of rain gauges, Measurement of snow, Computation of average rainfall and hydrograph analysis, Intensity duration curve, Rainwater discharges used in collection sewer design.

07 07 722 Industrial Wastewater Treatment
Water and wastewater characteristics, Rates & quality of water supply and wastewater for different industries, Treatment methods.

07 07 723 Surface Water Pollution Control
Pollution, Environment, Pollutants, Air pollution, Water, Land wastewater, Industrial wastes, Irrigation drains, Pesticides, Hyacinth effect in reducing pollutants in water, Transport of wastes in water bodies, Self-purification, Shore pollution, Lakes pollution.

07 07 724 Plumbing
Drinking water, Pipes and sanitary installations water supply to different buildings, Design of interior water systems, Solar heaters, Swimming pools, Interior drainage systems, Design of horizontal sewers.

07 07 725 Solid Wastes Control
Refuse collection and transport from urban and rural areas, Classification of refuse, Refuse analysis, Landfill, Incineration, Composting, Fuel recovery, Air and water pollution consideration.

07 07 726 Economics of Water and Wastewater Projects

Characteristics of (raw water, surface water and ground water, domestic sewage, storm runoff, industrial wastewater), Capital cost of treatment works (civil, mechanical, electrical and control), Maintenance and operation cost benefits from (water, gas, sludge), Recycle water price in the future, Environmental impacts.

07 07 727 Waste Recycle Processes
Origin of wastes, Process industry wastes, Food processing industries, Material industries, Chemical industries, Metals recycling, Waste paper recycling, Paper recovery, Paper recovery from urban waste, Particulate collection.

07 07 728 Hazard Wastes Control
Origin of wastes, Power plants wastes, Fuel processing wastes, Treatment of radioactive wastes, Cost of radioactive waste treatment.

07 07 729 Sanitary Chemistry and Microbiology
Physical, equilibrium and colloid chemistry, Quantitative chemistry, Turbidity, Color, PH, Acidity, Alkalinity, Hardness, Chlorine, Oxygen demand, Bacteria staining, Waster as carrier of diseases, Tests of coliform bacteria of importance to sanitary engineers, Algae, Protozoa, Viruses, Problems caused by microorganisms to the environment, Role of microorganisms.

07 07 811 Potable Water Engineering
Introduction of water supply, Fresh water resources and its characteristics, Design period for water supply components, Impurities in water, Inorganic contaminants, Common constituents of natural water, Standards of safe potable water, Sedimentation, Filtration, slow, rapid, direct, and pressure filters, Disinfection, Miscellaneous water treatment techniques, Design of water distribution systems, Storage and pump stations, Water pipes, corrosion and its prevention, Stress in pipes, Valves and appurtenances, Construction and maintenance of distribution systems.

07 07 812 Wastewater Engineering
Sources of wastewater, Fluctuation in wastewater, Combined and separate sewers, Design periods of sewer systems and treatment plants, Storm water flow, Sewer materials, appurtenances, construction, and maintenance, Measurement of flow in sewer lines, Design of sewer systems, Occurrence, effect, and control of the biological transformations in sewers, Collection sumps and pump stations, characteristics of wastewater, Preliminary and Primary treatment, Biological treatment, Sludge treatment and disposal, Advanced wastewater treatment.

07 07 813 Economy of Water and Wastewater Projects

Characteristics of fresh water, costs of water purification plants, Capital cost, Operation and maintenance cost, cost and benefits of pure and safe potable water, Characteristics of wastewater, raw domestic sewage, industrial wastewater, primary treated, secondary treated, and advanced treated, Effect of microbiological and chemical pollution on public health and environment, Effect of hazardous waste on environment, purpose and benefits of advanced wastewater treatment, Cost and benefits of wastewater reuse and industrial wastewater recycle, cost and benefits of complete purification of domestic wastewater, Effect of polluted potable water on public health in developing countries, costs of different processes of wastewater treatment.

07 07 814 Safe Reuse of Water

Characteristics of domestic sewage, industrial wastewater, and irrigation drainage, Effect of primary, secondary, and advanced treatment on wastewater characteristics, Effect of storage on treated water, positive and negative effect of water constituents on soil and plants protection of public health and farm animals, Environmental and social studies, Methods of irrigation, use of sludge as fertilizer, Suitable agricultural crops and products, Benefits of wastewater reuse, Standards used in international organizations for safe treated wastewater reuse.

07 07 815 Environmental Engineering

Natural environmental hazards, Greenhouse effect and ozone depletion, Acid rain, pollution of receiving water, Air pollution, solid wastes management, Hazardous wastes, Environmental impact assessment of engineering projects, Environmental assessment in water quality management planning, Environmental impact assessment of water supply projects, Environmental impact assessment of wastewater projects, Environmental benefits of preventing pollution, Pollution control laws, factors affecting environmental impact assessment, Environmental development, Environmental impact assessment of global projects, case studies.

07 07 816 Sanitary Chemistry

Elements, and compounds, chemical water analysis, Hydrogen ion concentration, Gas solubility, Alkalinity, colloids and coagulation, Organic compounds, Organic matter in wastewater, Laboratory chemical analysis, Jar test, Dissolved oxygen, Chemical oxygen demand, Total organic carbon, carbon absorption.

07 07 817 Sanitary Microbiology

Biological organisms, Ecological approach to the sludge, organisms present in activated sludge and the description of the process, Aquatic food chain, water borne diseases, Indicator organisms for water quality, water as a source of bacterial contamination, Areas where contaminants multiply, Physical and chemical methods of control, Economics of control, Tests for the coliform group, Examination of potable and surface water, BOD of

domestic sewage, BOD of industrial wastewater, Factors affecting growth in biological treatment systems, The enteric viruses in feces, Transmission of viruses in through water, presence of viruses in sewage, Removal of viruses by sewage treatment methods. Primary, secondary and disinfection.

07 07 601 Diploma Project in Sanitary Engineering
Engineering planning, detailed design and drawing project of one of the following subjects: Sewer system, Biological filters, Activated sludge process, Oxidation ditch, Stabilization ponds, Solid waste management, Wastewater reuse.

07 07 701 Master of Engineering Report in Sanitary Engineering

07 07 705 Master of Science Thesis in Sanitary Engineering

07 07 801 Doctor of Philosophy Dissertation in Sanitary Engineering

Department of Mechanical Engineering

The department of Mechanical Engineering offers the following programs:

1. Graduate Diplomas

1.1 Specialized Graduate Diploma in Mechanical Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass the following courses: (07 08 611, 07 08 625, 07 08 631, 07 08 645) in addition to the "diploma project" (07 08 601)
Elective courses: The student can choose the remaining 15 credit hours from the diploma courses 07 08 6xx.

2. Master Degrees

2.1 Master of Engineering in Mechanical Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass 6 courses (18 credit hours) from one of the following four groups 07 08 71x, 07 08 72x, 07 08 73x, 07 08 74x
Elective courses: The student can choose the remaining 4 courses (12 credit hours) from the other 3 groups of courses in the Master's course list.
The student is allowed to study a maximum of 6 credit hours as selective courses from other departments.

2.2 Master of Science in Mechanical Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
Compulsory courses: The student must pass 5 courses (15 credit hours) from one of the following four groups 07 08 71x, 07 08 72x, 07 08 73x, 07 08 74x
Elective courses: The student can choose the remaining 3 courses (9 credit hours) from the other 3 groups of courses in the Master's course list.
The student is allowed to study a maximum of 6 credit hours as selective courses from other departments.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Mechanical Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

Compulsory courses: The student must pass 4 courses (12 credit hours) from one of the following four groups 07 08 81x, 07 08 82x, 07 08 83x, 07 08 84x

Elective courses: The student can choose the remaining 2 courses (6 credit hours) from the other 3 groups of courses in the Master's course list.

The student is allowed to study a maximum of 6 credit hours as selective courses from other departments.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisite
1	07 08 611	Applied Heat and Mass Transfer	3	3	
2	07 08 612	Thermal Power Plants	3	3	
3	07 08 613	Heat Exchangers	3	3	
4	07 08 614	Power Plant Operation and Management	3	3	
5	07 08 615	Design of Refrigeration Equipment and Cycles	3	3	
6	07 08 616	Design of Central Air Conditioning Systems	3	3	
7	07 08 617	Industrial Ventilation and Smoke Management	3	3	
8	07 08 618	Special and Industrial Air Conditioning Systems	3	3	
9	07 08 621	Modern Automotive Engines	3	3	
10	07 08 622	Fuel Fires: Prevention and Extinguishing	3	3	
11	07 08 623	Fundamentals of Diesel Engineering	3	3	
12	07 08 624	Performance and Maintenance of Diesel Engines	3	3	
13	07 08 625	Fundamentals of Fuel Combustion	3	3	
14	07 08 626	Fundamentals of Gas Turbines	3	3	
15	07 08 627	Environmental Studies in Combustion Engineering	3	3	
16	07 08 631	Fluid Machinery	3	3	
17	07 08 632	Pipeline Design	3	3	
18	07 08 633	Hydraulic and Pneumatic Control Systems	3	3	
19	07 08 641	Sensors	3	3	

20	07 08 642	Robot Dynamics	3	3	
21	07 08 643	Vibration Problems in Industry	3	3	
22	07 08 644	Condition Monitoring and Diagnosis	3	3	
23	07 08 645	Engineering Materials	3	3	
24	07 08 646	Computer Aided Design	3	3	
25	07 08 647	Experimental Design and Error Analysis	3	3	
26	07 08 711	Industrial Ventilation	3	3	
27	07 08 712	Heat and Mass Transfer	3	3	
28	07 08 713	Thermal Design of Air Conditioning and Refrigeration Equipment	3	3	07 08 712
29	07 08 714	Humidification and Drying	3	3	
30	07 08 715	Advanced Power Plants	3	3	
31	07 08 716	Analysis and Design of Heat Exchangers	3	3	
32	07 08 717	Two-Phase Flow Heat Transfer	3	3	
33	07 08 718	Applications of Numerical Methods to Transport Phenomena	3	3	07 08 712
34	07 08 719	Heat and Mass Transfer II	3	3	
35	07 08 720	Cryogenic and Gas Liquefaction	3	3	
36	07 08 721	Design and Solar Energy Conversion Systems	3	3	
37	07 08 722	Fuels and Fundamentals of Combustion	3	3	
38	07 08 723	Environmental Topics in Combustion Engineering	3	3	
39	07 08 724	Thermodynamics of Combustion	3	3	
40	07 08 725	Combustion Phenomena in Spark–ignition Engines	3	3	07 08 722 or 07 08 724
41	07 08 726	Combustion Phenomena in Compression–ignition Engines	3	3	07 08 722 or 07 08 724

42	07 08 727	Gas Turbines	3	3	
43	07 08 728	Advanced Topics in Combustion Engineering I	3	3	07 08 725 or 07 08 726
44	07 08 729	Combustion Diagnostics and Measurements	3	3	
45	07 08 730	Novel Engines	3	3	
46	07 08 731	Mechanics of Continuous Media	3	3	
47	07 08 732	Advanced Fluid Mechanics	3	3	
48	07 08 733	Computational Fluid Dynamics I	3	3	
49	07 08 734	Measurements in Fluid Mechanics	3	3	
50	07 08 735	Turbulent Flow	3	3	
51	07 08 736	Flow Transients	3	3	
52	07 08 737	Multiphase Flow	3	3	
53	07 08 738	Hydraulic Machines	3	3	
54	07 08 739	Selected Topics in Fluid Mechanics I	3	3	
55	07 08 741	Modelling and Simulations	3	3	
56	07 08 742	Theory of Vibrations	3	3	
57	07 08 743	Digital Control	3	3	
58	07 08 744	Linear Control	3	3	
59	07 08 745	Composite Materials	3	3	
60	07 08 746	Finite Element Analysis	3	3	
61	07 08 747	Theory of Elasticity	3	3	
62	07 08 748	Theory of Lubrication	3	3	
63	07 08 749	Bearing Analysis	3	3	
64	07 08 811	Advanced Thermodynamics	3	3	

65	07 08 812	Numerical Analysis	3	3	
66	07 08 813	Advanced Turbulent Heat and Mass Transfer	3	3	07 08 712
67	07 08 814	Advanced Cooling Load Methods and Energy Management	3	3	
68	07 08 815	Advanced Topics in Thermal Engineering	3	3	07 08 712
69	07 08 816	Thermal Engineering Research	3	3	Approval of the supervisor
70	07 08 817	Advanced Conductive Heat Transfer	3	3	
71	07 08 818	Advanced Convective Heat Transfer	3	3	
72	07 08 819	Advanced Radiative Heat Transfer	3	3	
73	07 08 821	Heterogeneous Combustion	3	3	07 08 726
74	07 08 822	Advanced Gas Dynamics	3	3	
75	07 08 823	Advanced Topics in Combustion Engineering II	3	3	07 08 725 or 07 08 726
76	07 08 824	Applications of Unsteady Flow in Combustion	3	3	07-08-822
77	07 08 825	Doctoral Directed Research in Combustion Engineering	3	3	Approval of the supervisor
78	07 08 831	Viscous Flow	3	3	07 08 731
79	07 08 832	Advanced Experimental Methods for Fluid Systems	3	3	07 08 734
80	07 08 833	Computational Fluid Dynamics II	3	3	07 08 733
81	07 08 834	Simulation and Modeling of Turbulent Flows	3	3	07 08 732
82	07 08 835	Externally Pressurized Bearings	3	3	
83	07 08 836	Electro-hydraulic and Electro-pneumatic Systems	3	3	
84	07 08 837	Selected Topics in Fluid Mechanics II	3	3	
85	07 08 841	Theory of Plasticity	3	3	

86	07 08 842	Viscoelasticity	3	3	07 08 747
87	07 08 843	Selected Topics in Mechanical Design	3	3	
88	07 08 844	Advanced Dynamics	3	3	
89	07 08 845	Nonlinear Control	3	3	07 08 744
90	07 08 846	Selected Topics in Dynamic Systems	3	3	
91	07 08 601	Diploma Project in Mechanical Engineering	3	Presentation	
92	07 08 701	M.Eng. Scientific Report in Mechanical Engineering	3	Defense	
93	07 08 702	M.Sc. Thesis in Mechanical Engineering	8	Defense	
94	07 08 801	Ph.D. Dissertation in Mechanical Engineering	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 08 611 Applied Heat and Mass Transfer
Application of conduction heat transfer in designing insulated walls. Finned surfaces design. Transient conduction. Heat transfer by radiation. Factors affecting convective heat transfer. Laminar and turbulent convection over surfaces of different shapes and inside tubes and tube banks. Laminar and turbulent free convection over surfaces and inside enclosures. Mixed convection. Boiling and condensation. Evaporation.

07 08 612 Thermal Power Plants
Types of thermal power plants. Combined power plants. Mechanical design of power plants. Heat recovery boilers. Performance and operation of combined cycle. Advantages of combined cycle. Comparison between conventional and combined power plants.

07 08 613 Heat Exchangers
Types of heat exchangers. The overall heat transfer coefficient. Analysis of heat exchangers. Selection of heat exchangers. Thermal design of heat exchangers using TEMA code. Heat exchangers: materials, construction and corrosion. Flow induced vibration phenomena. Testing and inspection.

07 08 614 Power Plant Operation and Management

Safety laws and safety requirements in power plants. Environmental laws and environmental control systems. Boiler start up. Boiler normal and abnormal operations. Boiler idling and storage. Maintenance and inspection of steam generators. Turbine startup (cold and hot). Turbine lubricating and control circuits. Steam condensers and cooling tower operations. Part load problems. Load distribution between units and plants and economical load operation of power plants. Daily, weekly, and monthly power plants maintenance. The preventive maintenance for the power stations.

07 08 615 Refrigeration Equipment and Design
Air cooler. Compressor. Condenser. Cooling tower. Expansion devices. Control systems. Multi pressure systems. Flooded systems and refrigerant pumps.

07 08 616 Design of Central Air Conditioning Systems
Building survey. Cooling and heating load calculations. System selection. Equipment selection. Duct design. Water piping design. Ventilation and smoke management. Control systems. Block building load and diversity factor.

07 08 617 Industrial Ventilation and Smoke Management
Heat generation. Moisture accumulation. Displacement ventilation. Pressure control. Zone pressurization. Control of gaseous indoor and air contaminants applications.

07 08 618 Special and Industrial Air Conditioning Systems
Temperature control, humidity control, zone pressure control, air change and filtration codes requirements, clean rooms encompasses, textile manufacturing, candy processing, industrial drying, hospitals, museums, libraries, industrial and military control rooms.

07 08 621 Modern Automotive Engines
Modern trends in engine design. Combustion chambers. Valve train. Electronic injection in gasoline engines. Mixture control. Cooling and lubrication. Emission control requirements.

07 08 622 Fuel Fires: Prevention and Extinguishing
Fire causes. Flammable substances. Stoichiometric combustion. Fire prevention and extinguishing. International codes.

07 08 623 Fundamentals of Diesel Engineering
Types of diesel engines. Fuel pumps. Injectors. Governors.

07 08 624 Performance and Maintenance of Diesel Engines
Combustion chambers. Operating conditions. Performance maps. Emissions. Turbochargers. Engine testing. Maintenance.

07 08 625 Fundamentals of Fuel Combustion
Stoichiometry. Combustion kinetics. Energy balance. Flame propagation. Emissions.

07 08 626 Fundamentals of Gas Turbines
Types of gas turbines. Fuels. Ignition systems. Combustion chambers. Diffusers and nozzles. Compressors. Turbines. Emissions.

07 08 627 Environmental Studies in Combustion Engineering
Combustion products. Emission formation. Effects of operating conditions on emissions. Emission dispersion. Emission measurements and testing. Environmental regulations.

07 08 631 Fluid Machinery
Types of pumps. Positive-displacement and rotodynamic pumps. Theory of centrifugal pumps. Design, selection, operation, and maintenance of pumps. Methods of gas compression. Types of compressors, fans and blowers. Positive-displacement compressors. Theory of centrifugal and axial-flow compressors. Design, selection, operation, and maintenance of compressors, fans and blowers .

07 08 632 Pipeline Design
Basic equations of liquid and gas flows in pipes. Water piping systems and branches. Design of pipe networks. Hydraulic and mechanical design of oil pipelines. Natural gas pipelines. Compressed air piping systems. Economic considerations. Construction, operation, maintenance, and applications. Unsteady flow in pipeline.

07 08 633 Hydraulic and Pneumatic Control Systems
Generation, transmission, and utilization of power in systems in which the working fluid is oil or air. Analysis and design of pumps, cylinders, motors, valves, and other fluid components. Dynamic analysis and control of fluid power systems. Design and analysis of basic and advanced hydraulic and pneumatic circuits. Construction of some hydraulic equipment (hydraulic cranes, fork lifts, graders, shovels, or excavators). Hydraulic and pneumatic systems operation, troubleshooting techniques, and procedures of maintenance.

07 08 641 Sensors
Electromechanical transducers. Error and accuracy. Motion sensors, (resistance inductance, proximity, piezoelectric, eddy current). Force, torque and tactile sensors. Flow sensors (differential pressure, hotwire, electromagnetic, Laser Doppler). Temperature sensors (resistive, thermocouples, fiber optics, interferometrics). Ultrasonic, fiber optics and range sensors.

07 08 642 Robot Dynamics
Basics of Robotics. Homogeneous transformation. Arm kinematics. Inverse kinematics. Arm dynamics. Trajectory planning. Robot control system. Position, speed and force control of robot grippers. Practical examples.

07 08 643 Vibration Problems in Industry
Basic principles and sources of vibrations. Vibrations in buildings. Isolator selection. Plant room design and installation techniques and instrumentations of vibration measurement. Vibration control.

07 08 644 Condition Monitoring and Diagnosis
Vibrations concept. Causes of vibration. Maintenance, transmissibility, and impedance. Sideband frequencies. Fourier analysis. Vibration sensors. Data acquisition. Vibration monitoring. Preventive maintenance program. Vibration limits. Machine performance criteria.

07 08 645 Engineering Materials
Main types and properties of metals and alloys. Heat treatment. Polymers. Elastomers. Ceramics. Composites.

07 08 646 Computer Aided Design
Using computer in engineering design process, graphics, and numerical solutions. The finite element method. Using SIMULINK for the solution of the equations of motion. Using graphics for the design of mechanical parts. Programming project.

07 08 647 Experimental Stress Analysis
Basic equations and plane elasticity theory. Brittle coating methods. Electrical resistance strain gages. Semiconductor strain gages. Analysis of strain gage data. Optical methods and basic optics. Moire method. Photoelasticity .

07 08 711 Industrial Ventilation
Heat generations. Moisture accumulation. Displacement ventilation. Pressure control. Zone pressurization. Control of gaseous indoor and air contaminants. Smoke management. Applications.

07 08 712 Heat and Mass Transfer I
Conduction heat equation. 1-D conduction applications. Mathematical and numerical methods in 2-d conduction. Heat transfer by radiation through participating and non-participating media. Applications on combined conduction and radiation. Ficks law for mass transfer. Mass diffusion in gases and liquids.

07 08 713 Thermal Design of Air Conditioning and Refrigeration Equipment
Prerequisite: 07 08 712
Advanced topics on the design of heaters and humidifiers. DX coils. Chilled water coils. Evaporators. Air cooled condenser. Water cooled condenser. Expansion devices. Chillers and cooling towers.

07 08 714 Humidification and Drying
Humidification system components. Theoretical analysis and performance of humidification systems. Classification and selection of dryers. Drying mechanism. Calculation of drying rates and periods. Practical dryer design.

07 08 715 Advanced Power Plants
Steam boilers. Steam turbines. Gas turbines. Nuclear power plants. Advanced power plants. Effect of power stations on environment.

07 08 716 Analysis and Design of Heat Exchangers
Classification of heat exchangers. Advanced study on heat exchangers analysis of types: shell and tube, finned tubes, finned plates. Overall heat transfer and pressure drop. Thermal design of heat exchangers.

07 08 717 Two-Phase Flow Heat Transfer
Generalized constitutive equations for various two-phase flow regimes. Interfacial heat and mass transfer. Equilibrium and non-equilibrium flow models. Two-phase flow instability. One dimensional wave propagation. Two-phase heat transfer applications: convective boiling, pressure drop, critical and oscillatory flows.

07 08 718 Application of Numerical Methods to Transport Phenomena
Prerequisite: 07 08 712
Numerical techniques for solving selected problems in heat and mass transfer. Applications include free convection, boundary layer flow, two-phase flow, separated flow, flow in porous media. Effects of concentration and temperature gradients, chemical reactions, radiation and electric and magnetic fields.

07 08 719 Heat and Mass Transfer II
Mass, momentum, and energy equations, boundary layers, laminar and turbulent convection over surfaces and inside tubes, free convection, laminar and turbulent mass transfer, mass diffusion coefficient.

07 08 720 Cryogenic and Gas Liquefaction
Thermodynamics properties of gases mixture – Cycles and Equipment (separators - Columns – Compressors – Expanders) – Air fractionation – Nitrogen liquefaction –

Oxygen liquefaction – Hydrogen liquefaction – Helium liquefaction – Industrial LNG processes – Energy consumption

07 08 721 Design of Solar Energy Conversion Systems
Principles of solar energy _ The basic concepts and implementation of conversion processes._ Properties and availability of solar radiation and geometric relationship of sun/collecto_- procedures for solar thermal engineering calculations,_ Solar thermal power plants for electricity generation. Sensible and phase change energy storage.

07 08 722 Fuels and Fundamentals of Combustion
Types of fuels. Stoichiometry. Thermodynamics of combustion. Equilibrium. Flame propagation and flame quench. Droplet group combustion. Emissions.

07 08 723 Environmental Topics in Combustion Engineering
Combustion fundamentals. Emission formation. Effects of operating conditions. Emission dispersion. Emission standards, measurements, and testing. Emission control systems.

07 08 724 Thermodynamics of Combustion
Thermodynamic relations. Real-gas equations. Mixtures and solutions. Chemical reactions. Stoichiometry and adiabatic flame temperature. Gas tables and JANAF tables. Phase and chemical equilibrium. Association and dissociation. Simultaneous reactions.

07 08 725 Combustion Phenomena in Spark Ignition Engines
Prerequisite: 07 08 722 or 07 08 724
Modern fuel-injection systems. Electronic ignition. Heat release analysis. Knocking phenomena. Octane requirements. Chemical equilibrium of combustion. Emission formation.

07 08 726 Combustion Phenomena in Compression Ignition Engines
Prerequisite: 07 08 722 or 07 08 724
Injection transients. Spray atomization and ignition delay. Heat release analysis. Temperature fields in piston and combustion-chamber walls. Frictional losses. Flow through exhaust manifold and silencer design. Turbocharging and part-load problems.

07 08 727 Gas Turbines
Types of gas turbines. Types of diffusers. Design of turbine blades and compressor blades. Stage losses and multi-staging. Performance charts. Matching considerations.

07 08 728 Advanced Topics in Combustion Engineering I
Prerequisite: 07 08 725 or 07 08 726
The course covers new topics at Master's level in the areas of combustion and gas dynamics.

07 08 729 Combustion Diagnostics and Measurements
Experimental design and error analysis. Sensors. Digital signal processing and analysis. Flow visualization techniques. Combustion measurements. Wind tunnels.

07 08 730 Novel Engines
Stirling engines. Fuel–cell operated vehicles. Hydrogen-operated engines. Cryogenic engines. Hybrid vehicles. Solar-energy driven cars. Natural gas engines. Latest advances in the field.

07 08 731 Mechanics of Continuous Media
Cartesian tensor analysis. Stress. Traction vectors. Small and finite strain. Kinematics of continuous media. Conservation equations in Lagrangian and Eulerian coordinates. Constitutive equations for elastic solids and viscous fluids. Viscoelasticity and plasticity.

07 08 732 Advanced Fluid Mechanics
Navier-Stokes equations and constitutive theory. Exact solutions of the Navier-Stokes equations. Viscous flow fundamentals. Vorticity dynamics. Solution of the Navier-Stokes equations in their approximate forms. Thin shear layers and free surface flows. Boundary layer theory. Integral momentum methods. Introduction to turbulence.

07 08 733 Computational Fluid Dynamics I
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.

07 08 734 Measurements in Fluid Mechanics
Design and analysis of engineering experiments with an emphasis on measurement methods and standards. Data analysis. Regressions. General and detailed uncertainty analysis, including statistical intervals, propagation of bias and precision errors. Correlated bias approximations, and using jitter programs.

07 08 735 Turbulent Flow
Basic turbulent flow concepts. Origin of turbulence. Introduction to turbulence measurements. Review of experimental results on the statistics and structure of turbulent flows. Methods for calculation of turbulent flows. The problem of closure, semi-empirical, phenomenological and analytical theories of turbulence. Large-eddy and direct simulations of turbulence. Introduction to turbulence modeling. Eddy viscosity/diffusivity concept. Zero-equation models. One-equation models. Two-equation models. Introduction to second-moment closures. Applications to boundary layers, shear layers, jets, plumes, wakes and separated flows.

07 08 736 Pipeline Systems
Review of steady flow in pipes. Imperial pipe friction formulas. Networks of pipes. Non-linear network analysis. Pumps in systems. Fundamental concepts of unsteady flow. Solution by method of characteristics. Problems resulting from unsteady flow in pipe systems. Surge protection devices and techniques. Pipe modelling and simulations.

07 08 737 Multiphase Flow
Selected topics in multiphase flow including nucleation and cavitation. Dynamics of stationary and translating particles and bubbles. Basic equations of homogeneous two-phase gas/liquid, gas/solid, and vapor/liquid flows. Kinematics and acoustics of bubbly flows. Instabilities and shock waves in bubbly flows, stratified, annular, and granular flow.

07 08 738 Hydraulic Machines
Pump types and constructions. Pumps Performance curves. Pump drive. Pump controls and valves. Intakes and suction piping. Hydraulic loads. Pump testing. Special problems of pump design, and operating conditions. Selecting and purchasing pumps.

07 08 739 Selected Topics in Fluid Mechanics I
This course is intended to focus on one or more topics of interest to fluid engineers such as; industrial noise, cavitation, hydraulic transients, air pollution. Non-newtonian fluids. Drag reduction. Specifications and bids evaluation of hydraulic equipment. Mechanical seals for compressors and pumps. Lubrication. Aerodynamics. Compressible flow.

07 08 741 Modelling and Simulation
Basics of mathematical modeling. Experimental methods for modeling and identification. Physical analogies. Simulation and basics of parameter estimation methods. Recent simulation software and packages. Practical applications.

07 08 742 Theory of Vibrations
Continuous systems. Transient response of lumped parameter systems – Critical speeds of shafts & rotor dynamics – Gyroscopic effects of discs and rotor balance.

07 08 743 Digital Control
Discretization of continuous systems. Z-transforms. Closed loop performance and stability. Digital controllers and filters. State-space analysis. Pole placement and optimal regulators for discrete systems. Applications.

07 08 744 Linear Control

State-space system analysis. Controllability. Observability. Lyapunov stability. Pole placement. Design of servo systems. State observer. Quadratic optimal control. Design of control system with observer. Applications with MATLAB.

07 08 745 Composite Materials

Types and applications of composite materials. Macro-mechanical and micro-mechanical properties of lamina. Macro-mechanical behaviour of laminate. Stresses in metal-matrix fibrous composites. Experimental methods for measuring the properties of composite materials

07 08 746 Finite Element Analysis

Finite element analysis of beams. Element and interpolation functions. Plane stress. Finite element analysis of plates. Finite element analysis for elastic stability. Broader aspects of the finite element method. The finite element method in lubrication problems.

07 08 747 Theory of Elasticity

Analysis of stress and strain in three dimensions. Equations of equilibrium. Conditions of compatibility. Displacements. Plane stresses and strains in rectangular, polar, and curvilinear coordinates. Applications.

07 08 748 Theory of Lubrication

Modes of lubrication (hydrodynamic and hydrostatic lubrication). Reynolds' equation. Lubrication of mechanical components (plain bearings, rolling bearings, gears, chains, sliders, and wire ropes). Lubricants (types of lubricating oils and greases, solid lubricants, gas lubricants, and selection of lubricant type). Lubrication systems.

07 08 749 Bearing Analysis

Hydrodynamic and hydrostatic bearings. Gas bearings. Turbulence, inertia, and thermal effects. Dynamically loaded bearings. Bearing stability. Porous bearings. Antifriction bearings. Bearing materials. Lubricants.

07 08 811 Advanced Thermodynamics

Analysis of classical thermodynamics from the microscopic viewpoint. Topics include: ensemble methods, partition functions, translational, rotational and vibrational energy modes of an ideal gas, chemical equilibrium, imperfect gases, dense fluids, critical-point theories, mean free path concepts, Boltzmann equation, hydrodynamic equations from kinetic theory and properties of disordered composite media.

07 08 812 Numerical analysis

Arrangement of equations of the quantitative heat and the energy and moving of the lump. The marginal cases for the vines and the cases connected. Numerical analysis methods.

07 08 813 Advanced Turbulent Heat and Mass Transfer
Prerequisite: 07 08 712
Models of turbulence. Heat and mass transfer in turbulent external flows over plates and rounded surfaces. Turbulent flow inside ducts and tubes. Turbulent convection in compressible flow.

07 08 814 Advanced Cooling Load Methods and Energy Management
Transfer function method. CLTD/SCL/CLF method. Classical BIN method. Modified BIN method. Overall modeling strategies and building explorer. Computer system architecture. Hardware options. Software options. Computer-aided design. Artificial intelligence. Data acquisition. Building dynamics. Control of thermal storage systems.

07 08 815 Advanced Topics in Thermal Engineering
Prerequisite: 07 08 712

07 08 816 Thermal Engineering Research
The research includes the design of experiments and selecting the suitable numerical methods to perform scientific research for the Ph.D. degree.

07 08 817 Advanced Conductive Heat Transfer
Methods of solving multidimensional transient and steady heat conduction, approximate and exact methods of solving nonlinear conduction problems and heat conduction in composite media and anisotropic solids.

07 08 818 Advanced Convective Heat Transfer
Advanced topics in steady and transient, natural and forced convective heat transfer for laminar and turbulent flow through conduits and over surfaces, mass transfer in laminar and turbulent flow and inclusion of topics on compressible flow with heat and mass transfer.

07 08 819 Advanced Radiative Heat Transfer
Comprehensive and unified treatment of basic theories; exact and approximate methods of solution of radiative heat transfer in participating media, and the interaction of radiation with conductive and convective modes of heat transfer in participating and non-participating media.

07 08 821 Heterogeneous Combustion
Prerequisite: 07 08 726
Diesel injectors and nozzle types. Spray characteristics and droplet sizing. Spray penetration and air entrainment. Heat transfer and mass diffusion. Droplet burning and film combustion. Group combustion. Soot formation and particulate growth. Filters and trap regeneration. NO_x formation and catalytic converters.

07 08 822 Advanced Gas Dynamics
Basic concepts. Multi-dimensional compressible flow. Small perturbation theory. Method of characteristics. Waves in compressible flows. Unsteady flow in ducts. Numerical procedures of solution. Case studies.

07 08 823 Advanced Topics in Combustion Engineering II
Prerequisite: 07 08 724 or 07 08 725
The course will cover new topics not covered at Master's level in the areas of combustion and gas dynamics.

07 08 824 Applications of Unsteady Flow in Combustion
Prerequisite: 07 08 822
Fundamentals of unsteady flow. Dynamic-pressure exchangers. Pressure-wave utilization in reciprocating-engine manifolds. Supercharging. Pulsating combustors. Pulse ejectors. Passive wave-energy converters.

07 08 825 Doctoral Directed Research in Combustion Engineering
Prerequisite: Advisor's approval

07 08 831 Viscous Flow
Prerequisite: 07 08 731
Mechanics of viscous flow. Kinematics and dynamics of viscous flow. Exact and approximate solutions of the Navier-Stokes equations. Vorticity. The vorticity transport equation. Boundary layer theory. Laminar boundary layers. Boundary layer separation. Hydrodynamic stability.

07 08 832 Advanced Experimental Methods for Fluid Systems
Prerequisite: 07 08 734
Design of experiments. Velocity, pressure, temperature, and flow measurements of liquids and gases. Fundamentals of electronic signal processing and optics. Advanced experimental techniques, including laser-Doppler velocimetry. Hot-wire anemometry and thermocouples.

07 08 833 Computational Fluid Dynamics II

Prerequisite: 07 08 733
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. Grid generation techniques.

07 08 834 Simulation and Modeling of Turbulent Flow
Prerequisite: 07 08 732
Introduction to turbulence. Concepts of numerical accuracy and bandwidth. Solutions in differential form and wave space. The numerical representation of turbulent transport, production, and dissipation. Techniques for the simulation and modeling of turbulent flows, including direct numerical simulation (DNS), large-eddy simulation (LES), Reynolds-averaged Navier-Stokes (RANS) and the probability-density-function (PDF) method .

07 08 835 Externally Pressurized Bearings
Equation of motion. Types of bearings. Geometries of hydrostatic gas bearings. Performance improvement. Pressure distribution. Load and discharge. Effect of different factors on bearing performance. Design procedure.

07 08 836 Electro-hydraulic and Electro-pneumatic Systems
Proportional valves. Servo valves. Components of electrical control. Electro-hydraulic control circuits. Electro-pneumatic control circuits. Applications of electro-hydraulic and electro-pneumatic controls. Programmable control equipment. Programmable control applications.

07 08 837 Selected Topics in Fluid Mechanics II
This course is intended to focus on one or more topics of interest to fluid engineers such as; industrial noise, cavitation, hydraulic transients, air pollution. Non-newtonian fluids. Drag reduction. Specifications and bids evaluation of hydraulic equipment. Mechanical seals for compressors and pumps. Lubrication. Aerodynamics. Compressible flow.

07 08 841 Theory of Plasticity
Fundamentals of continuum mechanics. Equations of plastic state. Equations of elastic plastic equilibrium. Plane stresses and strains. Behaviour of elastic plastic bodies under variable loads.

07 08 842 Viscoelasticity
Prerequisite: 07 08 747
Classification of viscoelastic materials. Creep and relaxation tests. Harmonic tests. Notation of time response. Analogous study of viscoelastic behaviour. Superposition principles of Boltzman.

07 08 843 Selected Topics in Mechanical Design
Design of smart machine elements – Design of continuously variable transmission systems – Design of elastomers for various applications – Design of magneto and electro reological clutches and brakes – Advanced techniques and software for optimum machine elements design.

07 08 844 Advanced Dynamics
Lagrange's equation. Ignorable coordinates. Hamiltonian mechanics. Canonical transformations (Hamilton – Jacobi). Theory of variational principles of mechanics. Stability of multi-degree-of-freedom autonomous systems. Non-autonomous systems. Perturbation techniques.

07 08 845 Nonlinear Control
Prerequisite 07 08 744
Nonlinearities in physical systems. Phase plane analysis. Transformation and scaling methods. Stability analysis (Lyapunov's first and second method, frequency domain methods. Equivalent linearization; harmonic response, K&B, Galerkin's method, describing functions. Controller synthesis. Riccatti approach. Absolute stability approach.

07 08 846 Selected Topics in Dynamic Systems
Dynamic systems and their various applications in engineering – Dynamic system stability – Advances in dynamic systems characteristics – Stability of discontinuous systems – Discrete and continuous nonlinear dynamic systems – Recent simulation software and pakages.

07 08 601 Diploma Project in Mechanical Engineering

07 08 701 M.Eng. Scientific Report in Mechanical Engineering

07 08 702 M.Sc. Thesis in Mechanical Engineering

07 08 801 Ph.D. Dissertation in Mechanical Engineering

Department of Production Engineering

The department of Production Engineering offers the following programs:

1. Graduate Diplomas

1.1 Specialized Graduate Diploma in Manufacturing Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass six courses with a total of 18 credit hours with course numbers (07 09 611, 07 09 612, 07 09 613, 07 09 621, 07 09 642, 07 09 643).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

2. Master Degrees

2.1 Master of Engineering in Manufacturing Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass six courses with a sum of 18 credit hours with course numbers (07 09 711, 07 09 713, 07 09 721, 07 09 722, 07 09 741).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Industrial Engineering

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
Compulsory courses: The student must pass three courses equivalent to 9 credit hours with course numbers (07 10 711, 07 10 721, 07 19 714).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.3 Master of Science in Manufacturing Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must pass three courses equivalent to 9 credit hours with course numbers (07 09 713, 07 09 715, 07 09 741).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Industrial Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose from courses specified as "Doctorate courses". The student has the right to choose another three courses from another major.

3.1 Doctor of Philosophy in Manufacturing Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose from courses specified as "Doctorate courses". The student has the right to choose another three courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
1	07 10 631	Ergonomics and Biomechanics	3	3	
2	07 10 632	Industrial Safety and Occupational Health	3	3	
3	07 10 651	Engineering Cost Analysis	3	3	
4	07 10 711	Operations Research A	3	3	
5	07 10 712	Operations Research B	3	3	07 10 711
6	07 10 713	Simulation and Queuing Models	3	3	07 19 714
7	07 10 721	Plant Design And Material Handling	3	3	
8	07 10 722	Industrial Operations Management	3	3	07 10 711
9	07 10 723	Supply Chain Management	3	3	
10	07 10 724	Industrial Project Management	3	3	
11	07 10 731	Macroergonomics	3	3	
12	07 10 741	Industrial Information Systems	3	3	
13	07 10 751	Industrial Feasibility Study	3	3	
14	07 09 611	Forming Theories and Techniques	3	3	
15	07 09 612	Heat Treatment	3	3	
16	07 09 613	Material Selection	3	3	
17	07 09 621	Fundamentals of Cutting Processes	3	3	
18	07 09 631	Vibration Measurements and Analysis	3	3	
19	07 09 641	Error Analysis and Modeling	3	3	
20	07 09 642	Metrology Systems	3	3	
21	07 09 643	Industrial Quality Control	3	3	
22	07 09 710	Welding Methods and Welding Defects	3	3	
23	07 09 711	Solid Mechanics	3	3	
24	07 09 712	Forming Machines	3	3	
25	07 09 713	Manufacturing Properties of Engineering Materials	3	3	
26	07 09 714	Destructive and Non-destructive Testing of Welds	3	3	07 09 713
27	07 09 715	Advanced Metallic Alloys	3	3	
28	07 09 716	Plastics	3	3	
29	07 09 717	Finite Element Plasticity	3	3	
30	07 09 718	Failure Analysis and Prevention	3	3	
31	07 09 719	Special Topics in Material Forming	3	3	
32	07 09 721	Non-Conventional Cutting Methods	3	3	

33	07 09 722	Numerical Controlled Machines	3	3	
34	07 09 723	Design and Manufacturing of Cutting Tools	3	3	
35	07 09 724	Cutting with Abrasive Particles	3	3	07 09 721
36	07 09 725	Selected Topics in Machining Techniques	3	3	
37	07 09 731	Reverse Engineering	3	3	
38	07 09 732	Reliability Engineering and Machine Performance	3	3	
39	07 09 733	Maintenance Systems and Strategies	3	3	
40	07 09 734	Wavelet Analysis and Condition Based Maintenance	3	3	
41	07 09 735	Automatic Control and Robotics	3	3	
42	07 09 736	Selected Topics in Maintenance and Fault Diagnosis	3	3	
43	07 09 741	Statistical Design and Analysis of Experiments	3	3	
44	07 09 742	Laser and Optical Metrology	3	3	
45	07 09 743	Metrology of Pattern and Image Recognition	3	3	
46	07 09 744	Quality Assurance and Improvement	3	3	
47	07 09 745	Error Analysis in Measurement	3	3	
48	07 09 746	Quality Control Systems and Techniques	3	3	
49	07 09 747	Selected Topics in Dimensional Metrology	3	3	
50	07 10 821	Selected Topics in Planning and Management	3	3	
51	07 10 822	Selected Topics in Industrial Engineering	3	3	
52	07 10 823	Selected Topics in Operations Research Applications	3	3	
53	07 10 824	Selected Topics in Supply Chain Management	3	3	
54	07 10 831	Selected Topics in Industrial Safety	3	3	
55	07 10 832	Selected Topics in Human Factors Engineering	3	3	
56	07 10 841	Selected Topics in Information Systems	3	3	
57	07 09 811	Selected Topics in Forming Operations	3	3	

58	07 09 812	Sheet Metal Forming for Specific Industries	3	3	
59	07 09 813	Molten Metal Flow and Cooling Simulation	3	3	
60	07 09 814	Nanomaterials and Nanotechnology	3	3	
61	07 09 815	Selected Topics in Engineering Materials Technology	3	3	
62	07 09 821	Selected Topics in Machining Operations	3	3	
63	07 09 822	Machinability of Exotic € and Difficult-to-machine (DTM) Materials	3	3	
64	07 09 823	Design for Machining	3	3	
65	07 09 824	Machine Tools for High Speed Machining	3	3	
66	07 09 831	Selected Topics in Equipment Fault Diagnosis	3	3	
67	07 09 832	Failure Analysis of Mechanical Systems			
68	07 09 841	Selected Topics in Metrology and Measurement	3	3	
69	07 09 842	Selected Topics in Quality and Reliability	3	3	
70	07 09 843	Selected Topics in Micro- and Nano-Metrology	3	3	
71	07 09 844	Uncertainty Evaluation in Dimensional Measurements	3	3	
72	07 09 845	Selected Topics in Quality Systems and Applications	3	3	
73	07 09 851	Selected Topics in Material Inspection	3	3	
74	07 09 601	Diploma Project in Manufacturing Engineering	3	Presentation	
75	07 09 701	Master of Engineering Scientific Report in Manufacturing Engineering	3	Defense	
76	07 10 702	M.Sc. Thesis in Industrial Engineering	8	Defense	
77	07 09 702	M.Sc. Thesis in Manufacturing Engineering	8	Defense	
78	07 10 801	Ph.D. Dissertation in Industrial Engineering	24	Defense	
79	07 09 801	Ph.D. Dissertation in Manufacturing Engineering	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 10 631 Ergonomics and Biomechanics

The effect of human factors on systems performance. Human abilities and limitations. Anatomy, physiology of the human body. Bio mechanical aspects of hand tool and equipment design. Manufacturing systems design for better performance and human welfare.

07 10 632 Industrial Safety and Occupational Health

The relationship between man and environment. Factors, anatomical, social, and psychological affecting and affected by the work environment. Received external influences. The reaction. The impact of pollutants, the work environment to the worker. Workplace design to improve human performance. Hazardous chemicals and toxic. Noise control. Personnel protection equipment. Fire protection and prevention. Engineering product safety. Fault tree analysis. Risk analysis. The laws governing industrial safety and occupational health.

07 10 651 Engineering Cost Analysis

Review engineering costs and the relationship of the effect of time on value. The importance of cost analysis. Depreciation expense. Replacement and replacement policies. Risk analysis. Cost-benefit analysis. The impact of inflation on the cost analysis. Production costs. Budgets and balance sheet. Budget control.

07 10 711 Operations Research A

Formulations of LP. Linear Algebra. Simplex method. Sensitivity analysis. Assignment model. Transportation model. Multi-objectives and goal programming.

07 10 712 Operations Research B

Integer programming. Nonlinear programming. Quadratic programming. Dynamic programming. Network flow problems. Certainty and uncertainty in decision processes. Queuing theory: single service channel, multiple service channel.

07 10 713 Simulation and Queuing Models

Basics of simulation. Simulation models of queuing simple and complex. Simulation software packages. Process analysis and data collection. Choose a probability distribution of the input. Building a simulation model. Random numbers generation. Result analysis. Probabilistic and random processes

07 10 721 Plant Design and Material Handling

Basis of production planning systems and industrial projects. The foundations of product design and processes. The flow and material handling. Material handling systems. Warehouse. Mathematical models for facilities planning. Packaging and its role in the materials handling.

07 10 722 Industrial Operations Management

Basic concepts of production and operations management. Designing of products and services. Demand forecasting models. E-commerce and operations management. The basics of inventory management and the economic lot size. Determining the material requirements. Aggregate production planning. Scheduling.

07 10 723 Supply Chain Management

Supplier selection. Transportations systems. Vehicle routing and supply models. Site selection of storage and distribution systems. Inventory models. Geographic information system. Electronic commerce. The exchange of electronic data. Aggregate supply chain.

07 10 724 Industrial Project Management

Activity networks. CPM method. Probabilistic activity networks; structures. terminology, and PERT model. Models of time. Cost trade off. Resource planning in project networks.

07 10 731 Macroergonomics

Human performance of tasks. The structure of human-system communication. Human capabilities to use system components, and the design, specification, and evaluation of interfaces. The objectives of efficiency, safety, and comfort of users performing their tasks. Mini project.

07 10 741 Industrial Information Systems

Review of different IS. Elements of IS. A framework for Information Systems Architecture. The IS development methodology. The role of people in IS.

07 10 751 Industrial Feasibility Study

Element of feasibility studies. Financial and economical analysis. Equity and debt analysis. Economics, Financial project and economical measures. Cost analysis. Costing and break-even analysis. Technology selection. Plant design consideration. Capital Investment. Opportunity analysis. Technical feasibility. Basic engineering. Detailed engineering. Economical feasibility. Marketing feasibility. Financial feasibility. Basic principles of financing. Sources of financing. Business plans. Balance sheet. Income projection. Cash flow. Financial policies.

07 09 611 Forming Theories and Techniques

Classification. Fundamentals of plastic forming. Effect of temperature. Metallurgical changes. Formability. Rolling techniques. Forging techniques. Extrusion techniques. Technology of rod , wire and tube drawing. Sheet metal forming.

Flow curves. Effect of strain rates. Stresses. Effect of temperature. Effect of hydrostatic pressure. Strain hardening. Plasticity theories. Calculations of forces in forming processes. Slip line fields. Upper bound techniques. Viscoplasticity. Finite element analysis. Upsetting loads and stresses. Friction hills. Plain strain and axial symmetry. Loads and stresses in rolling. Effect of front and back tension. Torque and power in rolling. Extrusion pressures. Drawing. Theories of wire drawing. Limit stresses in bending.

07 09 612 Heat Treatment

Annealing. Recrystallization. Normalizing. Hardening. Martensite transformation. Surface hardening. Case hardening. TTT diagram. Martensite and bainite formation. Hardenability and weldability. Annealing. Normalizing. Hardening and tempering. Stress relief treatment. Solution treatment. Precipitation treatment.

07 09 613 Material Selection

Material selection for: high strength, high wear resistance, high temperature, use for corrosion resistance and other properties.

07 09 621 Fundamentals of Cutting Processes

The concept of material machinability. Evaluation of machinability. Recent trends of cutting tool materials. Tool wear and tool failure. Durability of cutting tools. Economic considerations in cutting processes. Surface integrity in cutting processes.

07 09 631 Vibration Measurements and Analysis

Types of vibrations in machinery and structures. Forced vibrations. Random vibrations. Vibration analysis techniques. Modal analysis. Use of temperature measurement as a supplement for vibration measurement for machinery. Diagnostic pressure monitoring and its use as a machinery inspection tool.

07 09 641 Error Analysis and Modeling in Metrology

Types and sources of errors in the measurements. The concept of tolerance and uncertainty in measurement. The concept and basics of the accumulation of errors. Modeling errors in measurement. Methods for calculating the uncertainty in measurement.

07 09 642 Metrology Systems

Basic elements of metrology systems. Automatic, on-line and in-process measurement and inspection systems. Data analysis and feedback systems. Intelligent metrology systems. Basics and applications of coordinate measurements. Coordinate measuring machines. Measurement strategies and error reduction

07 09 643 Industrial Quality Control

Concepts and the foundations of quality. Principles of statistical quality control. Collection and representation of data. Probability distributions of quality characteristics. Models and interactions between processes quality and product quality. Quality tools and techniques during and after processes. Applications of quality control systems. Principles and applications quality control charts for variables and attributes. Samples data distribution. Acceptance sampling. Types of samples. Sampling plans and techniques for attributes and variables. Applications of computers for online and offline quality control.

07 09 710 Welding Methods and Welding Defects

Gas welding. Gases. Filters. Safety. Shielded Metal Arc Welding (SMAW). Arc characteristics. Welding machines. Types of welding electrodes. Electric resistance welding (spot welding, seam welding, butt welds, stud welds). Sources of defects and how to eliminate them. Cracks. Porosity. Shrinkage cavities. Slag inclusions. Form defects. Distortions. **Special welding methods:** Submerged Arc Welding (SAW). Electro slag welding. MIG welding. TIG welding. Plasma welding. Electron beam welding. Laser welding. Ultrasonic welding.

07 09 711 Solid Mechanics

Tension test. Compression test. Bending test. Shear and torsion test. Notch impact tests. Hardness testing. Fatigue tests. Creep tests. Stress tensors. Two dimensional stresses. Mohr's circle. Three dimensional stresses. Stress deviators and mean stress. Analysis of strains. Strain energy. Yield criteria. Theories of plasticity.

07 09 712 Forming Machines

Types of presses and hammers. Types and specifications rolling equipment. Roll pass design. Extrusion presses. Drawing benches for bars and tubes. Wire drawing machines.

07 09 713 Manufacturing Properties of Engineering Materials

Classification of engineering materials. Properties of engineering materials (Mechanical, Electrical, Thermal, Environmental). Manufacturing processes and manufacturability. Casting and castability. Bulk forming and workability. Sheet forming and formability. Machining and machinability. Welding and weldability. Heat treatment and heat treatability. Selection of manufacturing processes.

07 09 714 Destructive and Non-destructive Testing of Welds

Tension test. Bending test. Neck break test. Notch impact tests. Determination of brittle transient temperature. Other special mechanical tests. Weld procedure. Qualification tests. Microscopic examination. Hardness distribution tests.
Visual inspection. Radiography: radiation, Alpha ray, isotopes, X-ray equipment. Radiation hazards and protection. Film development. Film characteristics. Interpretation.

07 09 715 Advanced Metallic Alloys

Crystal structure. Single crystal and polycrystalline materials. Defects of crystal structure. Effect on mechanical properties. Phase equilibrium diagrams. Ferrous materials and alloys. Non-ferrous materials and alloys. Clay products. Refractors. Aluminum Oxides. Silicon. Nitrides. Other Ceramics. Fiber reinforced materials. Strengthened metals. Ceramics and hard metals. Timber: classification, properties and testing.

07 09 716 Plastics

Polymers. Chain reactions. Step-reactions. Linear polymers. Crystalline and amorphous polymers. Cross linked polymers. Additives and fillers. Thermoplastics. Processing of polymers: casting, compression molding, transfer molding, injection molding, extrusion blow molding.

07 09 717 Finite Element Plasticity

General introduction to the Finite Element Method. Basic formulation for elastic deformation (types of elements, linear elements, plane-stress and plane-strain elements, three dimensional elements, displacement matrix, matrix of elastic constants, stiffness matrices, boundary conditions). Analysis of small plastic strain (yield stress, transfer from elastic to plastic behavior, effect of strain hardening, examples). Finite element plasticity on microcomputers. Analysis of large plastic strain. Applications on forming processes.

07 09 718 Failure Analysis and Prevention

Engineering aspects of failure and prevention. Manufacturing aspects of failure and prevention. Structural life assessment methods. Principles and practice of failure analysis. Tools and techniques in failure analysis. Types and mechanisms of fracture. Corrosion related failures. Wear failures. Distortion. Failures of mechanical components (shafts and axles, bearings, fasteners, dies, cutting tools, gears, pressure vessels, pipelines, etc.).

07 09 719 Selected Topics in Material Forming

07 09 721 Non-Conventional Machining Methods

Theories , fundamentals and applications. Advantages and disadvantages. Accuracy and machinability. Tool wear and factors affecting the following processes: electro-discharge machining, laser beam machining, electron beam machining, electrochemical machining, ultrasonic machining, water jet machining, abrasives jet machining.

07 09 722 Numerical Controlled Machines

Fundamentals and advantages of NC machines. System components. Programming CNC machines. Economical considerations. Performance tests of NC machines.

07 09 723 Design and Manufacturing of Cutting Tools

Cutting tool materials. Metallic and non–metallic cutting tool materials. Design of cutting tool: single point cutting tools, form cutting tools, reamers, broaches, gear cutting tools. Tool fixation. Turrets and magazines. Cutting tools manufacturing.

07 09 724 Cutting with Abrasive Particles

Principles of abrasive machining. Types of abrasive materials and properties. Mechanism of chip removal. Theoretical consideration. Applications. Specialized methods of abrasive machining.

07 09 725 Selected Topics in Machining Techniques

07 09 731 Reverse Engineering

Principles, concepts and procedures of reverse engineering. Identification, measurement and restoration of dimensions and geometry. Selection and application of dimensional and geometrical tolerances. Selection and testing of raw materials. Development and modification in reverse engineering. Basic criteria for evaluation and analysis of product performance.

07 09 732 Reliability Engineering and Machine Performance

Failure types and analysis. Reliability. Modes. Reliability testing. Reliability parameters. System reliability. Reliability optimization. Maintenance types and objectives. Maintenance effectiveness. Total Productive Maintenance

07 09 733 Maintenance Systems and Strategies

Basics of successful industrial maintenance. Problems and limits of application. Sample maintenance organizations. Structure and operation of maintenance organizations. Objectives of planned maintenance. Types of maintenance. Maintenance programs. Methods of planning maintenance. Maintenance records. Maintenance databases. Management of spare parts and crews in maintenance. Economics of maintenance. Computerized Maintenance Management Systems.

07 09 734 Wavelet Analysis and Condition Based Maintenance

The nature of wavelet analysis. The difference between the wavelet analysis and Fast Fourier Transformations. The use of wavelet analysis in condition based maintenance.

07 09 735 Automatic Control and Robotics

Automatic control. Open loop and closed loop control systems. Adaptive control. On-line control. Sensors. Robotic technology. Robot physical configuration. Work cell control. Robotics applications.

07 09 736 Selected Topics in Maintenance and Fault Diagnosis

07 09 741 Statistical Design and Analysis of Experiments

Introduction to experimental design and analysis of results. Statistical analysis. Statistical evaluation of experiments and analysis of variance. Single factor experiments with unrestricted randomness. Multiple factors experiments. Covariance and correlation analysis.

07 09 742 Laser and Optical Metrology

Types and properties of lasers. Applications of lasers in metrology. Holography and holographic interferometry and its applications in metrology. Optical sensors and their applications. Optical profiling. Principle, types and applications of optical fiber. Applications of optical fibers in metrology.

07 09 743 Metrology of Pattern and Image Recognition

Components of pattern recognition systems. Applications of image analysis and pattern recognition in metrology. Pattern recognition, preprocessing, feature extraction, and classification methods and algorithms.

07 09 744 Quality Assurance and Improvement

The concept and bases of quality improvement. Tools and methods of quality improvement. The foundations and methods of quality assurance. Specifications and international systems of quality assurance. Basics of Total Quality Management. Principles and applications of Six Sigma (6σ).

07 09 745 Error Analysis in Measurements

Errors in measurement (sources and types). Accumulation of errors in measurement. Estimation and evaluation of errors in measurement. Uncertainty evaluation in measurements.

07 09 746 Quality Control Systems and Techniques

Basics of quality control. Online quality control. Offline quality control. Statistical principles of quality control. Quality control tools and techniques. Loss function and Tagushi theory. Role of computers in quality control.

07 09 747 Selected Topics in Dimensional Metrology

07 10 821 Selected Topics in Planning and Management

07 10 822 Selected Topics in Industrial Engineering

07 10 823 Selected Topics in Operations Research Applications

07 10 824 Selected Topics in Supply Chain Management

07 10 831 Selected Topics in Industrial Safety

07 10 832 Selected Topics in Human Factors Engineering

07 10 841 Selected Topics in Information Systems

07 09 811 Selected Topics in Forming Operations

07 09 812 Sheet Metal Forming for Specific Industries

Characterization methods of sheet materials. Sheet metal formability. Anisotropy of sheet metal. Stress analysis of anisotropic materials. Bending. Cupping, redrawing and ironing. Stamping. Spinning. Roll forming and incremental forming. Forming limit diagram. Mechanical and physical properties of automotive materials. Materials selection for automotive components. Lightweight construction materials and techniques.

07 09 813 Molten Metal Flow and Cooling Simulation

Fundamentals of casting design. Finite elements for casting simulation. Models used in metal casting simulation. Design optimization (size, feeding system, metal fluidity, pour temperature, chilling). Estimation and remedy of casting defects using simulation tools. Simulation and analysis of investment casting.- Simulation and analysis of die casting. Fundamentals of weld design and welding problems. Models and assumptions used in welding simulation. Simulation and analysis of a simple SMAW operation. Simulation and analysis of TIG operation.

07 09 814 Nanomaterials and Nanotechnology

Introduction (definitions, properties and types). Sectors influenced by nanomaterials

(health, communication, energy, environment, transport, safety, security and defense). Special applications. Advanced nanomaterials (silicon substitutes, au, ag and pt, composite, catalysis). Nanotechnology. Selected manufacturing techniques.

07 09 815 Selected Topics in Engineering Materials Technology

07 09 821 Selected Topics in Machining Operations

07 09 822 Machinability of Exotic (E) and Difficult-to-machine (DTU) Materials

Definition and classification of E and DTM materials. Material properties and applications of E and DTM materials. Mechanics of hard machining. Selection of appropriate working conditions. Advanced cutting tool and cutting fluids. Surface integrity when machining E and DTM materials. Economics of cutting E and DTM materials. Special considerations when cutting E and DTM. Non-conventional technologies for cutting E and DTM materials.

07 09 823 Design for Machining

General design principles for manufacturability. History of DFM. General guidelines for design for machining. Design for turning. Screw cutting. Gear cutting. Drilling. Milling. Planing, shaping, and slotting. Broaching. Grinding. Honing, lapping, and superfinishing. Design for nontraditional machining. Electrical-discharge machining. Chemical and electrochemical machining. Laser and electron beam machining.

07 09 824 Machine Tools for High Speed Machining

Introduction to machine tools for removal processes. New concepts for structural components. New developments in drives and guide ways. Advanced controls for new machining processes. High speed machining. New developments in machining centers. Performance and precision of machining centers. Parallel kinematics for machine tools. New trends in conventional and non-conventional machine tools.

07 09 831 Selected Topics in Equipment Fault Diagnosis

07 09 832 Failure Analysis of Mechanical Systems

Modes of mechanical failure. General practice in failure analysis. Combined stress theories of failure. Fracture mechanisms in engineering materials. Linear elastic fracture mechanics. Stress intensity and fracture toughness. Fatigue failure and fatigue life prediction. Creep and stress rupture. Shock and impact failure. Buckling and instability. Wear mechanisms and wear analysis. Corrosion and stress corrosion cracking.

07 09 841 Selected Topics in Metrology and Measurement

07 09 842 Selected Topics in Quality and Reliability

07 09 843 Selected Topics in Micro- and Nano- Metrology

07 09 844 Uncertainty Evaluation in Dimensional Measurements

Concept of uncertainty in measurement. Measurement errors and distributions. Selection of the appropriate distribution. Error versus uncertainty. Developing the error model. Uncertainty estimation and variance distribution. Combinations of uncertainties. Variance addition rule. Error correlations and cross-correlation between error components. Confidence limits and expanded uncertainty. Type A uncertainty estimates and statistics for sampled values. Type B uncertainty estimates for different distributions (normal, lognormal, student's t and other distributions). Determining uncertainty according to ISO GUM procedure. Sensitivity coefficients - Expanded uncertainty .

07 09 845 Selected Topics in Quality Systems and Applications

07 09 851 Selected Topics in Material Inspection

07 09 601 Diploma Project in Manufacturing Engineering

07 09 701 Master of Engineering Scientific Report in Manufacturing Engineering

07 10 702 M.Sc. Thesis in Industrial Engineering

07 09 702 M.Sc. Thesis in Manufacturing Engineering

07 10 801 Ph.D. Dissertation in Industrial Engineering

07 09 801 Ph.D. Dissertation in Manufacturing Engineering

Department of Naval Architecture and Marine Engineering

The department of Naval Architecture and Marine Engineering offers the following programs:

1. Graduate Diplomas

1.1 Professional Diploma in Ship Maintenance and Repair

The student must complete 24 credit hours including 3 credit hours for the project.
Compulsory courses: The student must pass the following courses with a total of 18 credit hours from course numbers (07 11 621, 07 11 641, 07 11 661, 07 11 662, 07 11 683, 07 11 691).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.2 Specialized Graduate Diploma in Ship Design

The student must complete 30 credit hours including 3 credit hours for the project.
Compulsory courses: The student must pass 9 courses with a total of 21 credit hours with course numbers (07 11 621, 07 11 631, 07 11 641, 07 11 681, 07 11 683, 07 11 691, 07 11 622, 07 11 682, 07 11 692).

1.3 Specialized Graduate Diploma in Offshore Engineering

The student must complete 30 credit hours including 3 credit hours for the project.
Compulsory courses: The student must pass 9 courses with a total of 21 credit hours with course numbers (07 11 621, 07 11 631, 07 11 641, 07 11 683, 07 11 632, 07 11 691, 07 12 671, 07 12 672, 07 12 673).

2. Master Degrees

2.1 Master of Engineering in Marine Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass five courses with a sum of 15 credit hours with course numbers (07 11 741, 07 11 742, 07 11 743, 07 11 721, 07 11 792).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

2.2 Master of Engineering in Offshore Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.

Compulsory courses: The student must pass six courses with a sum of 18 credit hours with course numbers (07 12 773, 07 11 721, 07 11 731, 07 12 741, 07 12 772, 07 12 774).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

2.3 Master of Science in Naval Architecture and Marine Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must pass three courses with a sum of 9 credit hours with course numbers (07 11 721, 07 11 731, 07 11 741).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as “Master courses”. The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Naval Architecture and Marine Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

The following courses, if not taken before for the master degree, must be taken in addition to Ph.D. level courses: (07 11 721, 07 11 731, 07 11 741).

The student must choose three courses from those specified as “Doctorate courses”. The student has the right to choose three courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit Hours	Exam Duration	Pre-requisites
1	07 11 621	Hydrodynamics of Marine Units	3	3	
2	07 11 622	Ship Motion	3	3	07 11 621
3	07 11 631	Marine Structural Analysis (a)	3	3	
4	07 11 632	Marine Structural Analysis (b)	3	3	07 11 631
5	07 11 633	Structural Design of Marine Units	3	3	07 11 631
6	07 11 641	Marine Power Plants	3	3	
7	07 11 661	Shipyard Fabrication Processes	3	3	
8	07 11 662	Ship Maintenance and Repair	3	3	
9	07 11 681	Ship Design	3	3	
10	07 11 682	Ship Outfitting	3	3	07 11 651
11	07 11 683	Computer Applications in the Marine Field	3	3	
12	07 11 691	Economics of Marine Systems	3	3	
13	07 11 692	Marine Statutory Regulations	3	3	
14	07 12 671	Environmental Loads on Marine Units	3	3	
15	07 12 672	Offshore Systems	3	3	
16	07 12 673	Dynamics of Offshore Structures	3	3	07 11 631 07 11 632
17	07 11 721	Advanced Marine Hydrodynamics (a)	3	3	
18	07 11 722	Advanced Marine Hydrodynamics (b)	3	3	07 11 721
19	07 11 731	Advanced Marine Structure Analysis (a)	3	3	
20	07 11 732	Advanced Marine Structure Analysis (b)	3	3	07 11 731
21	07 11 733	Marine Composite Materials	3	3	
22	07 11 741	Marine Power Plants Systems (a)	3	3	07 11 741
23	07 11 742	Marine Power Plants Systems (b)	3	3	
24	07 11 743	Application of Energy in Marine Fields			
25	07 11 751	Marine Utilization of Energy	3	3	
26	07 11 761	Ship Production Planning and Control	3	3	
27	07 11 762	Quality Assurance Planning in Shipbuilding	3	3	
28	07 11 763	Accuracy Control in Shipbuilding	3	3	

29	07 11 781	Design of Modern Ship Types	3	3	
30	07 11 782	Special Topics in Ship Design	3	3	07 11 781
31	07 11 783	Computer Applications in the Marine Field	3	3	
32	07 11 791	Ship Salvage Operations	3	3	
33	07 11 792	Marine Pollution: Prevention and Control	3	3	
34	07 12 771	Dynamics of Ocean Waves	3	3	
35	07 12 772	Response of Offshore Structures	3	3	
36	07 12 773	Marine Pipelines	3	3	
37	07 12 774	Underwater Technology	3	3	
38	07 11 823	Computational Fluid Dynamics in Ship Hydrodynamics	3	3	07 11 721 07 11 722
39	07 11 824	Hydrodynamics of Marine Propellers	3	3	07 11 721
40	07 11 831	Theory of Ship Structures	3	3	07 11 731
41	07 11 832	Marine Structural Reliability	3	3	07 11 731
42	07 11 833	Marine Structure Dynamics	3	3	07 11 731 07 11 732
43	07 11 834	Structural Optimization	3	3	07 11 731
44	07 11 835	Material Fracture Analysis	3	3	07 11 731
45	07 11 841	Advanced Automatic Control in the Marine field	3	3	07 11 741
46	07 11 842	Advanced Marine Engineering	3	3	07 11 741
47	07 12 871	Stochastic Analysis of Ocean Waves	3	3	07 11 721
48	07 11 601	Diploma Project in Ship Maintenance and Repair	3	Presentation	
49	07 11 602	Diploma Project in Ship Design	3	Presentation	
50	07 11 603	Diploma Project in Offshore Engineering	3	Presentation	
51	07 11 701	Master of Engineering Scientific Report in Marine Engineering	3	Defense	
52	07 12 701	Master of Engineering Scientific Report in Offshore Engineering	3	Defense	
53	07 11 705	Master of Science Thesis in Naval Architecture and Marine Engineering	8	Defense	
54	07 11 801	Ph.D. Dissertation in Naval Architecture and Marine Engineering	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 11 621 Hydrodynamics of Marine Units
The motion of a viscous fluid. Navier-Stokes equation. Boundary conditions. Boundary layer theory. Conformal mapping. Source-sink distribution techniques. Green's theorem. Damping and added mass. Hydrofoil theory. Theory of wave resistance.

07 11 622 Ship Motion
Uncoupled modes of motion. Irregular seaways. Motion in an irregular seaway. Coupled motions. Nonlinear rolling motion. Loads due motion. Motion stabilization. Model tests, full scale trials and scale effects. Seakeeping considerations in design.

07 11 631 Marine Structure Analysis (a)
Idealization of marine structures. Classical theorems of structural analysis. Matrix structural analysis: forces and displacement methods. Virtual work, real and complementary energy.

07 11 632 Marine Structure Analysis (b)
Finite element methods. Element coordinate systems. Numerical integration methods. Basic elements. Axisymmetric shells and solids. Plate bending elements. FEM modeling of marine structures.

07 11 633 Structural Design of Marine Units
Hull girder bending moments and stresses. Hull girder shear forces and stresses. Hull torsion loading and stresses. Hull girder deflections. Local strength problems. Classification societies requirements.

07 11 641 Marine Power Plants
Power cycles. Operating characteristics and limitation. Advanced marine steam and gas turbine power plants. Advanced diesel marine power plants. Combined cycles. Propulsion. Heat exchangers. Pumps and compressors.

07 11 661 Shipyard Fabrication Processes
Steel cutting processes. Forming of plates and sections. Welding technology. Fabrication distortion. Fabrication residual stresses. Assembly and erection. Fabrication tolerances. Fabrication of non-ferrous materials

07 11 662 Ship Maintenance and Repair
Hull girder inspection and maintenance. Ship corrosion problems. Cathodic protection.

Surface preparation. Ship painting technology. The economics of ship maintenance. Classification societies requirements. Ship structural requirements. Design for inspection and maintenance. Technology of ship repairing. Non-destructive testing.

07 11 681 Ship Design
The concepts and requirements of ship design. Tendering and specifications. Detail design. Optimization problems in ship design. Computer software for ship design. Special craft. Unitization and containerization.

07 11 682 Ship Outfitting
Design and classification societies requirements. Deck equipment and machinery. Anchoring arrangements. Cargo hatch covers. Derricks and cranes. Steering gears and rudders. Mooring arrangements. Hull piping system. Ventilation. Insulation. Safety equipment.

07 11 683 Computer Applications in the Marine Field
Applications in marine field – Tutorials – CAD/CAM systems – Typical software packages for marine field- Project.

07 11 691 Economics of Marine Systems
Review of engineering economics. Shipbuilding cost estimation. Economics of ship operation. Feasibility analysis of marine systems. Contracts and specification. Scheduling and planning.

07 11 692 Marine Statutory Regulations
Government administration. International Maritime Organization (IMO). SOLAS. Surveys and certification. Subdivision and stability. Machinery and electric installations. Fire protection. Fire detection and fire extinction. Life-saving appliances. Radiotelegraphy and radiotelephony. Safety of navigation. Carriage of grain. Carriage of dangerous goods. Nuclear ships.

07 12 671 Environmental Loads on Marine Units
Sea waves: Characteristics of wind generated waves. Wave theories. Statistical procedures for analysis of wave data. Evaluation of wave parameters for design. Wave forecasting techniques. Wave forces. Wind load: wind direction and mean velocity. Turbulence effect. Wind forces. Interaction effects. Currents: surface wave modification. Wave-making resistance. Vortex shedding. Scouring and scour prevention.

07 12 672 Offshore Systems

Drilling systems. Types of ocean structures. Support systems. Offshore loading systems. Role of classification societies. Mooring and dynamic positioning systems. Pipe-laying. Diving and submersibles.

07 12 673 Dynamics of Offshore Structures
Single degree of freedom systems. Multi-degree of freedom systems. The analysis of offshore structures by spectral techniques. Wave forces on slender members. Diffraction problems. Effect of currents and winds. Dynamic response of typical structures. Effect of structural vibrations. Uses of models to predict dynamic loads and the response of structures.

07 11 721 Advanced Marine Hydrodynamics (a)
Review of vector algebra. Derivations of equations of motion. Viscous flows. Laminar and turbulent flows. Boundary layer theory. Navier-Stokes equations. Theory of ship resistance. Wave resistance.

07 11 722 Advanced Marine Hydrodynamics (b)
Motion of vessels in waves. Response in regular and irregular seas. Added mass and damping coefficients. Equations of motion of a ship in waves. Hydrodynamic forces and moments. Stability and control. Dynamic simulation.

07 11 731 Advanced Marine Structure Analysis (a)
Review of classical methods of structure analysis. Review of matrix algebra. Matrix methods for structural analysis: force and displacement methods. Methods of virtual work, real and complementary energy.

07 11 732 Advanced Marine Structure Analysis (b)
Finite element methods for marine structural analysis. Element coordinate systems. Numerical integration methods. Basic elements. Plate bending elements. FEM modeling of marine structures. Use of FEM computer packages.

07 11 733 Marine Composite Materials
Materials testing and evaluation. Stress analysis in composite materials. Laminated composite structures. Design considerations of composite structures. Marine applications.

07 11 741 Marine Power Plant Systems (a)
Design of ship power system components. Heat balance studies. Safety and pollution control. Electrical power systems. Modern diesel power plants, different cooling loads.

07 11 742 Marine Power Plant Systems (b)
Principles of fluid system design. Piping systems. Combustion in marine power plants.

Marine gas turbines. Renewable energy. Modern marine power plants.

07 11 743 Application of Energy in the Marine Field
Introduction. Types of energy. Electrical load calculation. Heat and cooling load calculations. Power systems. Fuel consumption. Marine energy systems. Cooling systems.

07 11 751 Marine Utilization of Energy
Primary energy. Types of fuels. Heat values. Renewable energy. Solar energy. Wind energy. Water energy. Fuel cell. Hydrogen fuel. Application of energy saving in the marine field.

07 11 761 Ship Production Planning and Control
Planning and scheduling. Network application in scheduling shipbuilding. Production control. PERT/CPM and other control techniques. Information systems. Standardization.

07 11 762 Quality Assurance Planning in Shipbuilding
Definitions and codes of practice. Quality control. Quality assurance management and planning. Case studies and applications.

07 11 763 Accuracy Control in Shipbuilding
Introduction. Statistical principles. Accuracy control planning. Executing. Evaluation. Applications.

07 11 781 Design of Modern Ship Types
Design of modern ship types such as: hydrofoils, SWATH, multi-hulls, hovercraft, planing craft, etc.

07 11 782 Special Topics in Ship Design
Advances in ship design as seen in recent research. Directed study in advanced topics in ship design.

07 11 783 Computer Applications in the Marine Field
Numerical modeling of ship lines – Numerical methods – CAD/CAM systems – Introduction to artificial intelligence. Software packages for the marine field. Project.

07 11 791 Ship Salvage Operations
Types of casualties. Ship stability. Ship strength. Oil and hazardous substances. Salvage plans and surveys. Foundering. Stranding. Restoring buoyancy. Lifting. Tanker salvage. Offloading hazardous cargos. Salvage calculations.

07 11 792 Marine Pollution: Prevention and Control
Sources of marine pollution. Hazards of marine pollution. Methods and measures of preventing and controlling marine pollution. Oil spill response methods: mechanical containment and recovery, chemical dispersion, in-situ burning, shoreline clean-up, treatment of recovered oil, disposal of oil and oil debris. Clean-up cost analysis.

07 12 771 Dynamics of Ocean Waves
Description and formulation of wave problems in the ocean. Development of classical wave theory. Free waves and forced waves. Diffraction, refraction and reflection of waves. Shallow-water theory.

07 12 772 Response of Offshore Structures
Dynamic response of platforms in regular and irregular seas. Second order forces and moments. Stability in sea waves. Mono-hull and twin-hull platform motion. Sea loads.

07 12 773 Marine Pipelines
Introduction. Materials. Pipe capacity. Limit-state design. Penetration in soil. Hydrodynamics. On-bottom stability. Finite element analysis. Installation.

07 12 774 Underwater Technology
Underwater equipment. Underwater cutting. Underwater welding. Underwater inspection. Underwater repair operations.

07 11 823 Computational Fluid Dynamics in Ship Hydrodynamics
Introduction to CFD. Flow equations. General approximation. Equations of motion. Momentum equations. Turbulence. Computational methods for ship waves. CFD applications to simulate flows around ships

07 11 824 Hydrodynamics of Marine Propellers
Review of basic hydrodynamics equations. Flow past propellers. Aerofoil design. Cavitation phenomena. Propeller types. Propulsive efficiency.

07 11 831 Theory of Ship Structures
Loads on ship structures. Response analysis. Methods of structural stability analysis. Buckling as a design criterion. Limit state analysis. Grillage theory. Theory of plates and shells. Local strength problems.

07 11 832 Marine Structural Reliability
Review of probability theory. Random processes. Extreme value distributions. Analysis of uncertainties. Reliability analysis methods. Modes of failure. Component and system

reliability. Fatigue reliability. Probabilistic description of loads on marine structure. Design considerations.

07 11 833 Marine Structure Dynamics
Dynamic forces on marine structures. Analysis of forces and deformations in marine structures. Single and multiple degrees of freedom systems. Linear and nonlinear response. Response spectra. Introduction to probabilistic methods in structural dynamics. Applications to marine structures.

07 11 834 Structural Optimization
Use of mathematical programming methods for structural design optimization including linear and nonlinear programming methods. Problem formulation. Application to minimum weight and minimum cost design.

07 11 835 Material Fracture Analysis
Elasticity/Plasticity. Fracture mechanics. Failure mechanisms. Structural and environmental factors. Defects. Tolerable and non-tolerable defects. Application to shipbuilding materials.

07 11 841 Advanced Automatic Control in Marine Field
Review of automatic control with marine applications. Ship steering. Ship control. Data logging and control. Computer control. Fluidics. Special topics in marine automation

07 11 842 Advanced Marine Engineering
Shafting system, vibration analysis and alignment – Steering gear systems, hydraulic and electrical – Instrumentation and control systems – Fuel technology, distillation, refining, testing – Watchkeeping and equipment operation, unattended machinery spaces (UMS) operation.

07 11 871 Stochastic Analysis of Ocean Waves
Introduction to probability theory and statistics. Random variables. Evaluation of data. Stochastic processes. Power spectral density techniques.

07 11 601 Diploma Project in Ship Maintenance and Repair
Independent individual study or investigation of problems in a field related to the Diploma, under the supervision of a faculty member.

07 11 602 Diploma Project in Ship Design
Independent individual study or investigation of problems in a field related to the Diploma, under the supervision of a faculty member.

07 11 603 Diploma Project in Offshore Engineering

Independent individual study or investigation of problems in a field related to the Diploma, under the supervision of a faculty member.

07 11 701 Master of Engineering Scientific Report in Marine Engineering

Independent individual report in the field of Marine Engineering, under the supervision of a faculty member.

0712 701 Master of Engineering Scientific Report in Offshore Engineering

Independent individual report in the field of Offshore Engineering, under the supervision of a faculty member.

07 11 705 Master of Science Thesis in Naval Architecture and Marine Engineering

For students working on an advanced research program leading to the completion of the master's thesis. Students registered for the master's degree must register every term in this course starting the third term of their registration. Course is taken on a satisfactory/unsatisfactory basic.

07 11 801 Ph.D. Dissertation in Naval Architecture and Marine Engineering

For students working on an advanced research program leading to the completion of the Ph.D. dissertation. Students registered for the Ph.D. degree must register every term in this course starting the first term after passing their qualifying examination. Course is taken on a satisfactory/unsatisfactory basis.

Department of Textile Engineering

The department of Textile Engineering offers the following programs:

1. Graduate Diplomas

1.1 Specialized Graduate Diploma in Spinning Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass four courses with a total of 12 credit hours with course numbers (07 13 611, 07 13 613, 07 13 614, 07 13 615,07 13 616).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.2 Specialized Graduate Diploma in Weaving Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass three courses with a total of 9 credit hours with course numbers (07 13 612, 07 13 613, 07 13 615, 07 13 616).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

2. Master Degrees

2.1 Master of Engineering in Textile Engineering

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must complete six courses with a sum of 18 credit hours with course numbers (07 13 711, 07 13 712, 07 13 713, 07 13 14, 07 13 715, 07 13 716).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Textile Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must complete six courses with a sum of 18 credit hours with course numbers (07 13 711, 07 13 712, 07 13 713, 07 13 14, 07 13 715, 07 13 716).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Architectural Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

Compulsory courses: The student must complete four courses with a sum of 12 credit hours with course numbers (07 13 811 to 07 13 816).

The student must choose the remaining courses from those specified as "Doctorate courses". The student has the right to choose another two courses from another major.

List of Diploma, Master and Ph.D. courses

No	Course Code	Course Name	Credit Hours	Exam Duration	Pre - requisites
1	07 13 611	Spinning Technology	3	3	
2	07 13 612	Weaving Technology	3	3	
3	07 13 613	Mechanics of Textile Machinery	3	3	
4	07 13 614	Textured Yarn Production	3	3	
5	07 13 615	Physics and Properties of Textile Raw Material	3	3	
6	07 13 616	Computer Application in Textiles I	3	3	
7	07 13 621	Technology of Yarn Formation	3	3	
8	07 13 622	Developments in Yarn Manufacturing	3	3	

No	Course Code	Course Name	Credit Hours	Exam Duration	Pre - requisites
9	07 13 623	Filament Yarn Production, Processing and Properties	3	3	
10	07 13 624	New Developments in Weaving Machinery	3	3	
11	07 13 625	Technology of Warp and Weft knitting	3	3	
12	07 13 626	Organization and Planning of Weaving Mills	3	3	
13	07 13 627	Cloth Production	3	3	
14	07 13 628	Performance Evaluation of Textile Materials	3	3	
15	07 13 629	Production Costing in The Textile Industry	3	3	
16	07 13 631	Non-woven Fabric Technology	3	3	
17	07 13 711	Advanced Studies in Yarn Evenness	3	3	
18	07 13 712	Multi-phase Weaving Machines	3	3	
19	07 13 713	Friction in Textile	3	3	
20	07 13 714	Organic Chemistry of Polymers	3	3	
21	07 13 715	Textile Quality and Process Control	3	3	
22	07 13 716	Statistics and Experimental Design	3	3	
23	07 13 721	Physical and Mechanical Properties of Yarns	3	3	
24	07 13 722	Textured Yarn Production and Properties	3	3	
25	07 13 723	Spinning Technology of Blended Yarns	3	3	

No	Course Code	Course Name	Credit Hours	Exam Duration	Pre - requisites
26	07 13 724	Spinning Mill Organization	3	3	
27	07 13 725	Advanced Woven Fabric Designs	3	3	
28	07 13 726	Advanced Weaving Preparation	3	3	
29	07 13 727	Knitted Fabric Technology	3	3	
30	07 13 728	Apparel Technology and Management	3	3	
31	07 13 729	Mechanics of Textile Structures	3	3	
32	07 13 731	Textile Material Design	3	3	
33	07 13 732	Total Quality Management in Textiles	3	3	
34	07 13 811	Theoretical Aspects in Spinning	3	3	
35	07 13 812	Theoretical Aspects in Weaving	3	3	
36	07 13 813	Mechanics of Textiles	3	3	
37	07 13 814	Processing Dynamics	3	3	

No	Course Code	Course Name	Credit Hours	Exam Duration	Pre - requisites
38	07 13 815	Polymer Engineering	3	3	
39	07 13 816	Textile Costing	3	3	
40	07 13 821	Advanced Yarn Studies	3	3	
41	07 13 822	Yarn Engineering	3	3	
42	07 13 823	Mechanics of Twisted Structures	3	3	
43	07 13 824	Theories of Yarn Formation in Modern Spinning Systems	3	3	
44	07 13 825	Advanced Knitting Systems and Fabrics	3	3	
45	07 13 826	Advances in Woven Fabric Formation and Structure	3	3	
46	07 13 827	Mechanics of Weaving Machinery	3	3	
47	07 13 828	Mechanical and Rheological Properties of Fibrous Materials	3	3	
48	07 13 829	Advanced Non-Woven fabric Processing	3	3	
49	07 13 831	Technology of Composites and Smart Textiles	3	3	
50	07 13 832	High-tech in Clothing Production	3	3	
50	07 13 601	Diploma Project in Spinning Engineering	3	Presentation	
51	07 13 602	Diploma Project in Weaving Engineering	3	Presentation	
52	07 13 701	Scientific Report for the Master of Engineering in Textile	3	Defense	

No	Course Code	Course Name	Credit Hours	Exam Duration	Pre - requisites
		Engineering			
53	07 13 705	Thesis for the Master of Science in Textile Engineering	8	Defense	
54	07 13 801	Ph. D. Dissertation in Textile Engineering	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 13 611 Spinning Technology
Advanced studies in the technology of opening lines and its effect on yarn properties. Advanced studies in the technology of yarn properties and machinery. Advanced technological studies in the combing. Drawing, roving and spinning operations. Advanced technology in open-end spinning. Jet-spinning and friction spinning. Advanced technology in winding.

07 13 612 Weaving Technology
Technical production of different carpets. Defects of textile products. Modern weaving machinery, single phase weaving machines. air-jet weaving machine, water jet weaving and rapier weaving machine

07 13 613 Mechanics of Textile Machinery
Vibration, analysis of different mechanisms in textile machinery. Energy conservation in spinning. Conventional weaving machines, projectile weaving machine. Air jet, water jet and rapier weaving machines

07 13 614 Textured Yarn Production
Properties and structure of polymers. Thermo-mechanical texturing techniques: false twist, stuffer-box, trapped twist, knife-edge, crinkle texturing. Mechanical texturing techniques: air–jet, intermingling/interlacing. Bi-Component texturing, differential shrinkage texturing, chemical texturing. Theoretical aspects of yarn formation using false twist and air-jet texturing techniques.

07 13 615 Physics and Properties of Textile Material
Structure of different textile materials. Physical, chemical and mechanical properties of different textile materials. Advanced methods for the measurement of the properties of textile materials

07 13 616 Computer Applications in Textiles I
Introduction of computers in textile industry, computer language, computer applications in different textile sectors, expert systems and database management systems.

07 13 621 Technology of Yarn Formation
Limitations of the existing spinning systems- principles of formation of yarns on new spinning systems, mechanisms of production of new yarn.

07 13 622 Developments in Yarn Manufacturing
A critical appraisal of developments in yarn manufacturing, with emphasis on their influence on process and products quality and range in short and long staple systems.

07 13 623 Filament Yarn Production Processing and Properties
Structure, properties and processes for manufacturing and treating continuous filament yarns. Response of fibers to elevated temperature, twist, false twist and various bulking processes. Yarn structures and properties required for stretch and molded fabrics. Independent laboratory and critical literature review in general area of filament yarn processing, properties and test methods.

07 13 624 New developments in weaving machinery
Modern methods of weaving, weaving on single phase weaving machines. projectile, air-jet, water-jet, rapier weaving and multi-phase weaving machines.

07 13 625 Technology of Warp and Weft Knitting
Modern knitting machines. Different knitted fabric structures, knitted fabric defects: causes and remedy. Geometrical engineering of knitted fabrics, design of knitting machines and their setting and maintenance.

07 13 626 Organization and planning of weaving mills
Tender and evaluation of textile machines. Layout, labor and machine efficiency. Labor allocation and number of machines. Weaving costs. Factors influencing economics in textile mills, feasibility study. Computer in textile mills.

07 13 627 Cloth Production
Concepts and practices for the production of apparel items, beginning with development of basic fit blocks and extending through the stylized garments using pattern engineering techniques, supported by computerized pattern development. Techniques for development of styled patterns which address issues of body measurements, body shape, comfort and fit.

07 13 628 Performance Evaluation of Textile Products
Standards, principles and effects of test conditions in measuring basic physical and mechanical properties of textile materials. Design of test and interpretation of test results in relation to end-use performance, product development, process control, research and development and other requirements.

07 13 629 Production Costing in the Textile Industry
Cost issues in yarn manufacturing, fabric formation, finishing, apparel production and retail operations. Traditional and activity-based costing systems. Relevance of costing to managerial decisions as well as cost reduction strategies.

07 13 631 Non-Woven Technology
Definition of non-woven, planary basic and combined systems. Principle of non-wovens. Development of production. Types of fibers suitable for non-woven fabrics. Different methods for web formation (mechanical – pneumatic – cross laying of web – polymer – to – web methods (centrifugal – compressed air – electro – static). Bonding methods (adhesive – heat fusing – adhesive power – needle punching – stitch knitted – spun bonded – thermoplastic screen bonding). Characteristics of different types and end uses.

07 13 711 Advanced Studies in Yarn Evenness
Mathematical model for yarn formation. Yarn evenness. Factors affecting yarn evenness. Measurement methods and control. Theoretical studies of the drafting process.

07 13 712 Multi-Phase Weaving Machines
Modern weaving machinery, multi-phase weaving machines. Warp way weaving machines. Weft way weaving machines.

07 13 713 Friction in Textiles
This Course aims to teach students the theories of friction and lubrication. The practical problems in textile processing and attempts to give critical account of drafting theories. Main methods and techniques used in measuring friction of textile materials.

07 13 714 Organic Chemistry of Polymers
Principles of step reaction and additional polymerizations; copolymerization; emulsion polymerization; ionic polymerization; characterization of polymers; molecular structure and properties.

07 13 715 Textile Quality and Process Control
Quality control and improvement methods for textile processes and products including quality systems, statistical control chart procedures, process capabilities, acceptance sampling plans, textiles process and product designs, on-line and off-line control systems

and specific quality factors governing textile products and processes and their variabilities.

07 13 716 Statistics and Experimental Design
Population and samples. Method of maximum likelihood. Test of hypothesis. Analysis of Variance. One-way ANOVA. Two-way ANOVA. Experimental Design for ANOVA. Design of experiments: Design of experiments with extremes: full factorial design, factorial replicates. Applications in textile industry.

07 13 721 Physical and Mechanical properties of yarns
Different types of yarns and their structures. Theories of yarn structures. Fiber arrangement in different yarn structures. Mechanics of staple fiber yarns. Mechanics of blended yarns.

07 13 722 Textured Yarn Production and Properties
Structure and properties of continuous filament yarns. Examine response to elevated temperature and variables for texturing methods for producing bulked, textured and torqued yarns. Testing of yarn behavior and discussion of problems encountered during processing.

07 13 723 Spinning Technology of Blended Yarns
The needs of blending, theories of blending, effect of fiber blending on yarn and fabric properties, technology of blending.

07 13 724 Spinning Mill Organization
Feasibility study for spinning mill, costing and cost e1ements in spinning mill, inventory control for materials and spare parts. Linear programming applications in textile mills. General computerized control for production

07 13 725 Advanced Woven Fabric Design
Design and production requirements for highly specialized woven fabric structures. The laboratory activities will include a project on design from concept to final production and finishing

07 13 726 Advanced weaving preparation
Automatic control in warping. Automatic tension control in sizing. Sizing of continuous filament. Preparation of super density warp sheet**.**

07 13 727 Knitted Fabric Technology
Review of knitted fabric production techniques. Technology of more advanced weft and warp knitting. Jersey and rib fabric modification techniques, yarn knitability and

productivity, yarns, creels, patterning and machinery developments, manufacture and properties of warp knit fabrics such as mesh, laid-in, weft insertion and plush. Quality measures, measurement and standards, defects and problem solving. Management of knitting operations**.**

07 13 728 Apparel Technology and Management
Requirements for garment manufacturing, raw materials specifications, properties and control. Apparel process objects, modern developments and control. End product quality and performance to satisfy the global customer demand. Quality assurance for garment products.

07 13 729 Mechanics of Textile Structures
Study of the basic mechanics of fibrous assemblies. Topics included are geometry and mechanical behavior of twisted, woven, knit, and non-conventional structures under various stress conditions, and end use application.

07 13 731 Textile Materials Design
Functional textile materials design, modeling techniques and fault analysis methodologies. Product development from initial design phase, testing, analysis, to prototype production. Advanced elements of textile materials design and development. Process-structure-property relationships of manufacturing processes. Risk and reliability. Design, testing, analysis, and prototype production**.**

07 13 732 Total Quality Management in Textiles
Management and quality engineering concepts, strategies, practices and operating tools required to initiate and sustain a Total Quality Management program which can succeed in modern textile environments.

07 13 811 Theoretical Aspects in Spinning
Theory of drafting and carding processes. Combing Theory. Theory of yarn balloon in ring spinning, winding and unwinding**.**

07 13 812 Theoretical Aspects in Weaving
Theory of weft insertion in conventional and non-conventional weaving machines. Air-jet, projectile, Rapier and water-jet

07 13 813 Mechanics of Textiles
Mechanical dependency relationships in textiles are discussed. Included are the role of fiber and yarn twist, yarn crimp, finishes, and coatings to mechanical response of textiles. Dynamic and static response to various types of loading are investigated. Tearing, abrasion, and wear properties as a function of textile form are presented.

07 13 814 Processing Dynamics
Theoretical analysis of the dynamics and machine-fiber assembly interaction in textile processes. The interrelations between mechanics of production and mechanical properties of yarn, fabrics, and other fiber assemblies are studied. Unit operations required to process fibers to the finished products are considered**.**

07 13 815 Polymer Engineering
Chemical, physical and mechanical properties of polymers and fibers; thermodynamics of crystallization, time dependent phenomena, fracture mechanics and rheology. Advanced topics on extrusion.

07 13 816 Textile Costing
The costs of raw materials, labor, overhead and waste are studied in relation to textile production and finishing. Case studies illustrate cost systems used in textile mills. Interrelationships between labor, machine and facilities are analyzed to determine their relative importance for cost reduction programs**.**

07 13 821 Advanced Yarn Studies
This section of Yarn Studies allows for an independent pursuit of advanced knowledge through a literature search in a selected area of research. Further, the course is structured toward an advanced study of the newer methods of yarn manufacture, and the latest developments in processing, computerized control, and testing methods. Relationships between yarn properties and product properties are investigated

07 13 822 Yarn Engineering
The processes necessary for the manufacture of continuous filaments, staple, bulk, and novelty and stretch yarns are studied. Staple yarn manufacturer including the processing of natural and manmade fibers on the carded cotton, combed cotton, woolen and worsted staple yarn manufacturing system. Quality control procedures are emphasized**.**

07 13 823 Mechanics of Twisted Structures
Structure and mechanics of twisted linear textiles (yarns, cords, ropes) with particular emphasis on translating fiber load deformation behavior into load deformation behavior of product.

07 13 824 Theories of Yarn Formation in Modern Spinning Systems
Principles and practices involved in modern yarn manufacturing; including machine-fiber interactions occurring during different processing stages.

07 13 825 Advanced Knitting Systems and Fabrics
Loop forming concepts and mechanisms of complex warp and weft-knitted fabrics. Structural design and limitations, potential applications and knitability. Analysis of mechanical systems and tensioning forces on fabric formation. The effect on dimensional and mechanical properties.

07 13 826 Advances in Woven Fabric Formation and Structure
Advances in formation mechanics and structure of woven fabrics covered through lectures, seminars and independent studies. Advances in yarn preparation processes, essential weaving motions, auxiliary motions, automation, and their impact on weaving room management. Recent research in formation of advanced complex woven structures**.**

07 13 827 Mechanics of Weaving Machinery
Energy conservation in the weaving machines. Air jet weaving machine, water-jet-weaving machine**.**

07 13 828 Mechanical and Rheological Properties of Fibrous Material
In-depth study of the stress-strain, bending, torsional, dynamic and rheological behavior of natural and man-made fibers. Presentation and discussion of theoretical relations and advanced techniques**.**

07 13 829 Advanced Non-Wovens Processing
An in-depth understanding of the mechanisms and processes used in the production of nonwoven materials. Design and operation of these mechanisms and processes. Process flow, optimization of process parameters, influence of process parameters on product properties

07 13 831 Technology of Composites and Smart Textiles
Introduction to smart textiles. Properties of smart textiles. Fields of applications. Materials applied. Production of smart textiles. Different theories in Bionics e.g. Lotus effect**.**

07 13 832 High-tech in Clothing Production
Automated assembly and manufacturing simulation, innovation in fabric joining methods, 3D design involving drape, fit and comfort simulation. Engineering value networks in fashion industry.

07 13 601 Diploma Project in Spinning Engineering

07 13 602 Diploma Project in Weaving Engineering

07 13 701 Scientific Report for the Master of Engineering in Textile Engineering

07 13 705 Thesis for the Master of Science in Textile Engineering

07 13 801 Ph. D. Dissertation in Textile Engineering

Department of Electrical Engineering

The department of Electrical Engineering offers the following programs:

1. Graduate Diplomas

1.1 Specialized Graduate Diploma in Electrical Power and Machines Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass six courses with a total of 18 credit hours from the list of diploma courses in Electrical Power and Machines (BB=15).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

2. Master Degrees

2.1 Master of Engineering in Electrical Engineering (Electronics and Communications)

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass six courses with a sum of 18 credit hours from the list of Master courses in Electronics and Communications (BB=14).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.2 Master of Engineering in Electrical Engineering (Electrical Power and Machines)

The student must complete 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass six courses with a sum of 18 credit hours from the list of Master courses in Electrical Power and Machines (BB=15).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.3 Master of Science in Electrical Engineering (Electronics and Communications)

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must pass six courses with a sum of 18 credit hours from the list of Master courses in Electronics and Communications (BB=14).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.4 Master of Science in Electrical Engineering (Electrical Power and Machines)

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.

Compulsory courses: The student must pass six courses with a sum of 18 credit hours from the list of Master courses in Electrical Power and Machines (BB=15).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Ph.D. in Electrical Engineering (Electronics and Communications)

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

The student can choose his/her courses from courses that are specified as "Doctoral courses". The student is allowed to choose 3 courses from another major.

3.2 Ph.D. in Electrical Engineering (Electrical Power and Machines)

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.

The student can choose his/her courses from courses that are specified as "Ph.D. courses". The student is allowed to choose 3 courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit hours	Exam Duration	Pre-requisites
1.	07 14 610	Computer Networks	3	3	
2.	07 14 611	Introduction to Digital Signal Processing	3	3	
3.	07 14 612	Introduction to Statistical Communications and Information Theory	3	3	
4.	07 14 631	Propagation of Electromagnetic Waves	3	3	
5.	07 14 632	Wave Propagation in the Earth's Atmosphere	3	3	
6.	07 14 660	Stochastic Systems	3	3	
7.	07 14 664	Mobile Communications	3	3	
8.	07 14 667	Digital Telephony and Switching Engineering	3	3	
9.	07 14 670	Principles of Pulse and Timing Circuits	3	3	
10.	07 14 671	Advanced Analog Integrated Circuits	3	3	
11.	07 14 672	Electrical and Magnetic Properties of Solids	3	3	
12.	07 14 673	Advanced Digital Integrated Circuits	3	3	
13.	07 14 674	Analog MOS Integrated Circuits	3	3	
14.	07 14 675	Advanced IC Processing and Layout	3	3	
15.	07 14 676	Computer-Aided Design of Integrated Circuits	3	3	
16.	07 14 677	Microwave Measurements	3	3	
17.	07 14 678	Communications Electronics	3	3	
18.	07 14 680	Electro-Optics and Lasers	3	3	
19.	07 14 690	Optical WDM Networks	3	3	
20.	07 15 611	Electrical Power Engineering	3	3	
21.	07 15 612	Design of Electrical Power Systems and Their Equipment	3	3	
22.	07 15 613	International Standards and Technical Specification of Electrical Power Equipment	3	3	

23.	07 15 614	Computer Applications in Electrical Power Engineering	3	3	
24.	07 15 615	Protection of Electrical Power Systems	3	3	
25.	07 15 620	Automatic Control	3	3	
26.	07 15 621	Linear Control Systems	3	3	
27.	07 15 622	Digital Control Systems	3	3	
28.	07 15 623	Programmable Logic Control	3	3	
29.	07 15 624	Applications of Microprocessors in Control and Instrumentation	3	3	
30.	07 15 625	Systems Identification	3	3	
31.	07 15 626	Control Methods Used in Electrical Systems	3	3	
32.	07 15 627	International Standards and Technical Specification for Control and Measuring Equipment	3	3	
33.	07 15 628	Digital Control Fundamentals	3	3	
34.	07 15 631	Electrical Machines & Automatic Control	3	3	
35.	07 15 632	Advanced Electrical Machines	3	3	
36.	07 15 641	Industrial Electronics (a)	3	3	
37.	07 15 651	Electrical Drives	3	3	
38.	07 15 652	Solid State Drives	3	3	
39.	07 15 653	International Standards and Technical Specification for Drive Equipment	3	3	
40.	07 14 710	Signal Detection	3	3	
41.	07 14 711	Teletraffic Engineering	3	3	
42.	07 14 712	Digital Signal Processing Architecture and Circuits	3	3	
43.	07 14 713	Adaptive Signal Processing	3	3	
44.	07 14 714	Fast Algorithms for Signal Processing	3	3	
45.	07 14 715	Image Processing	3	3	
46.	07 14 730	Numerical Methods for Electromagnetic Fields	3	3	
47.	07 14 731	Numerical Methods for Antennas	3	3	
48.	07 14 732	Electromagnetics	3	3	
49.	07 14 735	Wave Propagation in Biological Media	3	3	

50.	07 14 736	Microwave Antennas	3	3	
51.	07 14 737	Wave Propagation Theory	3	3	
52.	07 14 738	Antenna Arrays Theory	3	3	
53.	07 14 739	Advanced Electromagnetic Field Theory	3	3	
54.	07 14 740	Biomedical Instrumentation	3	3	
55.	07 14 741	Medical Imaging Systems	3	3	
56.	07 14 751	Acoustical Devices and Applications	3	3	
57.	07 14 760	Coding Theory	3	3	
58.	07 14 761	Digital Communication Theory	3	3	
59.	07 14 762	Spread Spectrum Communications	3	3	
60.	07 14 770	Quantum Mechanics	3	3	
61.	07 14 771	Quantum and Optical Electronics	3	3	
62.	07 14 772	Solid State Electronics	3	3	
63.	07 14 773	Super-conductive Devices and Circuits	3	3	
64.	07 14 774	Circuit Theory and Computer-Aided Analysis	3	3	
65.	07 14 775	Characterization and Computer Modeling of Semiconductor Devices	3	3	
66.	07 14 777	Solid States Devices	3	3	
67.	07 14 778	Solid State Microwave Circuits and Devices	3	3	
68.	07 14 780	Optical and Opt. Electronic Devices	3	3	
69.	07 14 810	Special Topics in Signal Processing	3	3	
70.	07 14 811	High Resolution Image Processing	3	3	
71.	07 14 820	Smart Antennas and MIMO Techniques	3	3	
72.	07 14 841	Advanced VLSI Design	3	3	
73.	07 14 842	Radio Frequency Integrated Circuit (RFIC) Technology and Design	3	3	
74.	07 14 843	Software Radios: Modern Radio Engineering	3	3	
75.	07 14 844	Advanced DSP & Filter Design	3	3	
76.	07 14 861	Advanced Wireless Communications	3	3	
77.	07 14 862	Special Topics in Communication Engineering	3	3	
78.	07 14 863	Optical Access Networks	3	3	
79.	07 14 864	Advanced Optical Communications Systems	3	3	

80.	07 14 870	Semiconductor Materials	3	3	
81.	07 14 871	Semiconductor Devices	3	3	
82.	07 14 881	Elementary Number Theory	3	3	
83.	07 14 882	Cryptography and Network Security	3	3	
84.	07 14 891	Nanotechnologies	3	3	
85.	07 15 711	Special Topics in Power System Engineering	3	3	
86.	07 15 712	New Topics in Power Systems Control	3	3	
87.	07 15 713	Renewable Energy Sources	3	3	
88.	07 15 714	Sustainable Energy Utilization	3	3	
89.	07 15 715	Smart Grids	3	3	
90.	07 15 717	Electrical Materials	3	3	
91.	07 15 720	Linear Control Systems	3	3	
92.	07 15 721	Non-Linear Control Systems	3	3	
93.	07 15 722	Digital Control Systems	3	3	
94.	07 15 723	Optimal Control Systems	3	3	
95.	07 15 724	Advanced Course in Control	3	3	
96.	07 15 725	Adaptive Systems and Identification Techniques	3	3	
97.	07 15 726	Control Systems Design and Simulation	3	3	
98.	07 15 728	Neural Networks	3	3	
99.	07 15 731	General Theory of Electrical Machines	3	3	
100.	07 15 732	Special Types of Electrical Machines	3	3	
101.	07 15 733	Dynamic and Simulation of Electrical Machines	3	3	
102.	07 15 741	Industrial Electronics (B)	3	3	
103.	07 15 751	Solid State Drives	3	3	
104.	07 15 752	Control of AC Drives	3	3	
105.	07 15 753	Microprocessor Control of Electric Drives	3	3	
106.	07 15 754	Digital and Logic Circuits for Solid State Drives	3	3	
107.	07 15 761	Selected Topics in Electrical Measurements	3	3	
108.	07 15 762	Phasor Measurement Units and Applications	3	3	
109.	07 15 771	Application of Mathematical	3	3	

		Methods in Electrical Engineering			
110.	07 15 811	Power System Analysis	3	3	
111.	07 15 812	Power System Planning	3	3	
112.	07 15 813	Optimal Operation of Power Systems	3	3	
113.	07 15 814	Transients in Power Systems	3	3	
114.	07 15 815	High Voltage Engineering	3	3	
115.	07 15 816	Static and Digital Protection Relays	3	3	
116.	07 15 818	Advanced Electrical Engineering Materials and Applications	3	3	
117.	07 15 819	Renewable Energy Utilization	3	3	
118.	07 15 820	Advanced Topics in Control of Electrical Systems	3	3	
119.	07 15 821	Advanced Course in Linear Control	3	3	
120.	07 15 822	Advanced Course in Nonlinear Control	3	3	
121.	07 15 823	Digital Control Systems	3	3	
122.	07 15 824	Optimal Control Techniques	3	3	
123.	07 15 825	Identification Methods and Adaptive Systems	3	3	
124.	07 15 826	Neural Network Control Systems	3	3	
125.	07 15 827	Artificial Intelligence and Applications	3	3	
126.	07 15 828	Fuzzy Control Systems and Applications	3	3	
127.	07 15 834	New Trends in Electrical Machines	3	3	
128.	07 15 835	Dynamic Modeling of Electrical Machines	3	3	
129.	07 15 841	Power Electronic Interface of Renewable Energy Sources	3	3	
130.	07 15 842	Design for Power Electronic Converters	3	3	
131.	07 15 843	Power Electronic-Based Control of Electric Power Systems	3	3	
132.	07 15 844	Advanced Industrial Automation	3	3	
133.	07 15 845	Advanced Industrial Electronics	3	3	
134.	07 15 846	Active Harmonic Filtering	3	3	
135.	07 15 891	High Voltage DC Transmission	3	3	
136.	07 15 601	Diploma Project in Power Engineering and Electrical Machines	3	Presentation	
137.	07 15 701	Scientific Report for Master of	3	Defense	

		Engineering (Electrical Machines and Power Engineering)			
138.	07 14 701	Scientific Report for Master of Engineering (Electronics and Communications)	3	Defense	
139.	07 15 705	M.Sc. Thesis in Electrical Engineering (Electrical Machines and Power Engineering)	8	Defense	
140.	07 14 705	M.Sc. Thesis in Electrical Engineering (Electronics and Communications)	8	Defense	
141.	07 15 801	Ph. D. Dissertation in Electrical Engineering (Electrical Machines and Power Engineering)	24	Defense	
142.	07 14 801	Ph. D. Dissertation in Electrical Engineering (Electronics and Communications)	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 14 610 Computer Networks

Architectures and protocols. Objective of computer networks, computer structure and components, switching techniques, network functions, layered network architectures, data link protocols, network control, transport and session protocols, presentation layer protocols. Specific examples and standard protocols are cited for point-to-point, satellite, packet radio, and local area networks.

07 14 611 Introduction to Digital Signal Processing

Discrete-time signals and systems. Z-transform. Discrete Fourier transform and Fast Fourier transform. Digital filter and implementation. Quantization affects. Random signal processing. Correlation canceling, prediction autoregressive processes. Two-dimensional signal processing. Nonlinear processing techniques. Spectrum estimation computer implementation of some of the considered techniques.

07 14 612 Introduction to Statistical Communications and Information Theory

Random processes and spectral densities, random signals through linear and nonlinear systems. Wide-sense stationary process and filtering, white noise, non-Gaussian

distributions. The concepts of source, channel, and rate of transmission of information. Entropy, mutual information, and channel capacity. Source coding. Rate distortion theory. Noisy channels; the coding theorem for finite state memory less channels. Markov chains. Applications.

07 14 631 Propagation of Electromagnetic Waves
Basic electromagnetic theory. Uniqueness theorem and boundary conditions. Electromagnetic potentials and Hertz vectors. Wave equation in different kinds of media including inhomogeneous, an isotropic and time varying. Plane wave in lossy dielectric media. Reflection and transmission. Surface waves. Propagation in ionized media. Propagation in layered media.

07 14 660 Stochastic Systems
Mathematics of control and estimation. Optimal filtering and prediction. Parameter estimation for stochastic dynamic systems. Control of stochastic systems. Filter design synthesis. RC active networks.

07 14 664 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.

07 14 667 Digital Telephony and Switching
Network hierarchy. Voice digitization. Different types of speech coding. Standard CCITT regulations. Circuit switching. Space-division switching. Time-division switching. Packet switching. Fast packet switching. Different protocols. Performance analysis of switched systems.

07 14 670 Principles of Pulse and Timing Circuits
Switching, timing, wave shaping, and logic circuits to generate the diversity of waveform and functions used in pulse systems, instrumentation, and computers. Emphasis on techniques of analysis and obtaining appropriate circuit models for solid state devices and IC's in these highly nonlinear circuits.

07 14 671 Advanced Analog Integrated Circuits
Analysis and design of bipolar analog IC's emphasizing quantitative study of circuit performance, figure of merit, limitations, and recent techniques for optimization. Linear IC's, operational amplifiers, wide-band, high frequency and low noise amplifiers; quasi-

linear circuits for signal processing multipliers and trans linear circuits, phase locked loops.

07 14 672 Electrical and Magnetic Properties of Solids

Electrical and magnetic properties of solids from a fundamental point of view. Introduction to band theory, surface states, dielectric and ferromagnetic materials, magnetic materials, ferrites ferromagnetism, and superconductivity.

07 14 673 Advanced Digital Integrated Circuits

Analysis and design of MOS and bipolar large-scale integrated circuits at the circuit level. Fabrication processes, device characteristics, parasitic effects and dynamic digital circuits for logic and memory functions. Calculation of speed and power consumption from layout and fabrication parameters, ROM, RAM, EPROM circuits design. Use of SPICE and other computer aids.

07 14 674 Analog MOS Integrated Circuits

Fundamentals of analog MOS integrated circuit design. Small-signal device and circuits models. Design of amplifiers, analog switches, sample and hold circuits, comparators and voltage reference. Analog subsystems, including A/D and D/A converters and switched capacitor filters.

07 14 675 Advanced IC Processing and Layout

In depth treatment of device structures, fabrication technologies and circuit design issues in Integrated circuits Optical, X-ray and e-beam lithograph, in implementation, oxidation and diffusion. Thin film deposition. Wet and dry etching and ion milling. Effect of phase and defect equilibria on process control.

07 14 676 Computer-Aided Design of Integrated Circuits

This course covers a wide variety of topics relating to the development of computer aids for integrated circuit design. It will emphasize the state-of the-art techniques and both the theoretical basis for the methods as well as the application of results to practical problems, including details of implementation. Topics to be covered include simulation, layout techniques, synthesis, verification, testing, and integrated design systems.

07 14 677 Microwave Measurements

Manual and automatic microwave network analyzer measurements. Power, power spectrum, and noise measurements. Characterization of devices and systems. Special topics will include design and construction of microwave devices, RCS and antenna measurements, micro strip measurements, and microwave circuit measurements. Laboratory experiments dealing with the above topics.

07 14 678 Communications Electronics
General electronic circuitry used in communication systems. Mixers, up & down converters, PLL, filter design, attenuators, phase shifters, Hilbert transformers, hybrids. Carrier and clock recovery circuits. Pulse and timing circuits. Signal processing circuits.

07 14 680 Electro-Optics and Lasers
Propagation of laser beams: Gaussian wave optics and the ABCD law. Crystal properties and the dielectric tensor. Electro optic effects and devices. Acousto-optic diffraction and devices. Introduction to nonlinear optics: coupled mode theory and second harmonic generation. Phase matching. Laser resonators, eigen modes, and stability analysis. Rate equation analysis. Homogeneous and inhomogeneous broadening mechanisms. Laser gain and gain saturation. Q-switching and mode locking. Special topics: laser pulse compression, Raman and Brillouin scattering, phase conjugation.

07 14 690 Optical WDM Networks
Review on light sources, light detectors, optical fibers, WDM concepts and components: operational principles of WDM, spectral width and optical bandwidth, implementation of WDM networks, design challenges. WDM multiplexers: 2 x 2 fiber coupler, star couplers, Mach-Zehnder interferometer multiplexers, diffraction gratings, fiber bragg gratings, waveguide grating router (WGR). Tunable optical filters: tunable fiber fabry-perot filters, tunable mach-zehnder interferometers, tunable multi-grating filters, acoustooptic tunable filter. Single-hop WDMA optical networking: broadcast-and-select WDMA networks, wavelength-routing WDMA networks, transmission protocols, fixed and semi-fixed assignment protocols. Random access protocols with no pre-transmission coordination: random access protocols with slotted aloha, protection against collision. Random access protocols with pre-transmission coordination: Aloha/Aloha protocol, slotted Aloha/Aloha protocol, Aloha/CSMA protocol, CSMA/Aloha protocol.

07 15 611 Electrical Power Engineering
High voltage technology. Insulation coordination. Distribution and power transformers; applications and testing. Power capacitors. Grounding of power systems; methods and devices.

07 15 612 Design of Electrical Power Systems and Their Equipment
Development in power equipment and related international standards, its specification and testing. Design of complete power systems applying computer aided design and use of modern power equipment.

07 15 613 International Standards and Technical Specification of Electrical Power Equipment

Covering the international standards e.g. IEC standards regarding the main specifications, testing, inspection and commissioning of power equipment.

07 15 614 Computer Applications in Electrical Power Engineering

Computer techniques for solving power engineering problems. The use of computer packages. Applications of numerical methods in power engineering.

07 15 615 Protection of Electrical Power Systems

Special types of electromagnetic relays. Back up protection system stability and out of step relaying. Reclosing and synchronizing. Protection of complete power systems. Relays coordination and tripping plans. Testing and calibration of relays. Tripping circuits and auxiliary relays. Commissioning tests of protection systems.

07 15 620 Automatic control

Review of linear systems classical methods of analysis. State space representation. Controllability and observability. Controller design. Observers. Introduction to digital system. State space representation of digital systems.

07 15 621 Linear Control Systems

Revision of single i/p single o/p systems. Multi i/p multi o/p systems. Controllability and observability of multi i/p multi o/p systems. Application to the design of optimal controllers. Stability of linear systems using different techniques.

07 15 622 Digital Control Systems

Revision of system analysis. Design using Z transformation. Static space discrete model. Controllability. Observability of discrete data control systems. Design of digital controllers. Stability of digital systems using different techniques.

07 15 623 Programmable Logic Control

Introduction on closed loop control systems as analog controllers. On/off controllers. Proportional, integral, derivative, and PID controllers. Digital controllers. Examples of industrial systems. Programmable controllers as industrial controllers. General characteristics and system layout. Operational procedures. Direct and digital logic. Addresses and registers timers and counters. Discrete functions. The sequencer analog operation. Loop and PID control. Sensing for PLC.

07 15 624 Applications of Microprocessors in Control & Instrumentation

Microprocessor interfacing; definitions, interfacing layers, interfacing considerations, bus interfacing; synchronous and asynchronous. Memory and peripheral interfacing; memory mapped and PIO. Analog interfacing to microprocessors. Analog-to-digital converters. (approach, method, applications). Digital-to-analog converters; approach, methods, applications. Interfacing A/D and D/A converters. Configurations of microprocessor based control and instrumentation systems.

07 15 625 Systems Identifications

Statistical and optimization fundamentals. Parameter tracking in self-optimizing systems. Impulse response identification. Parameter estimation with statistics. Parameter estimation without a priori statistics. Distributed parameter estimation. Frequency response estimation. Identification via inverse Laplace transform. Experimental methods. Luenberger optimal observer.

07 15 626 Control Methods used in Electrical Systems

Introduction to identification of electrical systems. The suitable system model. Conventional controllers. Hardware to generate sum and difference data, electrical methods, mechanical methods. Development of complete systems and construction of schematic diagrams. Examples of position control systems. Speed control systems. Voltage and frequency control systems. Programmable controllers. Interfacing techniques.

07 15 627 International Standards and Technical Specification of Electrical Power Equipment

Covering the international standards e.g. IEC standards regarding the main specifications, testing, inspection and commissioning of power equipment.

07 15 628 Digital Control Fundamentals

The digital computer in feedback control sampling. Z transforms. Digital filters. Discretization of continuous compensation. Discrete compensation design. Quantization errors. State variable design of digital controllers and observes. Laboratory experimental work to power systems. Modern nonlinear control of synchronous machines.

07 15 631 Electrical Machines & Automatic Control

D-Q model of synchronous machines. Per unit system. Simulation of synchronous machine. Linear models. Excitation systems. Effect of excitation on stability. Multi machines systems. Automatic voltage regulators. Excitation control.

07 15 632 Advanced Electrical Machines

Basic concepts of energy conversion. Electromagnetic fields in electrical machines. Special types of electrical machines (linear types, stepper motors, PM motors, and pole mixed type). Self-excited generators (stand-alone type).

07 15 641 Industrial Electronics (a)
Inverters (voltage and current commutated inverters). Methods of harmonic reduction. Cycloconverter. Four quadrant chopper. Firing circuits.

07 15 651 Electrical Drives
Concept and classification of electrical drives. Dynamics of electrical drives. Types of loads steady state and transient. Stability. Speed control of AC and DC motors. Starting of electric motors. Electric braking of electric motors. Rating and heating of motors. Load cycles. Thermal rating.

07 15 652 Solid State Drives
Four quadrant DC converters. Analysis of separately excited DC machine using speed. Current feedback loops. Slip energy recovery systems (constant torque, constant power systems). Soft starters for AC squirrel cage machines.

07 15 653 International Standards and Technical Specification for Drive Equipment
Covering the international standards e.g. IEC standards regarding the main specifications, testing, inspection and commissioning of electrical machines and drive equipment.

07 14 710 Signal Detection
Binary decisions. Bayes and Neymann-Pearson criteria. Reduction of uncertainty. Grahm-Schmitt orthogonalization. Likelihood ratios and detection criteria. Generalized matched filters. Wiener and Kalman filters. Optimum detectors. Signal parameter estimations. Applications in radar and communication systems.

07 14 711 Teletraffic Engineering
Elements of tele-traffic theory. Traffic units and variations. Dimensioning. Statistical description; traffic distributions, availability. Loss and delay systems. Loss system overflow. Grading. Link systems. Routing networks. Composite delay systems. Over-loading sensitivity.

07 14 712 Digital Signal Processing Architecture and Circuits
The architecture system design and hardware implementation real time signal processors and digital filters processing operations including the discrete Fourier transform. Discrete convolution. Cosine transform. Hartley transform and the estimation of power spectra.

Applications in speech processing; image processing, communication, sonar, and radar signal processing.

07 14 713 Adaptive Signal Processing
Theory and applications of adaptive filtering in system and signal processing. Iterative methods of optimization and their convergence properties; transversal filters; LMS algorithms. Adaptive Kalman filtering and least-squares algorithms. Applications to detection, noise canceling, speech processing. Computer implementations of some of the considered techniques.

07 14 714 Fast Algorithms for Signal Processing
Fast algorithms for short convolutions and the discrete Fourier transform. Number theoretic transforms. Multi-dimensional transforms and convolutions. Filter architectures. Computer implementations of some of the considered algorithms.

07 14 715 Image Processing
Theory and application of digital image processing. Multi dimensional signal processing. Random, quantization, image compression, enhancement, restoration, segmentation, shape description, reconstruction of pictures from their projections, pattern recognition.

07 14 730 Numerical Methods for Electromagnetic Fields
Mathematical methods in electrostatics. The canonical forms of partial differential equations. Finite difference approximations. Boundary and initial value problems. Interpolation and approximation. Finite element methods. Method of moments and applications. Computer implementations of some of the considered numerical methods.

07 14 731 Numerical Methods for Antennas
Numerical techniques for antennas - Solution of integral equations. Method of moments. Conjugate gradient, Fast Fourier Transform and finite element boundary integral methods. High frequency methods. Applications including planar antennas; strip dipoles and patches, arrays, apertures antenna synthesis and design. Computer implementations of some of the considered numerical methods.

07 14 732 Electromagnetic
Boundary value problems. Approximate solution. Analytical solution of boundary value problems. Electric fields and currents. Static and quasi-static magnetic fields. Interaction of charged particles with electric and magnetic fields. Special methods in field analysis. Applications.

07 14 735 Wave Propagation in Biological Media

Medical terminology. Dielectric behavior of biological molecules. Measurement of the electrical constants of the human body. Radiative signals in human body. Microwave components used for human body.

07 14 736 Microwave Antennas

Equivalence principle and radiation potentials. Uniform and non-uniform illuminated apertures. Horn antennas. Curved surface reflector antennas; paraboloid, spherical surfaces, shaped paraboloid and doubly curved surface reflector antennas. Ray optic methods and asymptotic techniques. Lens antennas. Micro strip antennas. Laboratory measurements of the parameters of some of the considered antennas.

07 14 737 Wave Propagation Theory

Wave propagation in an isotropic media; double refraction; ferrite, magnetized plasma media. Wave propagation in inhomogeneous media. Asymptotic and ray techniques; WKB method. Pulse propagation in dispersive media. Optimum design of signals for propagation in dispersive and inhomogeneous media. Scattering principles; scattering cross section, scattering from perfect conducting spheres and cylinders.

07 14 738 Antenna Arrays Theory

Linear and planar uniform arrays. Circular and elliptical arrays. Non-uniformly fed arrays. Array synthesis techniques. Phased arrays. Omni directional arrays. Adaptive arrays and beam forming. Random arrays and aperture thinning. Signal processing arrays.

07 14 739 Advanced Electromagnetic Field Theory

Guided waves, plane, cylindrical, spherical. Radiation, scattering and identification as boundary value problems. Introduction to tensor analysis. Propagation in multi-stream ionized and isotropic media. Propagation in moving media. Relativistic effects. Propagation in inhomogeneous and random media.

07 14 740 Biomedical Instrumentation

Nuclear Magnetic Resonance imaging and blood flow measurement principles. State-of-the-art techniques in medical instrumentation to measure parameters of direct clinical significance, NMR, electron spin resonance, viscosity determinations. Measurement and analysis of biopotentials and biomedical transducer characteristics; electrical safety, operational amplifiers for signal processing and computer interfacing. Signal analysis and display on the laboratory minicomputer.

07 14 741 Medical Imaging Systems

Basic modalities used for imaging internal structures within the volume of the body from a systems viewpoint: x-ray radiography, computerized tomography, magnetic resonance,

nuclear medicine, and ultrasound. Analysis of exciting proposed systems in terms of resolution, modulation transfer function, detection sensitivity, noise ability to visualize disease processes, arid potential for improving diagnosis.

07 14 751 Acoustical Devices and Applications

Electro acoustical transducers; definitions, analysis of different models, piezoelectric transducers, SAW devices and applications, acoustical filters, acoustical resonators, acoustical radiators. Beam forming methods, applications communication systems, applications in ultrasonic imaging.

07 14 760 Coding Theory

Introduction to variety of source coding techniques such as quantization, block quantization; and differential, predictive, transform and tree coding. Introduction to rate distortion theory. Channel coding; linear, cyclic, convolution and trellis coding. Encoding and decoding algorithms. Performance evaluation for s on a variety of communication channels.

07 14 761 Digital Communication Theory

Optimum receivers in Gaussian noise, maximum likelihood detection. Fundamental limits in coding and modulation, capacity and cutoff rates. Block, convolution and trellis coding. Continuous phase modulation. Viterbi detection. Coding for channels with interference, combined equalization and coding. Filtered channels and inter-symbol interference equalization. Fading channels.

07 14 762 Spread Spectrum Communications

Introduction to direct sequence, frequency hopping, chirp and hybrid systems. Processing gain. Interference and jamming signals. Bit error rate performance. Pseudo-noise generation. Synchronization and tracking techniques for DS and FH. Division multiple access. Applications in military, satellite, indoor wireless and fading channels.

07 14 770 Quantum Mechanics

Introduction to the methods of quantum mechanics with applications to atomic, molecular, solid state, nuclear and elementary practice physics.

07 14 771 Quantum and Optical Electronics

The laser principles; analysis of specific laser systems such as gas lasers, semiconductor lasers, and other solid-state lasers; laser dynamics, noise phenomena, nonlinear optics, guided wave optics, selected applications of coherent optics.

07 14 772 Solid State Electronics

Crystals structure and symmetries. Energy-band theory Cyclotron resonance. Tensor effective mass. Statistics of electronics state population. Recombination theory. Carrier transport theory. Interface properties. Optical processes and properties.

07 14 773 Superconductive Devices and Circuits
Introduction to superconductivity. Electron pairing. BCS and Ginzburg-Landu theories. Single-particle and Josephson tunneling. Electrodynamics of superconductors and Josephson junctions. Proximity effect. Mixed state in type II superconductors. Thin film. Applications in analog and digital circuits. Fabrication technology.

07 14 774 Circuit Theory and Computer-Aided Analysis
Device modeling formulation of network equations. Casualty, reciprocity, losslessness, passivity, stability, gain-bandwidth. Algorithms for computing linear, piecewise linear, And nonlinear resistive and dynamic circuits. Sparse materials. Explicit, implicit and stiff integration formulas and circuit interpretations. Sensitivity analysis. Nonlinear distortion.

07 14 775 Characterization and Computer Modeling of Semiconductor Devices
Computer simulation techniques for integrated circuit process and device modeling, such as bipolar current gain and MOS threshold voltage. Use of computer packages.

07 14 777 Solid States Devices
Physical principles and operational characteristics of semiconductor devices. Mechanics of carrier transport in solids and at interfaces, high field and hot carrier effect. Advanced discussion of bipolar and field-effect transistors with emphasis on the behavior dictated by present and probable future technologies.

07 14 778 Solid State Microwave Circuits and Devices
General properties of nonlinear solid-state microwave circuits. Negative resistance oscillators and amplifiers. Frequency converters and resistive mixers. Transistor amplifiers S-parameters design, power combiners and harmonic generators. Laboratory investigation of the properties of some of the considered circuits and devices.

07 14 780 Optical and Opt. Electronic Devices
Visible and infrared photo detectors, including PIN and avalanche photodiodes, photon counting devices and image intensifiers. Imaging detectors; including vidicons and Charge Coupled Devices. Display devices. Semiconductor lasers, acousto-optic, electro-optics and wave guide modulators; nonlinear optics, including second harmonic generation and optical bistability.

07 14 810 Special Topics in Signal Processing

This course introduces recent research topics in the area of signal processing algorithm design. Due to the continuous and the fast development nature in the area, the course mainly targets recent research papers in the field. This includes but not limited to the following topics: numerical linear algebra, convex optimization, inverse problems and regularization techniques, integer programming and relaxation methods, sparse signal representations.

07 14 811 High Resolution Image Processing

The fusion of low resolution images to obtain a high resolution image is a very exciting and challenging image processing technique. It has many applications such as remote sensing, medical imaging, pattern recognition and person identification. The course will cover: image processing techniques, image compression and interpolation techniques, image fusion techniques, applications to remote sensing and medical imaging. The uses of some modern signal processing techniques such as the wavelet transform and evolutionary algorithms will be considered.

07 14 820 Smart Antennas and MIMO Techniques

Smart antennas and multi-input-multi-output (MIMO) antennae systems are among the main techniques used in3G and 4Gmodern wireless communication systems. In addition to increasing the capacity and improving the spectral efficiency, these systems also provide good solutions to the mitigation of interference and multi-path fading effects. The course will cover: antenna array and diversity principals, adaptive array techniques, interference cancellation, direction of arrival (DOA) estimation, MIMO principles, space-time coding (STC), advances approaches for smart antenna design including evolutionary algorithms and artificial intelligence, spread spectrum CDMA and OFDM based smart antenna and MIMO systems.

07 14 841 Advanced VLSI Design

Advanced concepts in CMOS-based digital system design are studied. The topics include implementation of special purpose structures for complex digital systems, automation and verification of the design process, and design for testability; and design techniques for low-power design, power dissipation estimation, and application of low-power techniques in the different levels of the design hierarchy.

07 14 842 Radio Frequency Integrated Circuit (RFIC) Technology and Design

Integrated circuit (IC) implementation of RF circuits for wireless communications applications. Transceiver architectures for current wireless communications standards; active/passive device technologies for RFIC implementations; low noise amplifiers; mixers; frequency sources; power amplifiers; single-chip radios; and RFIC packaging and testing. Case studies of modern RFIC chip sets for current wireless communications standards are examined. The course involves circuit design at the IC level; modern

RF/microwave CAD software will be used in conjunction with the course. Design of a wireless transceiver functional block component RFIC chip.

07 14 843 Software Radios: Modern Radio Engineering
An introduction to software radios, devices that can be programmed to work with a variety of different radios. The course will cover the following topics: software radio architectures, existing software radio efforts, a review of basic principles, an analysis of receiver operation.

07 14 844 Advanced DSP & Filter Design
Advanced analysis, design, and realization of digital filters. Efficient Discrete Fourier Transform algorithm implementations, finite wordlength arithmetic, fixed point implementation, limit cycles, noise shaping, decimation and interpolation, multi-rate digital filter design, Hilbert transformers, analytic signal generation, basic adaptive filtering.

07 14 861 Advanced Wireless Communications
Cellular networks, fading and interference problems, signal detection of un-coded transmission over a narrowband fading channel, basic information theory of wireless channels, channel capacity, multiple access over fading channels ,orthogonal frequency division multiple access (OFDM), opportunistic communication and space-time multiple antenna communication, multi-input multi-output (MIMO) systems and multiuser detection.

07 14 862 Special Topics in Communication Engineering
New trends in Communication Engineering

07 14 863 Optical Access Networks
The course starts with an introduction to various access network technologies including DSL, cable networks and fiber-to-the-home (FTTH) networks. The advantages of FTTH using a passive optical network (PON) infrastructure as well as the different PON standards are addressed. The requirements and challenges of the different multiple-access techniques for PONs are also studied extensively. Finally, different next generation PON solutions are covered through state of the art PON research.

07 14 864 Advanced Optical Communications Systems
Introduction to optical communication systems; evolution of lightwave systems; components of a lightwave system; WDM systems; basic WDM multiplexers; advanced lightwave 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 lightwave systems; OFDM principles; optical OFDM systems; various types of optical OFDM; signal propagation in fibers; dispersion impairments; MIMO-OFDM perspective.

07 14 870 Semiconductor Materials
Basics of statistical mechanics and applications. Fundamentals of wave mechanics with some applications to microwave devices. Crystallography and specific types related to semiconductors. One and 3-dimensional band structure. The effect on phonon-photon, phonon-electron, photon-electron interaction. Cases of electron-electron ,photon-photon and phonon-phonon interactions. Hole and conduction electron concept in semiconductors. Mobility and diffusion concepts and their relation.

07 14 871 Semiconductor Devices
Diffusion and drift in a p-n junction. Equation of continuity and built-in voltage under no bias. Solution under forward and reverse bias. D.C. and small signal A.C. case. Equivalent circuit: diffusion capacitance and switching. Breakdown types in the junction. Bipolar transistor current-voltage equations under d.c. and small signal a.c. Approximate equivalent circuit. Junction field effect transistor, thyristor, silicon controlled rectifier, switching diode, and tunnel diode. Types of field effect transistor with p-n channel and short channel. Selected topics in microwave semiconductor devices.

07 14 881 Elementary Number Theory
Integers. Numbers. Sequences. Sums. Induction computer representation. Prime number. Euclidean Algorithm. Factorization. Chinese Reminder Theorem. Application. Wilson, Fermat and Euler's Theorems. Cryptology. Primitive Roots. Order of integer. Pseudorandom integers. Quadratic residues.

07 14 882 Cryptography and Network Security
Character ciphers. Block and stream ciphers. Exponential ciphers. Public. Key Cryptography Knapsack ciphers. Application and Algamal ciphers key cryptography. The RSA and Algamal ciphers. Data encryption standard. Advanced encryption standard. Applications.

07 14 891 Nanotechnologies
Introduction to nanotechnology (importance and challenges, concepts and scopes, types of nanostructures). Fabrication of nanostructures (nanoparticles sensitization, Layer-by-Layer (LbL) self-assembly, E-beam evaporation, Spin coating, Focused Ion Beam (FIB), Atomic force microscopy (AFM) for nanografting and nanolithography. Beam lithography, electro-spinning, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD). Atomic Layer Deposition (ALD). Characterization of nanostructures (optical techniques, imaging techniques, applications, nano-patterning.

07 15 711 Special Topics in Power System Engineering

Fault Analysis: general background: equivalent circuit (modeling) of different parts of power system, different methods of S.C. calculations. Zero sequence impedance for multi-parallel line with and without mutual coupling and its action on calculations. Uses of computer for 3-phase unbalance faults (short and open line or-simultaneously). Response of H.V.D.C. system to: D.C. line fault, A.C. line fault, by studying characteristics, modeling and detection. Rectifiers A.C. system fault. Inverters A.C. system fault distribution system: distribution system planning, load estimating, rating, choice of voltage, cost. Rural distribution system, choice of system line construction, substations, consumer connections. Urban distribution system; network layout, design of minimum cost networks. Interactive calculation for medium and low voltage distribution systems.

07 15 712 New Topics in Power Systems Control

New trends in controlling the power systems such as: large-scale power system control. Adaptive and optimal estimation (Kalman filtering) applied to power systems. Modern non-linear control of synchronous machines.

07 15 713 Renewable Energy Sources

Different types of energy available. What is renewable energy. Types of renewable energy; photovoltaic, wind, tidal wave, geo-thermal, biomass storage of energy. Economics of renewable energy systems. Management of renewable energy systems. Design of renewable energy systems. Hybrid energy sources. Applications and worked examples.

07 15 714 Sustainable Energy Utilization

Introduction and pineapples of sustainable energy. Essentials of fluid dynamics. Heat transfer. Solar radiation. Solar water heating. Green buildings and other solar thermal applications. Photovoltaic generation. Hydropower and artificial reservoirs. Power from the wind. The photosynthetic process. Biomass and biofuels. Wave power. Tidal power. Ocean thermal energy. Energy systems storage and transmission. Institutional and economic factors.

07 15 715 Smart Grids

Concepts of Smart Grids. Components of Smart Grids. Impact of Smart Grids on power industry, including renewable energy. Impact of Smart Grids on energy management and load management systems. Smart Grids and Green House energy and emission control. Polices of energy economics in view of Smart Grids.

07 15 717 Electrical Materials
Dielectric materials: polarization, frequency response, breakdown, piezoelectricity, ferroelectrics. Magnetic materials: domains and hysteresis curve. Review of microscopic theory. Stern Gerlach experiment. Magnetic resonance. Superconductivity.

07 15 720 Linear Control Systems
State-space representation of linear systems. Linearization techniques. Similarity transformations. Stability of linear multivariable systems. Controllability and design of different controllers. Observability and observer design. Design through separation property.

07 15 721 Non-Linear Control Systems
Linearization of nonlinear systems. Nonlinear control systems using relays. Types of nonlinear elements in control systems describing functions analysis of control systems. Phase plane analysis of control systems. Examples of nonlinear control systems. Stability analysis of nonlinear control systems. Examples from inertial instruments. Motor control. Fluid actuators. Spacecraft control. Missile and aircraft autopilots.

07 15 722 Digital Control Systems
Introduction to sampling theory and signal reconstruction. Z-transformation. Composite signal flow graph for digital systems. Time response and noise in digital systems. Frequency response. Synthesis of digital controllers. Statistical analysis and design of digital control systems. Nonlinear control systems.

07 15 723 Optimal Control Systems
Definition of optimal control problems. Formulation of discrete time optimal control problems as constrained mathematical programming problems. Formulation of continuous time optimal control problems as variational problems. The portraying necessary condition. Applications to a variety of specific optimal control problems from diverse disciplines Introduction to computational methods in optimal control.

07 15 724 Advanced Course in Control
Neural networks modeling and control. Large-scale systems control. Intelligent control. Adaptive prediction and filtering. Adaptive control of stochastic systems.

07 15 725 Adaptive Systems and Identification Techniques
Real time parameter identification. Model reference adaptive systems. Self-tuning regulator design. Gain scheduling technique. A unified approach for adaptive control. Stability convergence and robustness issues. Applications.

07 15 726 Control Systems Design and Simulation

Analog computers are used for simulation and troubleshooting techniques. Design of differential actuators and sensors. Model instruction techniques. Teams design, build, and test a miniature control system. Emphasis on the qualitative aspects of synthesis, generation of candidate design, and engineering tradeoffs in system selection.

07 15 728 Neural Networks

Anatomical and physiological properties of neural networks. Mathematical modeling. Information capacity. Network adaptation, learning, and self-organization. Applications to pattern recognition, associative memory, and classes of optimization problems. Algorithmic approaches; single and multi-layered, deterministic and stochastic. The problem of connectivity and implementation approaches.

07 15 731 Generalized Theory of Electrical Machines

Basic coordinates. Energy state functions and Lagrange's equation. Formulation of equilibrium equations for electromechanical systems. D-Q model of electrical machines and their applications to cross field machines. Unified theory of electrical machines. Application of matrix techniques.

07 15 732 Special Types of Electrical Machines

Review of torque production in electromechanical energy conversion devices. Stepper motors; types, step angle and types of drive circuits, stability and states of equilibrium. Reluctance motors; types and performance. Switched reluctance motors; types, performance and drive circuits. Permanent magnet machines; types of PM, constructions, performance and control. Switched mode machines.

07 15 733 Dynamics and Simulation of Electric Machines

Direct current machines; circuit model, dynamic characteristic of different types. Induction machines; circuit model, steady state and dynamic representation, simulation of different types, transients. Synchronous machines; effect of saliency, inductances, circuit model, equations, steady state characteristics, transient performance of synchronous machines.

07 15 741 Industrial Electronics (B)

Programmable logic controllers. Data loggers. Telemetry. Static frequency changers.

07 15 751 Solid State Drives

Four quadrant DC converters. Analysis of separately excited DC machine using speed. Current feedback loops. Slip energy recovery systems (constant torque, constant power systems). Soft starters for AC squirrel cage machines.

07 15 752 Control of AC Drives

Characteristics of inverter fed induction motors (single and three phases). Vector control of 3-phase I.M. Adaptive control of I.M. Microprocessor as controllers. Types of brushless DC drives.

07 15 753 Microprocessor Control of Electric Drives

Revision on microprocessor structure. Interface. Assembly language. Generation of gating signals for: 3-phase 6-pulse converter, 3-phase inverter, choppers, 3-phase AC voltage regulators. Use of microprocessor as PID controllers.

07 15 754 Digital and Logic Circuits for Solid State Drives

Control and driver circuits for stepper motor. Reluctance motor. Switched reluctance motors. PM machines.

07 15 761 Selected Topics in Electrical Measurements

Generalized approach to measuring systems. General functioning diagram. Input and output configuration. Input devices to measuring systems. Sensing elements; passive, active and digital transducers. Signal conditioning and data acquisition: DC and AC systems instrument amplifiers, A/D system sampling, A/D and D/A converters. Feedback measuring systems:; types of systems, inverse transducers.

07 15 762 Phasor Measurement Units and Applications

Synchronized Measurement Technology (SMT). Phasor Measurements Units (PMU). Installation of PMU's. Applications of various wide area monitoring, protection and control schemes (WAMPAC). Experiences of using WAM systems. Real time monitoring of a Power Plant Control System.

07 15 771 Application of Mathematical Methods in Electrical Engineering

Introduction to stochastic processes: probability, random variables, mean square estimation, stochastic processes and spectral analysis. Optimization methods: mathematical bases, unconstrained minimization, and minimization with constraints. Mathematical programming: linear programming, dynamic programming.

07 15 811 Power System Analysis

Modeling of power system elements. Steady state analysis of power system. Steady state sensitivity analysis. Power system data error detection and identification. Stochastic load flow. State estimation theory and applications.

07 15 812 Power System Planning

General planning: deterministic and probabilistic models. Transmission system planning: deterministic and probabilistic models. Automated transmission system expansion planning. Tellegen's theorem. Network sensitivity. Design of automated network including practical considerations. Automated planning using interactive graphics. Composite generation. Transmission reliability. Load forecasting.

07 15 813 Optimal Operation of Power Systems

Exact power system loss equation - Economic dispatch of thermal and hydrothermal units. Optimal power flow. Unit commitment; aspects and solution methods. Power system security monitoring. Steady state contingency analysis.

07 15 814 Transients in Power Systems

Review of traveling waves. Other transients on T.Ls. Transient modeling of power systems and components. Computing aids to the calculation of electrical transients. Insulation coordination. Case studies in electrical transients. Measuring techniques and surge testing.

07 15 815 High Voltage Engineering

Development in high voltage generation and measuring equipment. Latest research work and publications in the fields of liquid, solid and gas dielectrics. Development in high voltage power equipment. Specifications related to international standard and testing of high voltage power equipment.

07 15 816 Static & Digital Protection Relays

Static relays: types, design, characteristics and applications. Digital relays: theories, design, types and applications. Testing and calibration of the two types of relays.

07 15 818 Advanced Electrical Engineering Materials And Applications

Polarization and magnetization. Piezoelectricity and ferro-electricity. Dielectric materials and their application. Dielectrics in power equipment. Dielectrics in electronic equipment. Capacitors. Cables. Rectifiers. Memory devices and piezoelectric transducers. Magnetic storage. Superconducting material. Vast applications. Requirements of the armed services.

07 15 819 Renewable Energy Utilization

Heat engines. Ocean thermal energy conversion (OTEC). Ocean wave energy conversion (AWEC). Geothermal energy. Tidal energy thermoelectricity. Fuel cells. Hydrogen production and storage systems. Biomass. Photovoltaic solar cells. Solar tracking and control systems. Solar concentrators. Solar satellite systems. Wind Energy.

07 15 820 Advanced Topics in Control of Electrical Systems
Electrical networks representation in control systems. Electrical machines representation in control systems. Different servomotors in control systems. Representation and modeling of renewable energy power station. Control theories for different electrical systems.

07 15 821 Advanced Course in Linear Control
Linearization techniques. State space representation methods. Similarity transformations. Linearization by feedback. Stability analysis and optimization. Linear control systems theories. Separation property and design. Controllers and design.

07 15 822 Advanced Course in Nonlinear Control
Behavior of nonlinear system. Phase plane analysis. Describing function approach. Lyapunov stability theory. Feedback linearization. Sliding mode control. Case studies.

07 15 823 Digital Control Systems
Stability, controllability and observability of digital systems Analysis and design of digital control system. Configuration of direct digital control (DDC) systems in process control. Digital PID controllers. Case study: performance analysis and simulation using Matlab/Simulink of a selected practical process.

07 15 824 Optimal Control Techniques
Analytical solution of the general optimization problem for both continuous and discrete control systems. Linear quadratic regulators. Constrained input and state problems. Case study: particle, particle swarm optimization (PSO) technique and its application in a selected control process.

07 15 825 Identification Methods and Adaptive Systems
Introduction to adaptive systems. Real time parameter estimation. Model reference adaptive systems. Self-tuning regulators. -Gain scheduling techniques. Case studies.

07 15 826 Neural Network Control Systems
Introduction. Learning processes. Single and multilayer preceptors. Radial-basis function networks. Support vector machines. Neurodynamic programming. Neurodynamics.

7 15 827 Artificial Intelligence and Applications
Introduction. Artificial Intelligence techniques in Control systems Analysis and Control. Robotics. Neural and Fuzzy Machine Intelligence. Adaptive Fuzzy Control systems. Genetic Algorithms in Control system Analysis and Design.

07 15 828 Fuzzy Control Systems and Applications
Introduction. Basics of Fuzzy sets and Relations. Fuzzy Measures. Fuzzy Logic and reasoning. Fuzzy Logic Control Systems. Application of Fuzzy theory.

07 15 834 New Trends in Electrical Machines
PM machines. PM machines with fractional slot winding. Multiphase systems. Multiphase PM Machines. Multiphase Induction machines. Magnetic gearboxes. Active magnetic bearing. Bearingless drives.

07 15 835 Dynamic Modeling of Electrical Machines
Synchronous machine modeling. The one-axis model. The two-axes model. Higher-order models. Automatic voltage regulator dynamics. Turbine-governor dynamics. Power system stabilizers. Single-machine-infinite-bus (SMIB) systems. Multi-machine power systems. Steady state operating points. Linearization. Induction machine modeling. Doubly-fed induction generator (DFIG) dynamics. Wind turbine dynamics. Time-domain simulations, Performance of impedance relays during machine swing.

07 15 841 Power Electronic Interface of Renewable Energy Sources
Photovoltaic modules (PV) characteristics. DC-DC-AC conversion. Maximum power point tracking (MPPT). Wind turbine characteristics. AC-DC-AC conversion. Doubly-fed induction generator (DFIG) interface. Control of grid-side and generator-side converters. Control of injected active and reactive power. Synchronous frame current controller. DC voltage control.

07 15 842 Design for Power Electronic Converters
Transfer function of DC-DC converters. Design of closed loop controllers for DC-DC converters, Transfer function of DC/ AC converters. Design of closed-loop controllers for DC/AC converters. Design of proportional integral (PI) controllers. Passivity based controllers. Repetitive controllers for harmonic disturbance rejection. Adaptive controllers. Nonlinear controllers. Back-stepping controllers. Adaptive fuzzy controllers. Neural network controllers.

07 15 843 Power Electronic-Based Control of Electric Power Systems
Flexible AC transmission systems (Facts) - Static Var Compensator (SVC). Static Synchronous Compensator (STATCOM). Static Synchronous Series Compensator (SSSC). Unified Power Flow Controller (UPFC). Design of controllers. Using of Facts devices for power system voltage control, power flow control and damping of power system oscillations. High voltage DC systems (HVDC). Valve characteristics. Steady

state operating points. Control modes. Design of controllers. Power flow control. Transient stability enhancement using HVDC. Design of AC and DC harmonic filters.

07 15 844 Advanced Industrial Automation
Programmable Logic Controllers (PLC). PLC networks. Supervisory Control and Data Acquisition (SCADA) systems. Motor control centers (MCC). Distributed Control Systems (DCS).

07 15 845 Advanced Industrial Electronics
Resonant converters. Soft-switching converters. Zero-Voltage-Switching (ZVS) converters. Zero-Current-Switching (ZCS) converters. Z-source inverters. Multilevel-inverters. Cascaded inverters. Diode-clamping converters. Flying-capacitor converters. Load-sharing among parallel-connected inverters. Design of gate-drive circuits. Protection of power semiconductor devices.

07 15 846 Active Harmonic filtering
Active power filters. Circuit topologies. Harmonic extraction techniques. Reference current generation. Control techniques. Modulation techniques. Reactive power compensation. Four–wire systems. Load balancing and neutral current elimination.

07 15 891 High Voltage DC Transmission
History of HVDC transmission. HVDC advantages over HVAC systems technical merits. Economical considerations. Environmental aspects. Drawbacks facing HVDC. Categories of HVDC transmission: point to point, back to back, multi–terminal HVDC. HVDC transmission systems technology: LCC-HV system, VSC, HVDC system, MMC HVDC systems. Interaction between AC and DC systems.

07 15 601 Diploma Project in Power Engineering and Electrical Machines

07 15 701 Master of Engineering Scientific Report in Electrical Engineering (Power Engineering and Electrical Machines)

07 14 701 Master of Engineering Scientific Report in Electrical Engineering (Electronics and Communications)

07 15 705 Master of Science Thesis in Electrical Engineering (Power Engineering and Electrical Machines)

07 14 705 Master of Science Thesis in Electrical Engineering (Electronics and Communications)

07 15 801 **Doctor of Philosophy Dissertation in Electrical Engineering (Power Engineering and Electrical Machines)**

07 14 801 **Doctor of Philosophy Dissertation in Electrical Engineering (Electronics and Communications)**

Department of Computer and Systems Engineering

The department of Computer and Systems Engineering offers distinct graduate programs towards a master or doctorate degree. The diploma and master of engineering programs will be opened pending approval from the department council. The following programs are offered:

1. Master Degrees

1.1 Master of Science in Computer and Systems Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student should choose the courses from the master level course list after consulting his/her academic advisor/thesis supervisor and obtaining approval. At least one course from each specialization group is chosen to ensure breadth of knowledge.
The student can only register for Thesis credit hours after finishing at least 80% of the total credit hours corresponding to regular courses and after faculty approval of the supervisory committee assigned to the student.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Computer and Systems Engineering

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student should choose the courses from the Ph.D. level course list after consulting his academic advisor/thesis supervisor and obtaining approval. At least one course from each specialization group is chosen to ensure breadth of knowledge. Some courses may be from master level courses.
The student can only register for dissertation credit hours after passing the comprehensive exam and after approval of the supervisory committee assigned to the student.

List of Master and Ph.D. courses

	Course Code	Field	Course Name	Credit Hours	Exam Duration
1	07 16 711	S	Advanced Topics in Programming and Programming Languages	3	3
2	07 16 712	HS	Hardware – Software Computer Design	3	3
3	07 16 713	S	Distributed Database Systems	3	3
4	07 16 714	S	Advanced Topics in Software Engineering	3	3
5	07 16 715	S	Data Warehouse Systems and Tools	3	3
6	07 16 716	S	Advanced Topics In Database Systems	3	3
7	07 16 717	S	Advanced Data Structures and Algorithms	3	3
8	07 16 718	S	Randomized Algorithms	3	3
9	07 16 721	AHS	Network Security	3	3
10	07 16 722	H	Communications & Computer Networks	3	3
11	07 16 723	AHS	Parallel Computation	3	3
12	07 16 724	H	Advanced Topics In Computer Architecture	3	3
13	07 16 730	ACS	Fuzzy Logic with Engineering Applications	3	3
14	07 16 731	C	Nonlinear Control Systems	3	3
15	07 16 732	C	Optimal Control Theory	3	3
16	07 16 733	ACHS	Robotics	3	3
17	07 16 734	C	System Identification	3	3
18	07 16 735	AC	Programmable Logic Controllers (PLCs)	3	3
19	07 16 736	ACHS	Computer Controlled Systems	3	3
20	07 16 737	CH	Networked Control System	3	3
21	07 16 738	C	Adaptive Control	3	3
22	07 16 739	C	Linear stochastic control systems	3	3
23	07 16 741	AS	Artificial Intelligence	3	3
24	07 16 742	A	Neural Computing	3	3

25	07 16 743	AS	Multi-Agent Systems: Theory and Application	3	3
26	07 16 744	A	Optimization Theory	3	3
27	07 16 745	AS	Natural Language Processing	3	3
28	07 16 746	AS	Digital Image Processing	3	3
29	07 16 747	AS	Pattern Recognition	3	3
30	07 16 748	A	Bioinformatics	3	3
31	07 16 749	A	Simulation Techniques	3	3
32	07 16 750	AS	Computer Graphics	3	3
33	07 16 751	AH	Network Protocols	3	3
34	07 16 752	AHS	Mobile Computing	3	3
35	07 16 753	AS	Game Programming	3	3
36	07 16 754	AS	Data Compression	3	3
37	07 16 755	AS	Distributed and Intelligent Systems	3	3
38	07 16 756	A	Decision Analysis and Operations Research	3	3
39	07 16 757	AS	Combinatorial Mathematics	3	3
40	07 16 758	AS	Topics in Data Mining	3	3
41	07 16 760	AS	Text Information Systems	3	3
42	07 16 780	S	Directed Studies in Software and Computer Science (1)	3	3
43	07 16 781	S	Directed Studies in Software and Computer Science (2)	3	3
44	07 16 782	H	Directed Studies in Computer Engineering (1)	3	3
45	07 16 783	H	Directed Studies in Computer Engineering (2)	3	3
46	07 16 784	AC	Directed Studies in System Engineering (1)	3	3
47	07 16 785	AC	Directed Studies in System Engineering (2)	3	3
48	07 16 786	A	Directed Studies in Computer Applications (1)	3	3
49	07 16 787	A	Directed Studies in Computer Applications (2)	3	3
50	07 16 788	HS	Directed Studies in Computer Science and Engineering (1)	3	3
51	07 16 789	HS	Directed Studies in Computer Science and Engineering (2)	3	3

52	07 16 811	S	Directed Reading in Software and Computer Science (1)	3	3
53	07 16 812	S	Directed Reading in Software and Computer Science (2)	3	3
54	07 16 813	S	New Trends in Programming and Programming Languages	3	3
55	07 16 814	AS	New Trends in Software Engineering	3	3
56	07 16 816	AS	New Trends in Database Systems	3	3
57	07 16 817	S	New Trends in Algorithms and Data Structures	3	3
58	07 16 821	H	Directed Reading in Computer Engineering (1)	3	3
59	07 16 822	H	Directed Reading in Computer Engineering (2)	3	3
60	07 16 824	H	New Trends in Computer Architecture	3	3
61	07 16 831	C	Directed Reading in Systems Engineering (1)	3	3
62	07 16 832	C	Directed Reading in Systems Engineering (2)	3	3
63	07 16 841	A	Directed Reading in Some Computer Applications (1)	3	3
64	07 16 842	A	Directed Reading in Some Computer Applications (2)	3	3
65	07 16 850	AS	New Trends in Computer Graphics	3	3
66	07 16 854	AS	New Trends in Data Compression	3	3
67	07 16 855	HS	New Trends in Computer Science and Engineering (1)	3	3
68	07 16 856	HS	New Trends in Computer Science and Engineering (2)	3	3
69	07 16 857	HS	New Trends in Computer Science and Engineering (3)	3	3
70	07 16 858	AS	New Trends in Data Mining	3	3
71	07 16 705		Master of Science Thesis in Computer and Systems Engineering	8	Defense

72	07 16 801		Doctor of Philosophy Dissertation in Computer and Systems Engineering	24	Defense

A: Applications C: Control H: Hadware S: Software

Description of Courses for Graduate Programs (Master- Doctor of Philosophy)

0 7 16 711 Advanced Topics in Programming and Programming Languages
Programming language paradigms. Programming techniques. Structure of programming languages. Data systems : Data types, Mechanisms for data structuring, type equivalence, Type conversion. Control structures: sequencing, selection, iteration, parallel processing, exception handling. Alternatives in design of data system and control structures using examples from ALGOL60, Algol68, Pascal, C. C++, Java, and Ada.

07 16 712 Hardware – Software Computer Design
Overview of virtual machines. Processor architecture. Dynamic compilation: Automatic vectorization, Parallelization , intermediate representations , automatic code generation - JIKES (IBM research Java virtual machine) as an example. Case study–1 DAISY. Case study-2 CRUSOE

07 16 713 Distributed Database Systems
Distributed DBMS Architecture. Distributed Database Design. Database Integration. Data and Access Control. Distributed Query Processing. Query Decomposition and Data Localization. Query Optimization in Distributed Databases. Multi database Query Processing. Distributed Transaction Management. Distributed Concurrency Control. Distributed DBMS Reliability. Data Replication. Parallel Databases. Distributed Object Database Management. Peer – to – Peer Data Management. Web Data Management. Data Management on the Cloud .

07 16 714 Advanced Topics in Software Engineering
1. Review most well-known and emerging Models of Software Development Life Cycles (SDLC'S).Introduce analogy with search techniques. Agility metrics
2. Capability Maturity Model Integrated (CMMI).
3. Process areas procedures and templates of the Software Process Improvement model , developed by SECC, for small to intermediate enterprises (SPI-SME) :
   3.1. Project Management (PM).
   3.2. Product Development (PD): Requirements Definition, elicitation and validation. Analysis. High level and detailed design. Implementation. Testing
   3.3. Peer Review (PR).
   3.4. Quality Assurance (QA).
   3.5. Configuration Management (CM).

4. Exploring open source tools.
   4.1. Integrated Computer-Aided Software Engineering (ICASE).
   4.2. Testing tools + Issue tracking tools.
   4.3. Change management tools.
5. SWR - Risks & Estimation & Efforts.

07 16 715 Data Warehouse Systems and Tools

Warehouses and their basic concepts. Warehouses system components. Warehouses modeling and designing issues. Performance evaluation of the Warehouse. Data quality, Metadata, and Data transformation. OLAP, data mining and virtual Data Warehouses.

07 16 716 Advanced Topics in Database Systems

Part 1: Database Security

1- Data Security- how?

-Access Control, Security policies and models

2- Access Control in commercial Databases

3- Temporal Authorization models

4- Privacy preserving DBM systems, Access control for complex objects

5-SQL injection and SOL injection in commercial databases

Part 2: XML Data Management

1- XML basics

2- Web Application Scenarios

3- XQuery fundamentals

4- XQuery Full Text (Search Languages, Scoring, Query processing)

Part 3: Processing Massive Data Streams

1- Streams : Motivation and streaming Applications

2- Centralized Stream Processing

- Basic Streaming models and tools
- Stream synopses and applications

- Sampling and sketches
- Sliding Window model

3- Distributed Stream Processing

- One shot distributed stream querying
- Tree–based aggregation
- Robustness and loss
- Decentralized computation and gossiping

07 16 717 Advanced Data Structures and Algorithms

Data Structures: Amortized analysis, Splay trees, Finger trees, Fibonacci heaps, Leftist and skew heaps, Skip lists, Treaps. Approximation Algorithms: Set covering – Knapsack

– Traveling salesman – Max cut – Hardness of approximation. Parallel Algorithms: Parallel models and architectures – Sorting networks- Integer arithmetic – Maximal independent sets – Perfect matching.
Computational Geometry: Convex hulls – Line intersections – Duality – Polygon triangulations – Geometric data structures.

07 16 718 Randomized Algorithms
Classification of randomized algorithms. Sherwood, Las Vegas and Monte Carlo Algorithms. Tail inequalities, mutual and Pair wife independence. Randomized Complexity Classes. Improving 2-Sided error algorithms. The probabilistic method. Derandomization techniques and the method of conditional expectations. General random walks on graphs. Universal hash functions. Several applications. Specify some applications for example in cryptography and network scheduling.

07 16 721 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.

07 16 722 Network Communications
Data transmission and encoding. Modulation techniques. Multiplexing. Data link control. Switched Networks and Broadcast networks.

07 16 723 Parallel Computing
Principles of parallel computation. Classification of Parallel Computers. Concurrent programming Languages. Concurrent programming models. Parallel algorithms. Detecting parallelism in sequential programs.

07 16 724 Advanced Topics In Computer Architecture
Modern Computer Architecture; Multicore. Architecture for Power. Protection and Security. Disk technology. DRAM technology.

07 16 730 Fuzzy Logic with Engineering Applications
Classical sets and fuzzy sets. Classical relations and fuzzy relations. Fuzzification. Defuzzification. Neural networks. Genetic algorithms. Fuzzy-neural systems. Fuzzy Genetic systems. Engineering Applications of Fuzzy Logic.

07 16 731 Nonlinear Control Systems
This course is intended to introduce the student to the analysis of the qualitative behavior of nonlinear systems, and the synthesis and design of controllers for such systems. Techniques include state space analysis and describing function, Lyapunov's direct method, linearization, frequency domain stability analysis, and functional analysis methods. Additionally, techniques with a geometric flavor, including center manifold reduction, Lie algebraic approaches to nonlinear control systems.

07 16 732 Optimal Control Theory
The linear quadratic optimal control problem, Pontrtagin's maximum principle. The Hamiltonian and dynamic programming Cpriacible of Optimaling. Optimal control with free final state. Optimal control for system with penalty constrained final state. Optimal control problem with state constraints. Singular optimal control.

07 16 733 Robotics
Spatial transformations. Robot arm Kinematics Inverse kinematics. Robot arm dynamics. Trajectory planning. Robot arm control.

07 16 734 System Identification
Course provides introduction to the construction of linear dynamical models from experimental data using parametric and non-parametric identification techniques. Theoretical and practical aspects of these techniques are addressed. Introduction to methods for modeling, analyzing, and reasoning about discrete systems, such as hardware and software designs.

07 16 735 Programmable Logic Controllers (PLCs)
Hardware Components: PLC Definitions: CPU and other IC chips used, Input and Output Modules, Fixed and alterable Memory, Remote locations to Input/ Output Modules, Discrete and Analog Modules, On–Off Inputs/Outputs, Sensors, Relays and Photocells, … etc.
Programming and Software: Programming Format, Creating a Ladder Diagram for a certain process, Process scanning considerations. Basic PLC Functions: Basic PLC Time Function, Basic PLC counters Functions, Programs with both a counter and a timer. Advanced Functions: Types of PLC Analog Modules and Systems, Analog signal Processing, Examples of Real Industrial PLC applications. Visits to some Factories to illustrate some real existing PLC Systems.

07 16 736 Computer Controlled Systems
Introduction, Sampled data systems, Z-transform and its properties, Inverse of Z-transform, Closed loop performance and stability. Computer control schemes:

Supervisory and direct digital control systems, Digital PID control design, Pole placement digital control, Independent regulation and tracking pole placement control. SCADA (Supervisor Control And Data Acquisition) systems. Real time programming considerations. Applications.

07 16 737 Networked Control System
An Introduction to Networked Control Systems. Networking for Control: Technologies and Models. Simulation of Networked Control Systems. Middleware for Distributed Control Systems. Distributed Estimation and Consensus. Distributed Optimization. Decentralized Control. Decentralized and Hybrid MPC. Stability and Control of Networked Control Systems. Feedback Control over Limited-capacity Channels. Event-triggered and Self-triggered Control.

07 16 738 Adaptive Control
Lyapunov-based adaptive control methods. Model-based and non-model based controllers. Adaptive algorithms.

07 16 739 Linear stochastic control systems
Probability and random processes – integrals and stochastic differential equations - analysis of discrete-time linear stochastic control systems - optimal estimation for discrete-time linear stochastic systems - optimal control of discrete-time linear stochastic systems - continuous-time linear stochastic control systems - optimal control of continuous-time linear stochastic systems - stability analysis of stochastic differential equations.

07 16 741 Artificial Intelligence
Knowledge Representation Techniques. Problem Solving by Searching. Constraint Satisfaction Problems. Logic Programming. Uncertain Knowledge and Probabilistic reasoning. Planning. Machine Learning (Decision Trees, Neural Nets). Applications (Natural Language Processing, Perception, Robotics).

07 16 742 Neural Computing
Introduction. Associative memory and Hop field model. Simple perceptrons. Delta rule and learning by backpropagation in multiplayer networks. Other learning paradigms: competitive learning, neocognitron, adaptive resonance theory, principal component analysis, Boltzman machine.

07 16 743 Multi-Agent Systems: Theory and Application
Basic Agent Definitions. Basis of Agent theory: planning agents, distributed planning, introduction to cognition. Agents in software Engineering. Agent Modeling Language (AML). MAS Languages: KQML, FIPA. MAS Platforms: FIPA-OS, Agent Cities.

Agents and information systems: exposure to systems such as KRASH, Carnot, RETSINA, Info Sleuth. Agents and e-Commerce: bidding and auctions, Web-based transactions, Agents and mobility.

07 16 744 Optimization Theory
Defining the nonlinear programming problem. Unconstrained optimization using derivatives: gradient method, Newton's method, conjugacy and conjugate directions, and others. Unconstrained search methods. Constrained nonlinear programming methods. Linear approximation methods. Penalty functions. Lagrange multipliers. Necessary and sufficient conditions for optimality.
Adding non-traditional methods such as these inspired from nature like ant colonies and those methods based on avantum computation.

07 16 745 Natural Language Processing
Overview. Language Layers. Translation Networks. Augmented Translation Networks. Case Grammars. Question Answering and Summarization. Machine Translation.

07 16 746 Digital Image Processing
Image formation and perception. Computer representation. Enhancement and restoration. Segmentation. Encoding and data compression. Reconstruction from projections. Scene understanding. Matching and recognition. Selected applications.

07 16 747 Pattern Recognition
Introduction to pattern recognition as a process of data analysis. Representation of features in multidimensional space as random vectors. Similarity and dissimilarity measures in feature space. Bayesian decision theory. Discriminant functions and supervised learning. Clustering analysis and unsupervised learning. Estimation and learning. Feature extraction and selection. Introduction to syntactic P.R. Selected applications.

07 16 748 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.

07 16 749 Simulation Techniques
Modeling and digital computer simulation of large scale systems. Discrete event simulation, statistical tests, random number generators, experimental design of simulation experiments. Introduction to simulation languages as SIMSCRIPT, GPSS, SLAM, and SIMAN which can be used in the final project. Input distribution specification. Random number generators, generating random variable. Statistical analysis of simulation output data.
Prerequisites: "probability theory and statistics"

07 16 750 Computer Graphics
Review of basic concepts in 2-D graphics. `Representation of 3-D models. Generation of 3-D models (creating perspective drawing and perspective transformations). Hidden line/hidden surface algorithms. Shading models (illumination and reflection models). (Realistic images). GPU Programming.

07 16 751 Network Protocols
Overview of network and Internet protocols. Abstract Notation for network protocols (AP). More on processes and Connections. Data Transfer and Multiplexing. Error detection and error recovery. Flow Control. Routing. Switching. Congestion Control. Seminars on selected topics.

07 16 752 Mobile Computing
Introduction to mobile computing. Software architectures and mobile computing models. Location management for networks with mobile users, Tracking mobile users, Mobile IP and its variants, Management of location data, Routing/ forwarding messages to mobile users, Flow control/buffering for open connections, Data management. Transport layer protocols in mobile computing environment, Mobile networks analogues of TCP and UDP, Supporting real-time applications, Maintaining QoS guarantees in the presence of mobility. Wireless scheduling and resource management, Scheduling and channel access algorithms, Resource reservations and admission control. System level support, Disconnected operations, Weak connectivity, Caching, Failure recovery. Location management. Applications and case studies.

07 16 753 Game Programming
Specialized systems, path finding, movement, tactical issues, general purpose architectures, decision making architectures, scripting, learning , multi-party games.

07 16 754 Data Compression
- Statistical Methods
- Dictionary Methods

- Applications

07 16 755 Distributed and Intelligent Systems (1)
Bringing together the concepts from different fields such as database, operating systems, networks, artificial intelligence, architecture, and parallel processing that are essential in understanding, evaluating and building distributed intelligent systems. Enhance the student ability to scientifically criticize and discuss research papers. Develop reading, writing and presentation skills.
The student is required to select-under the supervision of the instructor-at least two recent papers from well-known international journal (usually tutorial or survey papers) that are related to the course objective. The student shall make a report on the selected papers and make at least two complete presentations to the other students and demonstrate his understanding of the topic. The student is also required to participate in the discussion of other students' work. The final exam contain questions from all presented work.

07 16 756 Decision Analysis and Operations Research (2)
Theory and methods for the analysis of decisions under uncertainty. The use of expert judgment and value of information. The encoding of attitudes toward risk. Applications selected from capital investment, bidding, purchasing. inspection, inventory control and other areas.

07 16 757 Combinatorial Mathematics
Generating Functions. Recurrence Relations. The Principle of Inclusion and Exclusion. Polya's Theory of Counting. Fundamental Concepts in the Theory of Graphs. Trees, Circuits, and Cut-sets. Planar and Dual Graphs. Domination, Independence, and Chromatic Numbers. Transport Networks. Matching Theory. Adding the following: Ramsey's theorem, Van Der Warden theorem, Sezmerdy's theorem .

07 16 758 Topics in Data Mining
Introduction. Data Preprocessing. Data Warehouse and OLAP Technology: An Introduction. Advanced Data Cube Technology and Data Generalization. Mining Frequent Patterns, Association and Correlations. Classification and Prediction. Cluster Analysis. Web mining. Open research issues in data mining.

07 16 760 Text Information Systems
Theory and application of text information systems. Information retrieval including text preprocessing (morphological analysis, stemming, POS tagging, etc.), retrieval models (vector space, probabilistic models, language models, and advanced models), text indexing techniques and document ranking. Evaluation metrics. Relevance and pseudo feedback. Query expansion. Information filtering. Text mining including data mining style and the NLP-style techniques for text mining. Text classification. Text

dimensionality reduction and text clustering. Text summarization. Topic modeling. Information extraction and sentiment analysis.

07 16 780 Directed Studies in Software and Computer Science (1)

07 16 781 Directed Studies in Software and Computer Science (2)

07 16 782 Directed Studies in Computer Engineering (1)

07 16 783 Directed Studies in Computer Engineering (2)

07 16 784 Directed Studies in System Engineering (1)

07 16 785 Directed Studies in System Engineering (2)

07 16 786 Directed Studies in Computer Applications (1)

07 16 787 Directed Studies in Computer Applications (2)

07 16 788 Directed Studies in Computer Science and Engineering (1)

07 16 789 Directed Studies in Computer Science and Engineering (2)

07 16 811 Directed Reading in Computer Science and Software (1)
Students will be directed towards relevant publications in Computer Science and Software. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 812 Directed Reading in Computer Science and Software (2)
Students will be directed towards relevant publications in Computer Science and Software. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 813 New Trends in Programming and Programming Languages

07 16 814 New Trends in Software Engineering

07 16 816 New Trends in Database Systems

07 16 817 New Trends in Algorithms and Data Structures

07 16 821 Directed Reading in Computer Engineering Field (1)
Students will be directed towards relevant publications in the Computer Engineering field. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 822 Directed Reading in Computer Engineering Field (2)
Students will be directed towards relevant publications in the Computer Engineering field. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 824 New Trends in Computer Architecture

07 16 831 Directed Reading in Systems Engineering (1)
Students will be directed towards relevant publications in the Systems Engineering. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 832 Directed Reading in Systems Engineering (2)
Students will be directed towards relevant publications in the Systems Engineering field. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 841 Directed Reading in Some Computer applications
Students will be directed towards relevant publications in some computer applications. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 842 Directed Reading in Some Computer applications
Students will be directed towards relevant publications in some computer applications. Requirements would include class presentations and discussion of topics of interest. Term reports are also encouraged as a tool for student's evaluation.

07 16 850 New Trends in Computer Graphics
07 16 854 New Trends in Data Compression
07 16 855 New Trends in Computer Science and Engineering (1)
07 16 856 New Trends in Computer Science and Engineering (2)
07 16 857 New Trends in Computer Science and Engineering (3)
07 16 858 New Trends in Data Mining

Department of Nuclear and Radiation Engineering

The department of Nuclear and Radiation Engineering offers the following programs:

1. Graduate Diplomas

1.1 Specialized Graduate Diploma in Nuclear Power Plants

The student must complete 30 credit hours.
Compulsory courses: The student must pass six courses with a total of 18 credit hours with course numbers (07 17 601, 07 17 611, 07 17 612, 07 17 613, 07 17 614, 07 17 631).
Elective courses: The student can choose the remaining credit hours from the following courses (07 17 622, 07 17 623, 07 17 624, 07 17 625, 07 17 626, 07 17 629).

1.2 Specialized Graduate Diploma in Nuclear Radiation and Environment

The student must complete 30 credit hours.
Compulsory courses: The student must pass six courses with a total of 18 credit hours with course numbers (07 17 602, 07 17 622, 07 17 624, 07 17 625, 07 17 626, 07 17 629).
Elective courses: The student can choose the remaining credit hours from the following courses (07 17 611, 07 17 621, 07 17 623, 07 17 627, 07 17 628, 07 17 631, 07 17 641).

2. Master Degrees

2.1 Master of Science in Nuclear and Radiation Engineering

The student must complete 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must choose from the following courses (07 17 710, 07 17 711, 07 17 712, 07 17 713, 07 17 714, 07 17 715, 07 17 716, 07 17 717, 07 17 718, 07 17 719, 07 17 721, 07 17 722, 07 17 723, 07 17 724, 07 17 725, 07 17 731, 07 17 732, 07 17 741).
The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Nuclear Sciences and Technology

Students who want to enroll in the Master of Science in Nuclear Sciences and Technology program should have a B.Sc. in Science or Engineering. Students do not have to take non-credit courses from the B.Sc. level prior to admission to this program. In

order that the student obtains the Master of Nuclear Sciences and Technology, he/she must achieve 32 credit hours divided as follows:

1) 8 credit hours of thesis: 07 17 706
2) Compulsory Courses: 10 credit hours (07 17 751, 07 17 752, 07 17 753, 07 17 754, 07 17 755).
3) Elective Courses: 14 credit hours. The student must choose the required courses from one of the following lists:

A. Radiation Protection
(07 17 761, 07 17 762, 07 17 781, 07 17 782, 07 17 783, 07 17 784, 07 17 785, 07 17 786, 07 17 787, 07 17 788).
B. Nuclear Applications and Techniques
(07 17 761, 07 17 762, 07 17 771, 07 17 772, 07 17 773, 07 17 774, 07 17 775, 07 17 776, 07 17 777, 07 17 778).
C. Nuclear Engineering
(07 17 761, 07 17 762, 07 17 790, 07 17 791, 07 17 792, 07 17 793, 07 17 794, 07 17 795, 07 17 796, 07 17 797, 07 17 798, 07 17 799).

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Nuclear and Radiation Engineering

The student must mplete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose from the following courses (07 17 811, 07 17 812, 07 17 813, 07 17 814, 07 17 815, 07 17 816, 07 17 817, 07 17 821, 07 17 822, 07 17 823, 07 17 824, 07 17 831, 07 17 832, 07 17 841).
The student has the right to choose another three courses from another major.

List of Diploma, Master and Ph.D. courses (except for the Master of Nuclear Sciences and Technology)

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
1	07 17 611	Transport Theory	3	3	
2	07 17 612	Advanced Nuclear Power Stations	3	3	
3	07 17 613	Heat Transfer in Nuclear Reactors	3	3	

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
4	07 17 614	Nuclear Reactor Safety	3	3	
5	07 17 621	Radiation Damage in Materials	3	3	
6	07 17 622	Waste Management	3	3	
7	07 17 623	Transportation and Management of Radioactive Materials	3	3	
8	07 17 624	Environmental Aspects of Nuclear Energy	3	3	
9	07 17 625	Radiation Detection Techniques	3	3	
10	07 17 626	Radiation Protection	3	3	
11	07 17 627	Health Physics	3	3	
12	07 17 628	Advanced Applications of Nuclear Radiation	3	3	
13	07 17 629	Nuclear Environmental Pollution	3	3	
14	07 17 631	Nuclear Materials	3	3	
15	07 17 641	Environmental Protection	3	3	
16	07 17 710	Fusion Reactors Technology	3	3	
17	07 17 711	Neutron Transport Theory	3	3	
18	07 17 712	Nuclear Fuel Management	3	3	
19	07 17 713	Reactor Measurements and Control	3	3	
20	07 17 714	Economics of Nuclear Power Plants	3	3	
21	07 17 715	Reactor Experiments	3	3	
22	07 17 716	Special Topics in Nuclear Engineering	3	3	
23	07 17 717	Modeling and Simulation in Nuclear Engineering	3	3	

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
24	07 17 718	Monte Carlo Applications in Nuclear Engineering	3	3	
25	07 17 719	Numerical Methods in Nuclear Engineering	3	3	
26	07 17 720	Nuclear Reactor Thermal Hydraulics	3	3	
27	07 17 721	Interaction of Radiation with Matter	3	3	
28	07 17 722	Plasma Processing	3	3	
29	07 17 723	Special Topics in Radiation Engineering	3	3	
30	07 17 724	Nondestructive Testing	3	3	
31	07 17 725	Radiation Detection Lab	3	3	
32	07 17 726	Nuclear Security and Safeguards	3	3	
33	07 17 727	Advanced Reactor Safety	3	3	
34	07 17 728	Design of Nuclear Power Plants	3	3	
35	07 17 731	Materials Characterization Techniques	3	3	
36	07 17 732	Fatigue in Engineering Materials	3	3	
37	07 17 741	Renewable Energy	3	3	
38	07 17 811	Advanced Reactor Theory	3	3	
39	07 17 812	New Trends and Features in Nuclear Power Plants	3	3	
40	07 17 813	Seminars in Nuclear Engineering	3	3	
41	07 17 814	Digital Simulation in Nuclear Engineering	3	3	
42	07 17 815	Monte Carlo Techniques in Nuclear Engineering	3	3	
43	07 17 816	Fusion Reactor Design	3	3	

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
44	07 17 817	Reactor Kinetics and Control	3	3	
45	07 17 821	Advanced Plasma Physics	3	3	
46	07 17 822	Seminars in Radiation Engineering	3	3	
47	07 17 823	Charged Particles Accelerators	3	3	
48	07 17 824	Radiation Measurements Lab	3	3	
49	07 17 831	Composite Materials	3	3	
50	07 17 832	Radiation Effects in Nuclear Materials	3	3	
51	07 17 841	Desalination	3	3	

List of Diploma, Master and Ph.D. courses (except for the Master of Nuclear Sciences and Technology)

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
1	07 17 751	Nuclear Physics	2	2	
2	07 17 752	Fundamentals of Nuclear Science and Engineering	2	2	
3	07 17 753	Radiation Detection and Measurements	2	2	
4	07 17 754	Radiation Protection and Shielding	2	2	
5	07 17 755	Computational and Simulation Methods in Physics	2	2	
6	07 17 761	Radiation Transport	2	2	
7	07 17 762	Mathematical Methods in Physics	2	2	
8	07 17 771	Optimization Principles and Techniques	2	2	
9	07 17 772	Radioisotopes and Designing of Radiogauges	2	2	

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
10	07 17 773	Radiographic Testing and Technology	2	2	
11	07 17 774	Radioisotope Production	2	2	
12	07 17 775	Radioisotopes and Industrial Processes	2	2	
13	07 17 776	Diagnostics and Therapy Using Nuclear radiation	2	2	
14	07 17 777	Radioisotopes in Mining and Well Logging	2	2	
15	07 17 778	Applications of Radioisotopes in Agriculture	2	2	
16	07 17 781	International Regulations of Radiation Protection	2	2	
17	07 17 782	Assessment of Radiation Exposure	2	2	
18	07 17 783	Radiation Measurements and Dosimetry	2	2	
19	07 17 784	Radiation Sources and Irradiation Facilities	2	2	
20	07 17 785	Environmental Impact and Monitoring of Nuclear Radiation	2	2	
21	07 17 786	Design and Analysis of Shielding and Protection Facilities	2	2	
22	07 17 787	Radioactive Waste Management	2	2	
23	07 17 788	Biological Radiation Effects	2	2	
24	07 17 790	Advanced Nuclear Materials	2	2	
25	07 17 791	Research and Power Reactors	2	2	
26	07 17 792	Advanced Reactor Analysis	2	2	
27	07 17 793	Reactor Operation Experiments	2	2	
28	07 17 794	Reactor Parameters Measurements	2	2	
29	07 17 795	Instrumentation and Control of Nuclear Power Plants	2	2	

No.	Course Code	Course Name	Credit Hours	Exam Duration	Prerequisites
30	07 17 796	Reactor Thermal Hydraulics	2	2	
31	07 17 797	Fuel and Waste Management	2	2	
32	07 17 798	Computer Codes in Reactor Analysis	2	2	
33	07 17 799	Reactor Safety, Regulations and Safeguards	2	2	

34	07 17 601	Diploma Project in Nuclear Power Plants	3	Presentation	
35	07 17 602	Diploma Project in Nuclear Radiation and Environment	3	Presentation	
36	07 17 705	M.Sc. Thesis in Nuclear and Radiation Engineering	8	Defense	
37	07 17 706	Master Thesis of Nuclear Sciences and Technology	8	Defense	
38	07 17 801	Ph.D. in Nuclear and Radiation Engineering Dissertation	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 17 611 Transport Theory
Transport equation. Exact solutions for simple-modeled systems. Nonlinear transport equation. Approximate solutions of the transport equation.

07 17 612 Advanced Nuclear Power Stations
Fast reactors technology. Fusion reactors. Evolutionary generation III, generation IV. Different reactor systems.

07 17 613 Heat Transfer in Nuclear Reactors
Heat transfer in reactor elements. Mixed two phase flow. Boiling. Critical heat flow. Boundary layer.

07 17 614 Nuclear Reactor Safety
Types of plants layout and physical structure. Concept of reactor protection system. Safety concepts. Introduction to reliability and fault, event tree analysis. Introduction to engineering safety feature systems. Markov chain for large multiplex system. Multi

attribute utility theorem and PSF for human errors. Introduction to artificial intelligence and operator machine interface problems.

07 17 621 Radiation Damage in Materials

Nature of disordered metals. Production of point defects. Mobility of point defects. Defect clusters in irradiated metals. Effect of irradiation induced defects on the mechanical properties of metals. The collision cascade. Computer experiment. Formation of binary collision approximation. The collision cascade and large displacements. Annealing and annihilation of defects. Ionic self-irradiation.

07 17 622 Waste Management

Production of nuclear waste. Strategies for waste disposal. Engineered multibarrier system. Waste-rock interactions. Isotope migration. Disposal sites. Burial technology. Study of burial site. Waste solidification, packaging, and transportation. Radionuclide transport models for shallow land burial sites monitoring. Spent fuel storage and disposal.

07 17 623 Transportation and Management of Radioactive Materials

Processing and storage of radioactive materials. Mmethods of assessing the environmental impact of radioactive materials. Regulations and licensing of radioactive materials (using, storage and transportation). Analysis of risks of routine transportation and transportation accidents.

07 17 624 Environmental Aspects of Nuclear Energy

Radiations releases from nuclear power plants (source term, dispersion, and dose assessment calculations). Thermal energy releases. Compatibility of nuclear plants with environmental architecture. Environmental data base analysis linked with dispersion codes. Review of International codes.

07 17 625 Radiation Detection Techniques

Slow neutron detection. Fast neutron detection methods. Cerenkov detectors. Liquid ionization and proportional counters. Photographic emulsion. Track-etch detectors. Foil activation multichannel analyzer. Low background detection.

07 17 626 Radiation Protection

Radiation sources. Radiation dosimetry. Recommended radiation levels. Determination of absorbed dose in man. Biological radiation effects on man. Applications of the numerical methods for the attenuation of gamma rays and neutron attenuation.

07 17 627 Health Physics
Introduction and historical review of the interaction of radiation with matter. Operational dosimetry. Shielding. Radiation detection theory. Radiation monitoring of personnel. Biological effects of radiation. Internal, external exposure and environmental dispersion.

07 17 628 Advanced Applications of Nuclear Radiation
Radioguaging. Radiography. Systems analysis. Oil logging. Radiation detectors. Nuclear medicine. Radiation therapy. Computer tomography. Imaging techniques.

07 17 629 Nuclear Environmental Pollution
Natural radioactive elements. Radioiodine pollution. Radiocesium and strontium pollution. Pollution with actinides. Pollution with short lived isotopes.

07 17 631 Nuclear Materials
Properties of U metal, U and Pu oxides. Crystal structure. Stoichiometry. Defects and fabrication. Fuel element thermal properties. Fuel chemistry. Solid fission products. Swelling and fission gas bubbles. Void swelling and creep. Properties of nuclear fuel. Fuel design for different reactors. Quality control and assurance.

07 17 641 Environmental Protection
Industrial waste treatment. Off gas treatment. Cleanup of polluted water resources. Reclamation of polluted soils. Decontamination. Other means of environmental protection.

07 17 710 Fusion Reactors Technology
Fusion reactions. Plasma firing. Reactor components: the plasma, the sheath, heating, cooling, the magnet, system for fuel charging, vacuum, the limiter, converter. Magnetic confinement. Inertial confinement.

07 17 711 Neutron Transport Theory
Neutron transport equation. Exact solutions for simple-modeled systems. Nonlinear transport equation. Approximate solutions of the transport equation.

07 17 712 Nuclear Fuel Management
Introduction to computational methods and theory. In-core fuel management using computer packages. Fuel management in different reactor systems. Optimization methods.

07 17 713 Reactor Measurements and Control
Methods of reactor control. Problems of control. Simulation of control. Reactor measurements.

07 17 714 Economics of Nuclear Power Plants
Review of economics of nuclear energy. Management of nuclear energy. Comparison of nuclear energy and alternative energy sources.

07 17 715 Reactor Experiments
Introductory experiment. Reactor operation experiments. Reactor engineering and technology experiments. Reactor physics experiments. Neutron physics experiments.

07 17 716 Special Topics in Nuclear Engineering
Lectures and recitation on recent advances in Nuclear Engineering.

07 17 717 Modeling and Simulation in Nuclear Engineering
Review of unified system of governing equations. Electronic analysis of engineering systems. Time and Laplace domain and relationship with frequency domain. Balance equation for mass, scale analysis in nuclear power plant models, and stiff system. Energy and momentum. Digital, analogue, electronic, and hybrid simulation techniques. Parity simulation techniques for different nuclear power plant systems. Data acquisition methods for NPP simulations and modeling. Modular structure for large scale system programming.

07 17 718 Monte Carlo Applications in Nuclear Engineering
Monte Carlo method and its applications. Neutron transport. Plasma transport. Radiation transport. Nonlinear transport equation. Rarified gas dynamics. Time scale for collisions. Limitations of the method. Other applications of Monte Carlo solution of finite difference equations.

07 17 719 Numerical Methods in Nuclear Engineering
Solution of linear equations. Roots of an equation. Numerical integration. Approximation theory. Curve fitting. Introduction to solution of differential equations.

07 17 720 Nuclear Reactor Thermal Hydraulics
Overview of nuclear reactor systems. Heat generation in reactors. Thermal constraints. Thermal hydraulic phenomena in LWRs. Heat transfer characteristics in single phase flow. Pool boiling and flow boiling. Governing equations for single phase convective heat transfer and its applications. Fundamental aspects of two phase flow. LOFA and LOCA.

07 17 721 Interaction of Radiation with Matter
Theory of electromagnetic interactions. Theory of atomic collisions. Passage of high energy charged particles through matter.

07 17 722 Plasma Processing
Plasma source ion implantation. Plasma etching. Plasma coatings. Plasma extractive metallurgy. Plasma chemistry. Electrical discharges in gases and arc technology.

07 17 723 Special Topics in Radiation Engineering
Lectures and recitation on recent advances in radiation engineering.

07 17 724 Nondestructive Testing
Principles of nondestructive testing. Nondestructive testing in the nuclear energy field. Eddy current methods and techniques. Ultrasonic methods and techniques. Radiation techniques.

07 17 725 Radiation Detection Lab
Different experiments for alpha, beta, gamma and neutron measurements.

07 17 726 Nuclear Security and Safeguards
The IAEA safeguards legal framework, Nuclear Nonproliferation Treaties (NPT), Effective implementation of safeguards**,** Safeguards measuring tools, control and accountancy of nuclear materials, Fundamental elements of nuclear security: deterrence, detection, response (DDR), nuclear security planning for nuclear and radiation facilities, physical protection systems of nuclear facilities, technology and equipment of physical protection, nuclear security cultures (concepts and models).

07 17 727 Advanced Reactor Safety
Safety systems and functions, safety analysis report and LOCA, probabilistic safety analysis, safety goals and risk informed decision making, integration of safety analysis into operational requirements, significant nuclear accidents.

07 17 728 Design of Nuclear Power Plants
Characteristics of design and operation of NNP, LIGHT AND HEAQVY WATER REACTORS, control system, features of steam generators, pressurizer and reactor pressure control, components outside the reactor island.

07 17 731 Materials Characterization Techniques
Principles of materials characterization. Sample preparation. Electron beam instruments. Electron-specimen interactions. Interpretation of diffraction information.

07 17 732 Fatigue in Engineering Materials
Influence of repeated stress in engineering design, fatigue testing machines and procedures, factors influencing fatigue properties, theory of fatigue failure.

07 17 741 Renewable Energy
Energy technology. Renewable energy and the future. Advantages and disadvantages. Limitations. Types of renewable energy: wind energy, solar energy, hydro-electric, bio-energy, tidal power, wave energy, geothermal energy, ocean thermal, fuel cells. The availability and integration of different energy types.

07 17 811 Advanced Reactor Theory
Neutron transport equation. One speed transport theory. Solution of the transport equation by multigroup methods. Perturbation theory. Neutron thermalization and resonance absorption.

07 17 812 New Trends and Features in Nuclear Power Plants
New trends and features in designing and building generation III+ , generation IV and Fusion reactors.

07 17 813 Seminars in Nuclear Engineering
The students attend and give lectures and recitations on recent advances in nuclear engineering.

07 17 814 Digital Simulation in Nuclear Engineering
System modeling of engineering systems. Implicit and explicit integration routines. Setting of the ordinary differential equations for system governing equations. Large scale system with delayed operator. Introduction of hybrid and electronic simulation. Graphical and interactive code structure for large simulation package. Fuzzy controller and data acquisition.

07 17 815 Monte Carlo Techniques in Nuclear Engineering
Monte Carlo method and its applications in Nuclear Engineering. Computer codes used in nuclear applications.

07 17 816 Fusion Reactor Design
Overview of the fusion reactor. Design of different fusion reactor systems and components. ITER features and design. New and planned fusion systems.

07 17 817 Reactor Kinetics and Control
Control of nuclear reactor systems. Development of basic control theory. Analysis of reactor and reactor systems using control methods. Development of control methods and optimum-control methods. Effects of nonlinearities.

07 17 821 Advanced Plasma Physics
Development of plasma kinetic theory. Collision processes. Orbit and hydrodynamic theory. Equilibrium and stability. Nonlinear effects. Waves in cold and hot plasmas. Landau damping. Cyclotron damping. Magnetohydrodynamic equilibria and instabilities. Introduction to nonlinear processes.

07 17 822 Seminars in Radiation Engineering
The students attend and give lectures and recitation on recent advances in radiation engineering.

07 17 823 Charged Particles Accelerators
Historical review to accelerators theory. Classical dynamics to thermal theory and relativistic mechanics. Types of accelerators. Calculations in orbital theory. Applications of accelerators. Synchrotron radiation sources.

07 17 824 Radiation Measurements Lab
Different experiments for detection and measurements of alpha, beta, gamma and neutron radiation.

07 17 831 Composite Materials
Physical and mechanical properties of polymers, metals, ceramics, cementitious, and biological composite systems. Lamination and strength analyses. Static and transient loading. Fabrication, recycling, design and applications of composite materials.

07 17 832 Radiation Effects in Nuclear Materials
Radiation effects in solids. Defect production. Radiation effects on materials: creep, hardening, fracture, fatigue, void swelling and creep.

07 17 841 Desalination
Flash desalination. Multistage flash evaporation. Vapor compression desalination. Solar desalination. Freezing hydrate processes. Solvent extraction. Membrane processes. Reverse osmosis. Electrodialysis. Ion exchange processes. Desalination plant. Nuclear energy in desalination. Economics of desalination processes.

Description of Courses for the Master of Nuclear Sciences and Technology

07 17 751 Nuclear Physics
Radioactivity. Elements of nuclear structure. Alpha, beta and gamma radiation. Nuclear reactions. Nuclear models. Cross sections and nuclear data processing. Fission and fusion.

07 17 752 Fundamentals of Nuclear Science and Engineering
Neutron interaction with matter. The nuclear chain reaction. The nuclear fuel cycle. Nuclear reactors. Radioisotopes production and utilization.

07 17 753 Radiation Detection and Measurements
Interaction of nuclear radiation with matter (heavity and light charged particles, neutrons, x-ray and gamma rays). General properties of detectors. Types of detectors. Spectroscopy and spectra unfolding. Pulse signal processing. Detector systems. Detector calibration.

07 17 754 Radiation Protection and Shielding
Introduction to atomic structure. Application of radionuclide (medical, industrial, agriculture, research and training). Dosimetric quantities and units. Biological effect of radiation. Scope of basic legal frame work of radiation protection. Internal, external and effective dose. Principles of shielding.

07 17 755 Computational and Simulation Methods in Physics
Numerical integration. Iterative methods. Monte Carlo method. Finite difference methods. Finite element methods. Interpolation and approximation methods. Numerical solution of linear and non-linear systems. Concepts of computer modeling and simulation.

07 17 761 Radiation Transport
Point kernel technique. Boltzmann transport equation. The Monte Carlo method. Moments method. Discrete ordinate method. Application to neutron transport, plasma physics, photon transport, electron conduction in solids.

07 17 762 Mathematical Methods in Physics
Fourier and Laplace transformations. Special and orthogonal functions. Variation principle and optimization methods. Eigenvalues and Eigenvectors.

07 17 771 Optimization Principles and Techniques
Fundamental optimization methods. Linear and quadratic programming. Integer programming. Network models and dynamic programming methods of operations research. Unconstrained optimization methods. Nonlinear equations. Constrained optimization methods. Convex optimization. Global optimization. Parallelism in optimization.

07 17 772 Radioisotopes and Designing of Radiogauges
Methodology of using radioisotopes. Application of radioisotopes (industry, agriculture, medicine, environment). Nondestructive control. Dating using radioactivity. Forensic methods. Applications of radiotracers.

07 17 773 Radiographic Testing and Technology
Introduction to radiography. Radiography equipment and installations. Welding techniques. Metal materials. Classification of flaws. Codes and standards. Safety aspects.

07 17 774 Radioisotopes production
Radioisotope production for medical and industrial purposes. Radionuclides generation and separation. Purification and constraints for manufacturing a radiopharmaceutical product. Waste management. Conceptions of hot cells and ventilation systems. Maintenance of installations. Safety, environmental and pertinent issues in cases of normal operation and emergency.

07 17 775 Radioisotope and Industrial Processes
Radiation technology utilizing gamma or x-ray sources and electron accelerators (material modification, sterilization, food irradiation, polymer/rubber processing). Applications of radiotracers and sealed sources (production, control and quality enhancement). Nondestructive testing. Radiography. Neutron activation analysis.

07 17 776 Diagnostics and Therapy Using Nuclear Radiation
Diagnostic imaging (radiography, computed tomography, nuclear medicine). Dosimetry of radiation fields (percent depth dose, dose calculations for rotational therapy, isodose curves, treatment planning, point dose calculations, dose calculations for irregular fields.

07 17 777 Radioisotopes in Mining and Well Logging
Neutron and gamma-ray sources. Review of radiation detection methods. Lithology, porosity and fluid characteristics of materials. Computer simulation with neutrons and gamma-ray transport codes. Optimization techniques. Experimental applications.

07 17 778 Applications of Radioisotopes in Agriculture
Techniques for developing new plant species. Pest control. Reducing fertilizer consumption. Killing insects and rodents. Destroying bacteria. Viruses and molds in food.

07 17 781 International Regulations of Radiation Protection
Scope of basic legal frame work of radiation protection. Legislative framework. The regulatory authority. Regulatory system. Regulatory assessment. Preparedness for emergencies and accidents.

07 17 782 Assessment of Radiation Exposure
Safety and security of sources. Safety of transport and storage of radioactive waste management. Environmental monitoring. Individual and workplace monitoring. Basic concepts for emergency preparedness for a nuclear accident or radiological emergency. Training of personnel. Exposure in the industry and in the medical fields.

07 17 783 Radiation Measurements and Dosimetry
Radiometric quantities and interaction coefficients. Radiation protection quantities. Dosimetric calculations. Atomic absorption spectroscopy. X-ray fluorescence. Neutron activation analysis. Particles induced x-ray emission. Mossbauer spectrometry. Beta counting systems. Alpha spectrometry. Gamma spectrometry.

07 17 784 Radiation Sources and Irradiation Facilities
Different uses of irradiation processes. Types of irradiation facilities (irradiation using alpha, beta, gamma, neutrons, x-rays). Radiation sources used in irradiation processes.

07 17 785 Environmental Impact and Monitoring of Nuclear Radiation
Monitoring at source (external radiation and liquid and gaseous effluents, verification of compliance with discharge limits). Environmental monitoring (atmosphere, water bodies, foodstuff, other environmental indicators). Verification of compliance with derived environmental reference levels, survey techniques. Application to different sources (NPP, waste facilities, including repositories, mining and milling, tailings, contaminated land).

07 17 786 Design and Analysis of Shielding and Protection Facilities
Design features. Ventilation systems. Shielding calculations (safety interlocks, remote handling equipment, fume hoods, hot cells, glove boxes, changing rooms, physical barriers, storage facilities, liquid effluent pipeline and decay control, fixed radiation monitors, warning signs, quality assurance). Commissioning survey and regulatory review. Shielding calculations for (x-ray facility, cobalt therapy room, accelerator room).

07 17 787 Radioactive Waste Management
Sources of radioactive waste. Waste types: classification and characterization. Principles of radioactive waste. Waste minimization. Pre-disposal waste management (collection, segregation, treatment, conditioning, secure storage). Management of waste from decommissioning. Solid waste disposal. Environmental dose assessment.

07 17 788 Biological Radiation Effects
Basic radiation chemistry. Effects of radiation on cells. Deterministic effects (effects of whole body irradiation, effects of partial body irradiation). Stochastic effects. Effects on the embryo and the fetus. Hereditary effects and radiation detriment.

07 17 790 Advanced Nuclear Materials
Properties and selection of materials for nuclear systems. Implications of radiation damage and effects to reactor materials. Material problems in nuclear engineering.

07 17 791 Research and Power Reactors
Characteristics of a nuclear reactor system. Gas type reactors (Magnox, AGR, RBMK). Light water reactors (PWR, BWR, VVER). Heavy water reactors (Candu, SGHWR, EL4). Fast breeder reactors. High temperature reactors. New projects (EPR, ABWR, SBWR, AP600). Other projects (ADS, Molten salts, GEN IV). Research reactors and their applications.

07 17 792 Advanced Reactor Analysis
Review of nuclear physics. Interaction of neutrons with matter. Nuclear fission (chain reacting systems, neutron diffusion). Neutron moderation without absorption. Neutron moderation with absorption and fission. Low energy neutrons. Fermi theory for the bare thermal reactors. Multiregion reactors (the group diffusion method, the multigroup diffusion). Transport theory. Diffusion approximation. Perturbation theory. Reactor kinetics. Heterogeneous reactors. Changes in reactivity.

07 17 793 Reactor Operation Experiments
Introduction and approach to critical, control rod calibration and worth measurements. Power calibration. Temperature, coefficient of reactivity and reactivity measurements.

07 17 794 Reactor Parameters Measurements
Flux mapping. Time and space dependence of neutron flux using pulsed neutron techniques. Neutron age in water. Measurement of diffusion parameters of moderator. Importance function for neutron absorbers.

07 17 795 Instrumentation and Control of Nuclear Power Plants
Basic instrumentation (temperature, pressure, flux, vibration). Basics of control. Classification of instrumentation and control systems (defense in depth, independence, single failure criterion, reliability, testability, specific design criteria for computer-based systems, qualification and validation, IAEA safety guides). Contemporary methods for data evaluation (databases, testing of reliability estimation based on databases, stochastical methods). Examples of nuclear instrumentation in NPP.

07 17 796 Reactor Thermal Hydraulics
Heat generation in the reactor. Transport equations (single- and two-phase flow). Thermal analysis of the fuel elements. Two-phase flow dynamics. Single heated channel (steady state and transient analysis). Flow loops. Computer codes. The pressurizer

behavior in a PWR. Temperature distribution in irradiation rigs. The reactor in case of a LOCA and MSLB.

07 17 797 Fuel and Waste Management

Components and material flow sheets for nuclear fuel cycle. Fuel management inside the reactor. Waste characteristics, sources of radioactive wastes. Compositions and classification. Radioactivity and heat generation. Waste treatment technologies. Waste disposal technologies. Safety assessment of waste disposal.

07 17 798 Computer Codes in Reactor Analysis

Solving the diffusion equation using multigroup method. Solution of the transport equation. Principles of programming and software. Exercises on reactor core and shielding codes.

07 17 799 Reactor Safety, Regulations and Safeguards

Principles and safety related systems. Deterministic safety analysis. Accidents and transients. Analysis of consequences. Physical protection and protection systems. Requirements and conditions for licensing of nuclear facilities. Basic safeguards principles and approaches. National and international laws and treaties.

07 17 601 Diploma Project in Nuclear Power Plants

07 17 602 Diploma Project in Nuclear Radiation and Environment

07 17 705 M.Sc. Thesis in Nuclear and Radiation Engineering

07 17 706 Master of Nuclear Sciences and Technology Thesis

07 17 801 Ph.D. in Nuclear and Radiation Engineering Dissertation

Department of Chemical Engineering

The department of Chemical Engineering offers the following programs:

1. Graduate Diplomas

1.1 Professional Diploma in Pollution Protection and Environmental Engineering

The student must complete 24 credit hours.

Compulsory courses: The student must pass the following five courses with a total of 15 credit hours (07 18 641, 07 18 642, 07 18 652, 07 18 653, 07 18 654).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.2 Professional Diploma in Petroleum Refining and Petrochemicals

The student must complete 24 credit hours.
Compulsory courses: The student must pass the following five courses with a total of 15 credit hours (07 18 641, 07 18 642, 07 18 661, 07 18 681, 07 18 682).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

1.3 Specialized Diploma in Chemical Engineering

The student must complete 30 credit hours.
Compulsory courses: The student must pass the following six courses with a total of 15 credit hours (07 18 611, 07 18 648, 07 18 651, 07 18 661, 07 18 681, 07 18 682).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Diploma courses"

2. Master Degrees

2.1 Master of Engineering in Chemical Engineering

The student must pass 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
Compulsory courses: The student must pass six courses with a sum of 18 credit hours with course numbers (07 18 711, 07 18 712, 07 18 725, 07 18 731, 07 18 741, 07 18 751).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

2.2 Master of Science in Chemical Engineering

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
Compulsory courses: The student must pass four courses with a sum of 12 credit hours with course numbers (07 18 711, 07 18 712, 07 18 731, 07 18 741).

Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses". The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Chemical Engineering

The student must pass 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
Compulsory courses: The student must pass four courses with a sum of 9 credit hours with course numbers (07 18 811, 07 18 821, 07 18 831, 07 18 834).
Elective courses: The student can choose the remaining credit hours from any other courses that are specified as "Master courses" or any other level.
The student is allowed to choose 3 courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course name	Credit Hours	Exam Duration	Pre-requisites
1	07 18 611	Transport Phenomena (A)	3	3	
2	07 18 621	Alternative Energy Sources	3	3	
3	07 18 641	Air Pollution (Types and Sources)	3	3	
4	07 18 648	Water Pollution (Types and Sources)	3	3	
5	07 18 651	Applied Microbiology	3	3	
6	07 18 652	Analysis of Water and Industrial Liquid Wastes	3	3	
7	07 18 653	Solid Wastes and its Treatment	3	3	
8	07 18 654	Environmental Engineering	3	3	
9	07 18 661	Corrosion and Equipment Protection	3	3	
10	07 18 671	Extrusion of Plastics (A)	3	3	
11	07 18 672	Polymer Composite Processing	3	3	
12	07 18 673	Fiber Formation Engineering	3	3	
13	07 18 681	Petroleum Refining Engineering	3	3	
14	07 18 682	Petrochemicals Technology	3	3	

15	07 18 711	Advanced Separation Techniques	3	3	
16	07 18 712	Advanced Mass Transfer	3	3	
17	07 18 724	Fuel	3	3	
18	07 18 725	Advanced Heat Transfer (A)	3	3	
19	07 18 731	Advanced Chemical Reaction Engineering	3	3	
20	07 18 741	Advanced Thermodynamics of Chemical Reactions	3	3	
21	07 18 751	Treatment of Industrial Liquid Wastes	3	3	
22	07 18 752	Solid Wastes and its Treatment	3	3	
23	07 18 753	Design of Waste Treatment Units	3	3	
24	07 18 754	Application of Biotechnology in Pollution Control	3	3	
25	07 18 755	Bio-chemical Engineering	3	3	
26	07 18 761	Advanced Study in Electrochemical Processes	3	3	
27	07 18 771	Polymer Additives	3	3	
28	07 18 772	Monomers Production Engineering	3	3	
29	07 18 774	Advanced Material Science	3	3	
30	07 18 775	Science and Engineering of Polymers	3	3	
31	07 18 781	Fertilizers	3	3	
32	07 18 782	Gases Production Technology	3	3	
33	07 18 792	Modeling and Simulation	3	3	
34	07 18 793	Simulation (Case Studies)	3	3	07 18 792
35	07 18 794	Numerical Methods in Chemical Engineering	3	3	
36	07 18 811	Transport Phenomena (B)	3	3	
37	07 18 821	Advanced Heat Transfer (B)	3	3	
38	07 18 822	Combustion and Tubular Furnaces Design	3	3	
39	07 18 823	Advanced Material Science	3	3	
40	07 18 824	Chemical Engineering Fluid Dynamics	3	3	
41	07 18 825	Fluidization Engineering	3	3	

42	07 18 831	Reactor Design	3	3	
43	07 18 832	Optimization Methods	3	3	
44	07 18 833	Catalysis	3	3	07 18 731 07 18 712
45	07 18 834	Applied Mathematics for Chemical Engineers	3	3	
46	07 18 835	Rheology	3	3	
47	07 18 871	Extrusion of Plastics (B)	3	3	
48	07 18 891	Mathematical Models and Polymer-Reactors Design and its Control	3	3	
49	07 18 601	Diploma Project in Pollution Protection and Environmental Engineering	3	Presentation	
50	07 18 602	Diploma Project in Petroleum Refining and Petrochemicals	3	Presentation	
51	07 18 603	Project for Specialized Diploma in Chemical Engineering	3	Presentation	
52	07 18 701	Scientific Report for the Master of Engineering in Chemical Engineering	3	Defense	
53	07 18 705	Thesis for the Master of Science in Chemical Engineering.	8	Defense	
54	07 18 801	Dissertation for the Doctor of Philosophy in Chemical Engineering.	24	Defense	

Description of Courses for Graduate Programs (Diploma- Master- Doctor of Philosophy)

07 18 611 Transport Phenomena (A)
Viscosity and momentum transfer, effect of temperature and pressure on viscosity, velocity distribution in laminar flow, falling film flow, annular flow, creep flow round a sphere, continuity equation, flow of incompressible fluids.

07 18 621 Alternative Energy Sources

Solar energy, H2 energy, energy from agricultural wastes, geothermal energy, wi9nd energy, hydro-energy.

07 18 641 Air Pollution (Types and Sources)
Air pollutants (particulates and gases), characteristics of suspended and carried particulates, density, particle volume, ways of dust suspension and carry over, gaseous pollutants and its sources (SO2, SO3, H2S, CL2, CO, N2 oxides) allowable limits of concentration of gaseous pollutants, effect of air pollutants on environment (mankind, animals and plants).

07 18 648 Water Pollution (Types And Sources)
Effect of industrial wastes on water pollution, effect of pollutants on municipal and industrial feed waters and on the aquatic life, organics and its effect on dissolved oxygen, aerobic reactions, bio07 18 mical oxygen demand and its calculations, chlorination processes, self-cleaning of water ways and rivers, relation between BOD and COD, removal of bacteria by water treatment, fungus control in water, underground water pollution.

07 18 651 Applied Microbiology
Micro-organisms (types, classes, effect on life), bacteria, enzymes and yeasts (methods of multiplication, nutrition need, its bio07 18 mistry), preparation of bacteria and fungus and its identification, sterilization, fermentation industry.

07 18 652 Analysis of Water and Industrial Liquid Wastes
Acidity and alkalinity, required and residual chlorine, different metals, chlorides, cyanides, color, fluorides, fats, hardness, iodides, different N2 compounds, BOD and COD, DO, pH, phosphates, TDS and TVS, silica, phenol, sulfates, sulfides, odor and taste.

07 18 653 Solid Waste and its Treatment
Sources of different solid wastes, treatment and disposal of municipal solid wastes, industrial solid wastes and its treatment before landfill, biological oxidation, stabilization.

07 18 654 Environmental Engineering
What's environment. Pollution sources soil, water and air. Natural sources. Industrial sources. Agriculture. Environment protection. Pollution prevention and waste recovery. Chemical and physical units used in treatment. Design of equipment.

07 18 661 Corrosion and Equipment Protection

Basics of corrosion, electro07 18 mical nature of corrosion, Tafel extrapolation of passivity, polarization, design consideration to combat corrosion, cathodic and anodic protection, protection by coatings.

07 18 671 Extrusion of Plastics (A)
The extruder and its components, flow equations, single extruders, velocity distribution in flow channels, equations representing melt extrusion, isothermal operation, efficient operation.

07 18 672 Polymer Composite Processing
Size reduction. Crushing. Mixing (simple – plane – dispersed – vigorous) plastic mixer. Solid- dry- melt mixing. Molds. Pellets. Composite variables.

07 18 673 Fiber Formation Engineering
Crystallization under tension, heat treatment, internal structure of fibers, engineering problems, spinning from melts and solutions, analysis of spinning operation variables.

07 18 681 Petroleum Refining Engineering
Atmospheric distillation, vacuum distillation, treatment of distillates, raising the octane number, desulphurization, isomerization, thermal and catalytic cracking, coking, uses of different distillates.

07 18 682 Petrochemicals Technology
Reactions of H2 and CO, oxidation of olefins, chlorination of paraffins, nitration of parafins, manufacture of olefins, hydration of olefins, oxidation of olefins, chlorine and bromine compounds, diolefines, aromatics and naphthenes.

07 18 711 Advanced Separation Techniques
Adsorption, ion exchange, freeze drying, fractional distillation, gas diffusion, dialysis and electrodialysis.

07 18 712 Advanced Mass Transfer
Finite stages contactors, maximum allowable vapor velocity in distillation towers, factors affecting plate efficiency, design details of different trays, packed trays, liquid distribution, pressure drop and flooding.

07 18 724 Fuel
Coal, combustion calculations, composition of flue gases, incomplete combustion and efficiency of boilers, heating value, testing of liquid fuels (viscosity, flash point, volatility, octane and cetane numbers, diesel index, residual carbon), fuel pollutants (S), gas fuels (natural gas, LPG, blast furnace gases, coke oven gases, water gas).

07 18 725 Advanced Heat Transfer (A)
Design of different types of heat exchangers, condensers and boilers. Heat transfer in furnaces and its design.

07 18 731 Advanced Chemical Reaction Engineering
Non-ideal flow (residence time distribution, mixing model(mixing of fluids, reactor design for heterogeneous systems, non-catalytic reactions of fluids with solid surfaces, reaction rate for constant volume spheres and that of decreasing volume, controlling step, design applications.

07 18 741 Advanced Thermodynamics of chemical Reactions
Thermodynamic properties of real fluids, fugacity and activity, steam power stations, Rankin cycle reheated, chemical equilibrium, thermal effects, air cooling cycles.

07 18 751 Treatment of Industrial Liquid Wastes
Systems of collecting liquid wastes, biological characteristics of raw waters and industrial liquid wastes (bacteria, fungi, BOD) primary methods of treatment (sedimentation, bio-filtration, bio-aeration, stabilization ponds, aerobic and anaerobic digestion). Advanced treatment techniques (removal of suspended matter, nitrification and denitrification, removal of dissolved matter) reuse of waters and its problems, treatment of raw waters, mixing and flocculation, water softening.

07 18 752 Solid Waste and its Treatment
Sources of different solid wastes, treatment and disposal of municipal solid wastes, industrial solid wastes and its treatment before landfill, biological oxidation, stabilization.

07 18 753 Design of Waste Treatment Units
Settling units, mixing units, filtration units, centrifugal separation units, absorption towers, scrubbing towers, bio-filters, bag filters, de-nitrification units, precipitation units of heavy metals.

07 18 754 Application of Biotechnology in Pollution Control
Analysis of industrial liquid wastes, BOD and COD and its determination, characteristics of some industrial liquid wastes, tertiary treatment, types and activity of micro-organisms used in industrial liquid wastes, methane bacteria and treatment of agricultural wastes, use of micro-organisms acting on sulfur and phosphors in pollution control, aeration and oxidation methods, bio-energy and biogas.

07 18 755 Biochemical Engineering

Fermentation of amino acids. Biocatalysm. Production to plant cell. Treatment of liquids. Biosafety. Biological processes and health care. Bioreactors. Biotensing. Technologies of processes.

07 18 761 Advanced Study in Electrochemical Processes
Role of man transfer for and kinetics is electrochemical processes. Design and operation of electrochemical reactors. Time of electrochemical methods for industrial wastewaters. Energy conversion using electrochemical.

07 18 771 Polymer Additives
Stabilizers, anti-oxidants, coloring, anti-flame additives, anti-bio-deterioration materials, greases, separating materials, releasing agents, crystallization aids, plastisizers, coloring.

07 18 772 Monomers Production Engineering
Raw materials. production of double bond monomers and productions of condensation monomers.

07 18 775 Science and Engineering of Polymers
Molecular weights and molecule weight distribution. Mechanical and thermometer berries. Internal structure. Thessaly structure. Thermodynamics of polymers. Transport phenomena in polymers. Wheatgrass for: lipoid felid. Compo rite mete materials.

07 18 781 Fertilizers
Nitrogen and Phosphurus fertilizers (ammonium nitrate, urea, ammonium phosphates, tri-poly-phosphates, super-phosphates), compound fertilizers.

07 18 782 Gases Production Technology
Petroleum gases. Natural gas. Drying gases. Prevention of hydrates. Removal of hydrogen sulfade. Removal of sulfur oxides. Production of gas separation process.

07 18 792 Modeling and Simulation
Mathematical models for mass, energy and momentum balances in the different chemical processes, simulation of different industrial units and deviation of the used models.

07 18 793 Simulation (Case Studies)
Application of the computer programs in the simulation of the different industrial units, selection of the optimum operating conditions, some economic studies.

07 18 794 Numerical Methods in Chemical Engineering

Fundamentals of computational mathematics; discretization & roundoff errors. Buler, Taylor, Runge-Kutta, extrapolation and linear multistep methods .Analysis of stability &convergence. Error estimation and automatic step control. Boundary and Eigenvalue problems. Fundamentals of the finite difference method and related discretization errors. Stability, consistency & convergence.

07 18 811 Transport Phenomena (B)
Overall mass, momentum, and mechanical energy balances for isothermal systems, friction loss, stable and transient flow, effect of temperature and pressure on thermal conductivity of gases and liquids, thermal conductivity of solids, thermal conductivity in the presence of outside heat source, heat transfer for viscous medium, heat transfer in fins, natural and forced convection currents.

07 18 821 Advanced Heat Transfer (B)
Design of different types of heat exchangers, condensers and boilers. Heat transfer in furnaces and its design.

07 18 822 Combustion and Tubular Furnaces Design
Heating value, approximate and ultimate balances in combustion (mass and energy), use of combustion charts, chimney losses, pollution control.

07 18 823 Advanced Material Science
Crystalline structure of metals, phase diagrams, copper and nickel alloys, rubbers, ceramics, glasses, composites, fiber-reinforced materials, cement, concrete, wood and asphalt.

07 18 824 Chemical Engineering Fluid Dynamics
Applications of fluid dynamics to chemical engineering systems. Theory and practice of laminar and turbulent flow of Newtonian and non-Newtonian fluids in conduits and other equipment. Multi-phase flow. Introduction to the dynamics of suspended particles, drops, bubbles, foams, and froth. Selected topics relevant to chemical and other engineering disciplines.

07 18 825 Fluidization Engineering
Fundamentals of fluidization, two-phase flow theory and powder characteristics, structure and property of the emulsion phase and bubbles, mass and heat-transfer in fluidized beds with and without chemical reaction.

07 18 831 Reactor Design
Single ideal reactors and its design, multiple reactors systems, autocatalytic reactions, effect of temperature and pressure.

07 18 832 Optimization Methods
Search methods for single and multiple combinations, linear programming, restricted and unrestricted optimization, case studies.

07 18 833 Catalysis
Contact catalysis, adsorptive catalysis, contact catalysts, selectivity, catalysis equations, diffusion controlled reactions, design of catalytic reactors.

07 18 834 Applied Mathematics for Chemical Engineers
This unit of study consists of two main strands: statistical analysis of data and numerical (computer based) methods for solution of equation sets. By the end of the statistical analysis strand, students should be proficient in applying the basic principles of statistical analysis, and appreciate how they can be applied to a variety of engineering applications. The following statistical tools are studied: normal distribution, the test statistic z, confidence intervals for the population mean, t-distribution, hypothesis testing, data fitting, uncertainty analysis, propagation of random errors and analysis of variance. The numerical methods strand will see students become proficient in: solution of single and multivariable algebraic equations; solution of nonlinear differential equations; use of Excel and Matlab for data manipulation and equation solving; use of commercial flow sheeting software (Hysys) for solving engineering problems.

07 18 855 Rheology
Elastic rheology, rheological models, viscous rheology, dynamic loading, reduction and loss factors, transport factor, flow systems and the effect of molecular weights **and its** distribution, primary viscosity and its minimum value, 2-dimensional flow in spiral extruders, combined extrusion.

07 18 871 Extrusion of Plastics (B)
Processing. Momentum transport equation. Plasticization. Aspect ratio. Types and nature of outlet dies. Polymers in extrusion. Trade names and symbols. Properties of proceeding speciation.

07 18 891 Mathematical Models and Polymer-Reactors Design and its control
Steady state model. Differentiation model. O-Z transformation. Reactors. Traditional classification of reactors. Continuous and non-continuous reactors for addition reactions in different types of reactors. Heat transfer in reactors. Constituency of homogenous reactors. Control of single phase reactors. Heterogeneous reactions in different reactors. Reactions stability in multiphase systems. Condensation reactions in different reactors.

07 18 601 Diploma Project in Pollution Prevention and Environmental Engineering

07 18 602 Diploma Project in Petroleum Refining and Petrochemicals

07 18 603 Project for Specialized Diploma in Chemical Engineering

07 18 701 Scientific Report for the Master of Engineering in Chemical Engineering

07 18 705 Thesis for the Master of Science in Chemical Engineering

07 18 801 Dissertation for the Doctor of Philosophy in Chemical Engineering.

Department of Engineering Mathematics and Physics

The department of Engineering Mathematics and Physics offers the following programs:

1. Master Degrees

1.1 Master of Engineering in Engineering Mathematics

The student must pass 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Mathematics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

1.2 Master of Engineering in Engineering Physics

The student must pass 30 credit hours in the form of courses and an additional 3 credit hours in the form of a scientific report.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Physics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

1.3 Master of Science in Engineering Mathematics

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Mathematics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

1.4 Master of Science in Engineering Physics

The student must pass 24 credit hours in the form of courses and an additional 8 credit hours in the form of a thesis.
The student must choose his courses from the list of courses that are specified as "Master courses" in **Engineering Physics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 2 courses from another major.

3. Doctor of Philosophy- Ph.D. Degree

3.1 Doctor of Philosophy in Engineering Mathematics

The student must pass 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose his courses from the list of courses that are specified as "Ph.D. courses" in **Engineering Mathematics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 3 courses from another major.

3.1 Doctor of Philosophy in Engineering Physics

The student must complete 18 credit hours in the form of courses and an additional 24 credit hours in the form of a dissertation.
The student must choose his courses from the list of courses that are specified as "Ph.D. courses" in **Engineering Physics**. The department council determines the specialization according to the courses that the student selects. The student is allowed to choose 3 courses from another major.

List of Diploma, Master and Ph.D. courses

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
1	07 19 711	Mathematical Analysis	3	3	
2	07 19 712	Linear Algebra	3	3	
3	07 19 713	Numerical Analysis	3	3	
4	07 19 714	Probability and Statistics	3	3	
5	07 19 715	Functional Analysis	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
6	07 19 716	Ordinary Differential Equations	3	3	
7	07 19 717	Analytical Mechanics	3	3	
8	07 19 718	Special Topics in Engineering Mathematics	3	3	
9	07 19 719	Partial Differential Equations	3	3	
10	07 19 720	Perturbation and Asymptotic Methods	3	3	
11	07 19 721	Numerical Solution of Partial Differential Equations	3	3	
12	07 19 722	Topology and Graph Theory	3	3	
13	07 19 723	Special Topics in Engineering Mechanics	3	3	
14	07 19 724	Fluid Mechanics	3	3	
15	07 19 725	Structural Dynamics	3	3	
16	07 19 726	Robot Dynamics	3	3	
17	07 19 727	Special Topics in Engineering Physics	3	3	
18	07 19 731	Mathematical Physics	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
19	07 19 732	Statistical Thermodynamics	3	3	
20	07 19 733	Quantum Physics	3	3	
21	07 19 734	Solid State Physics	3	3	
22	07 19 735	Atomic and Nuclear Physics	3	3	
23	07 19 736	Electromagnetic Wave Theory	3	3	
24	07 19 737	Applied Optics	3	3	
25	07 19 738	Lasers and their Applications	3	3	
26	07 19 740	Special Topics in Engineering Geometry	3	3	
27	07 19 741	Differential Geometry	3	3	
28	07 19 742	Foundation of Statistics	3	3	
29	07 19 743	Mathematical Modeling	3	3	
30	07 19 744	The Boundary Element Method	3	3	
31	07 19 745	Quantum Mechanics	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
32	07 19 746	Hydrogen Energy Technologies	3	3	
33	07 19 747	Regression Analysis and Design of Experiments	3	3	
34	07 19 748	Simulation of Stochastic Systems	3	3	
35	07 19 749	Queuing Theory	3	3	
36	07 19 811	Advanced Ordinary Differential Equations	3	3	
37	07 19 812	Optimization Theory and Techniques	3	3	
38	07 19 813	Advanced Perturbation and Asymptotic Techniques	3	3	
39	07 19 814	The Finite Element Method	3	3	
40	07 19 821	Solid Mechanics	3	3	
41	07 19 822	Dynamics of Space Flight	3	3	
42	07 19 823	Advanced Analytical Mechanics	3	3	
43	07 19 824	Advanced Dynamics of Rigid Bodies	3	3	
44	07 19 825	Wave Propagation in Continuous Media	3	3	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
45	07 19 826	Nonlinear Systems	3	3	
46	07 19 831	Solid State Electronics	3	3	
47	07 19 832	Acoustics	3	3	
48	07 19 833	Electrodynamics	3	3	
49	07 19 834	Quantum Theory of Solids	3	3	
50	07 19 841	Computer Aided Geometric Design	3	3	
51	07 19 851	Stochastic Processes	3	3	
52	07 19 861	Mathematical Modeling and System Identification	3	3	
53	07 19 701	M.Eng. Scientific Report in Engineering Mathematics	3	Defense	
54	07 19 702	M.Eng. Scientific Report in Engineering Physics	3	Defense	
55	07 19 705	M.Sc. Thesis in Engineering Mathematics	8	Defense	
56	07 19 706	M.Sc. Thesis in Engineering Physics	8	Defense	
57	07 19 801	Ph.D. Dissertation in Engineering Mathematics	24	Defense	

No.	Course Code	Course Name	Credit hours	Exam Duration	Prerequisites
58	07 19 802	Ph.D. Dissertation in Engineering Physics	24	Defense	

Description of Courses for Graduate Programs (Master- Doctor of Philosophy)

07 19 711 Mathematical Analysis
Boolean algebra. mapping. Denumerable sets. Real numbers: Axioms. Ordering. Tietze Urysohn extension theorem. Metric spaces: fundamentals. Continuous mapping. Limits. Cauchy sequences. Compactness. Space of continuous functions: Derivatives. Formal rules of derivation. Sets and functions. Axioms for the real numbers. Suprema and infima and the axioms of bounds. Real sequence. Real series. Hilbert spaces. Differential calculus. Integration.

07 19 712 Linear Algebra
Linear vector spaces. Basis. Linear dependence and independence. Linear transformation. Eigenvalues and eigenvectors. Positive definite matrices. Linear programming.

07 19 713 Numerical Analysis
Solutions of algebraic equations. Interpolation. Numerical integration and differentiation. Numerical solution of ordinary differential equations. Approximation theory. Error analysis. Computer applications.

07 19 714 Probability and Statistics
Concepts of probability. Conditional expectations. Independence. Laws of large numbers. Probability models and distributions. Introduction to stochastic processes theory. Sampling. Theory of estimation.

07 19 715 Functional Analysis
Normed spaces. Banach spaces. Seperability. Arzela-Ascoli theorem. Ston-Weierstrass theorem. Hahn Banach theorem. Dual spaces. Riesz representation theorem. Hilbert spaces.

07 19 716 Ordinary Differential Equations
Existence and uniqueness. Linear systems. Analytic systems. Autonomous systems. Stability theory. Sturm-Liouville theory. Introduction to partial differential equations.

07 19 717 Analytical Mechanics
Types of Dynamical systems. Constraints and its classification. Degree of freedom. Generalized coordinates. Lagrange Multipliers. Lagrange Equation of the first type. Kinetic Energy of a Dynamical System. Potential Energy. Virtual Work. Generalized Forces. Lagrange's Equation of Motion of a Holonomic Dynamical system. Energy Change Theorem. Energy Equation for a Conservative Holonomic Dynamical System. Hamilton's Function. Hamilton Equations. Canonical Transformations. Hamilton-Jacobi Equations. Poisson's Brackets. Routh Function. Routh Equations of motion. Ignorable (Cyclic) Coordinates in the Equations of Motion At Lagrange ,Hamilton ,and Routh.

07 19 718 Special Topics in Engineering Mathematics
This course is studied through specialized and advanced topics covering: Advanced topics in mathematical analysis and applications, advanced topics in Algebra and applications, advanced topics in probability and statistics and application.

07 19 719 Partial Differential Equations
Diffusion equations for nonuniform media. Solution of the nonhomogeneous equation subjected to time dependent boundary conditions both in Cartesian as well as other coordinate systems. The Laplace and Poisson equations. Applications of complex variables technique. Green’s function for time independent and time dependent problems. The method of characteristics for the wave equation and propagation of discontinuities. Introduction to the application of integral transforms.

07 19 720 Perturbation and Asymptotic Methods
Exposition of various methods. Regular perturbation theory. Singular perturbation theory. Initial and boundary layers. Method of multiple scales. Ray theory. Two times methods. Application problems.

07 19 721 Numerical Solution of Partial Differential Equations
Fundamentals of the finite difference method. Implementation to the diffusion, wave and Poisson equations. Discussion of stability, consistency and convergence of the methods presented. The method of characteristics for hyperbolic equations. Examples.

07 19 722 Topology and Graph Theory
Introductory general topology. Graph theory: Definitions. Isomorphic graphs. Connectivity. Optimization. Planarity and coloring. Trees. Routed tress. Binary tress. Applications.

07 19 723 Special Topics in Engineering Mechanics
This course is studied through specialized and advanced topics covering: Advanced topics in Engineering Mechanics and applications.

07 19 724 Fluid Mechanics
Introduction. Equations of motion. Continuity _Momentum Equations. Bernoulli's Energy Equation. Theory of Impulse. Two Dimensional Motion. Connection with the Energy Equation. Theory of complex variables. Conformal transformations. Surface Waves. Viscosity.

07 19 725 Structural Dynamics
Free and forced vibration of single-degree-of-freedom, multiple-degree-of-freedom, and continuous systems. Vibration of continuous systems; Modal Analysis.

07 19 726 Robot Dynamics
Homogeneous transformation, Forward kinematics using Denavit-Hartenberg notation, Multiple solutions of inverse kinematics, Singularity and Redundancy, Workspace considerations, Differential motion and velocities, Derivation of the equations of motion using Lagrange Equation and Hamilton's Principle, Planning paths using the dynamic model, Force analysis and transformation of forces and moments between coordinate frames, Independent joint control of manipulators

07 19 727 Special Topics in Engineering Physics
This course is studied through specialized and advanced topics covering: Advanced topics in Engineering Physics and application.

07 19 731 Mathematical Physics
Basic principles. Modeling: vibrating string. One-dimensional wave equation. Separation of variables. D'Alembert solution for the wave equation. One-dimensional heat flow. Heat flow through an infinite rod. Modeling: vibrating film. Two-dimensional wave equation. Bessel equation. Properties of the Laplace transform. Properties of the Fourier transform. Fourier transform of the convolution.

07 19 732 Statistical Thermodynamics
Introducing the statistical methods. Statistical description of a particle system. Statistical thermodynamics. Maxwell-Boltzmann distribution. Simple applications of statistical thermodynamics. Bose-Einestein and Fermi-Dirac distributions. Applications: Law of mass action; transport phenomena.

07 19 733 Quantum Physics
Special theory of relativity. Duality: particle properties of waves; wave properties of particles. Atomic spectra and atomic structure. Elementary quantum mechanics. Quantum theory of the hydrogen atom. Atoms with multiple electrons. Molecules. Atomic reactions.

07 19 734 Solid State Physics
Crystal structure. Diffraction of waves by crystals. Reciprocal lattice. Elastic constants and elastic moduli. Crystal binding. Phonons: lattice vibrations; thermal properties. Dielectrics. Fermi energy of a multi-electron system. Electrical conductivity at high frequencies. Plasmons. Binding energy. Thermoionic emission. Energy bands. Semiconductor crystals. Fermi surfaces. Metals.

07 19 735 Atomic and Nuclear Physics
Atomic structure. Thomson's model of the atom. Rutherford's theory of α-particles scattering. The Special theory of relativity: Michelson-Morley experiment. The Compton effect. The hydrogen atom. Multi-electron atoms. Isotopes. α-decay. β-decay. γ rays and γ-decay. Elementary particles. Nuclear reactions. Nuclear forces and nuclear structure.

07 19 736 Electromagnetic Wave Theory
Vector analysis. Electrostatics. Boundary conditions in electrostatics. Multiple poles. Dielectrics. Magnetostatics. The magnetic field due to a steady current in free-space. The magnetic field in the presence of matter. Electromagnetic induction. Magnetic energy method of solving field problems subjected to certain boundary conditions.

07 19 737 Applied Optics
Electromagnetic waves. Interference. Fraunhofer and Fresnel diffraction. Polarization. Laser. Resonators. Optical waveguides. Optical fibers. Introducing nonlinear optics. Fourier optics. Holographs.

07 19 738 Lasers and their Applications
Atomic structure. Atomic quantized transitions. Stimulated emission and amplification. The rate equation. Saturation. Q switching. Coherent optical oscillations. Laser oscillation. Dynamic and transient effects. Confinement. Mode locking. Frequency modulation. Nonlinear lasers. Applications: medical; industrial; in the communication field.

07 19 740 Special Topics in Engineering Geometry
This course is studied through specialized and advanced topics covering: Projective geometry. Central projection. Stereographic projection. Gonomonic projection. Map projection. Four dimensional descriptive geometry. Kinematic geometry.

07 19 741 Differential Geometry
Representation of planes. Representation of space curves. Curvature and osculating plane. Torsion. Involute and evolute. Representation of surfaces and characteristics. Mapping of different types.

07 19 742 Foundation of Statistics
Sampling distributions. Point and interval estimations. Properties of estimators. Testing statistical hypothesis. Types of errors. Linear and multiple variance.

07 19 743 Mathematical Modeling
Mathematical modeling: an introduction, discrete models, continuous models, probabilistic models, optimization models, applications and investigating some cases.

07 19 744 The Boundary Element Method
The Green's theorem and Green's identities. Boundary integral formulation of differential equations. Boundary elements and applications to steady and time dependent problems. Computational aspects of the method.

07 19 745 Quantum Mechanics
Schrödinger equation and its solution. Continuous and discrete spectra of Schrödinger equation. Approximate methods to solve Schrödinger equation. Statistical interpretation of quantum mechanics. Harmonic linear oscillator. Perturbation theory. Quantum theory of radiation. General theory for the motion of a particle in a uniform central field. Solving simple problems in spherical coordinates. The hydrogen atom in an electric field. Particle scattering by a central force. The atom in a magnetic field.

07 19 746 Hydrogen Energy Technologies
Physical and chemical properties of hydrogen. Hydrogen production technologies from: fossil fuels; biomass; water. Energy storage: gaseous storage; liquid storage; metal hydrides. Hydrogen conversion technologies. Applications.

07 19 747 Regression Analysis and Design of Experiments
Linear regression. Test of lack of fit. Multiple regression using matrix approach. Nonlinear regression. Completely randomized designs. Randomized complete blocks. Latin square. Factorial and incomplete blocks.

07 19 748 Simulation of Stochastic Systems
Generating random numbers. Generating discrete random variables. Generating continuous random variables. Discrete event simulation. Statistical analysis of simulation outputs. Applications.

07 19 749 Queuing Theory
Description and performance evaluation of queueing systems. Relevant stochastic processes. Elementary queueing systems. Markovian and non-Markovian queueing systems. Networks of queues.

07 19 750 Computational Methods for Digital Image Processing
This course introduces the mathematical formalism for describing imaging systems, with emphasis on systems whose response has been constrained to be linear in dynamic range and which also does not depend on spatial location in the scene. Specifically, it provides mathematical foundations and computational methods for digital manipulation of images; image acquisition ; image segmentation; image projections and rectification; image statistics and point processing; linear and nonlinear image filters; Fourier domain processing; compression and applications of partial differential equations, calculus of variations and differential geometry in digital image processing.

07 19 751 Computational Geometry
Introduction to differential geometry of curves and surfaces. Offset of curves. Offset of surfaces. Algorithms: intersection of line segments. Convex hull. Closest pair of points.

07 19 752 Mathematics of 3D graphics
Coordinate systems. Vector algebra. Affine and projective geometry. Matrices and geometric transformation. Numerical linear algebra and equation solving. Differential geometry. Interpolation and approximation. Modeling of curves and surfaces: splines.

07 19 753 Introduction to Geodesy and Map Projection
Spherical trigonometry, geodetic co-ordinate systems, satellite orbits computations, map projections of the spherical earth.

07 19 754 Operations Research
Linear programming and sensitivity analysis (graphical method and algebraic method) – integer programming (branch-and-bound technique, cutting plane method) – game theory – simple queueing models – inventory models – applications.

07 19 755 Number Theory
Abstract structures (groups, rings and fields, finite fields, field extensions) - modular arithmetic – Fermat's law - Special congruences – Chinese remainder theorem - quadratic residues and quadratic reciprocity – index calculus - elliptic curves – applications in public key cryptography and symbolic computations.

07 19 756 Cryptology

Introduction to the field – Symmetric key cryptosystems and their cryptanalysis: Stream Ciphers and Block ciphers – Block ciphers examples: Caesar Substitution Cipher, Hill cipher, Data encryption standard (DES), Advanced Encryption Standard – Hashing algorithms - Public key cryptosystems and various primitives: Encryption, Digital Signatures, Signcryption, Key agreement – Attacks on well-known hard computational/ decisional problems.

07 19 757 Calculus of Variations

Introduction - The method of variations in problems with fixed boundaries-Variational problems with moving boundaries and certain other problems-Sufficient conditions for an extremum-Variational problems involving a conditional extremum- Direct methods in Variational problems

07 19 758 Computational Matrix Algebra

Introduction-Matrices-Determinants and elementary matrices-Solutions of simultaneous equations: n equations in n variables-Gaussian elimination and computer arithmetic-Solutions of simultaneous equations: m equations in n variables-Vector spaces-Eigenvalue problems
-Numerical calculation of eigenvalues

07 19 759 Stochastic Modeling

Basic elements of stochastic modeling: sample paths, probability and statistics, simulation.
Arrival-counting process: a generic process, the Poisson process, the renewal arrival-counting process. Discrete-time processes: Markov chains, time-dependent and time-independent performance measures. Continuous-time processes: Markov processes, time-dependent and time-independent performance measures, semi-Markov processes. Queueing processes: standard notations, birth-death queues, Markovian queues, queueing networks.

07 19 760 Difference Equations

Factorial polynomials - Finite differences and difference operator- Elementary theory of summation-The determination of the difference equations- First order difference equations- Linear difference equations with constant coefficients- Linear difference equations with variable coefficients

07 19 761 Fourier series

Trigonometric Fourier series - Orthogonal system- Convergence of trigonometric Fourier series- Trigonometric series with decreasing coefficients- Operations on Fourier series

07 19 762 Applied Analysis (Inequalities and Summability)

PART (I): Inequalities

Basics- Functions- Holder and Minkowski's inequalities- Mean value inequality- Inequalities involving monotincity hypotheses- Examples on inequalities- Bernoulli's numbers and polynomials

PART (II): Summability

Theory of sequences and series- What is a series?- Definition of the sum of a series- Euler's transformation- Conservative and regularity theorems- Conservative and regularity theorems for matrix transformation between sequence spaces- Semi continuous transformations-Limitation theorems -Inclusion and equivalence theorems

07 19 763 Integral Equations

Classification of Integral Equations. Definitions.- Some important identities.- Relationship between linear differential equations and Volterra integral equations.- Special types of kernels- Nonlinear integral equations. Integral Equations of the Convolution Type-Integral transforms- The Laplace transforms.- The Fourier transforms.- Volterra integral equation of the first kind- Volterra integral equation of the first kind with logarithmic kernel.- Abel's problem: Abel's integral equation and its generalization. Method of Successive approximations (Neumann series - Iterates and resolvent kernel - Degenerate kernels - Nonhomogenous). Fredholm equations with degenerate kernel.- Approximating a kernel by a degenerate one- Collocation method).

07 19 764 Nonlinear Ordinary differential Equations

Introduction -The method of slowly varying amplitude and phase. Jacobian elliptic functions - Hyper geometric functions - Elliptic functions - Differentiation of Jacobian elliptic functions - Elliptic Integrals.

07 19 765 Nanomaterials

Introduction to Nanoscience, zero/one/ two/ three-Dimensional Nanostructures, Special Nanomaterials, Nanostructures Fabricated by Physical Techniques, Characterizationof Nanomaterials, Some Applications of Nanomaterials.

07 19 766 Physical Optics

Geometrical Optics, Mathematics of light as a wave, Electromagnetic Theory, Propagation of Light , Superposition of Waves, Polarization, Interference, Diffraction.

07 19 767 Optical WDM systems

Optical systems, WDM concepts and components, WDM multiplexers, Tunable optical filters, Fiber Bragg Grating, Applications.

07 19 768 Basics of Nanotechnology
Introduction to Nanotechnology, Fabrication of Nanostructures, Optical/ electricaland Imaging Characterization of Nanostructures, Some Related Applications.

07 19 769 Solar Cells
Basics of semiconductor junctions, Introduction to photovoltaic cells, Materials properties and Physics of devices, Heterojunction solar cells, Dye-sensitized solar cells, Organic solar cells.

07 19 770 Quantum and Optoelectronic Devices
Introduction to optoelectronic devices,, The rise of III-nitrides, The evolution of nitride semiconductors, III-nitrides light emitting sources and photo-detectors, Radiative and non-radiative recombination, Electrical and optical properties of LEDs, Basic principles of semiconductor optical amplifiers, Structures and materials of semiconductor optical amplifiers.

07 19 771 Fuel Cell Systems and Technologies
The principles of electrochemistry, and thermodynamics, kinetics, and heat and charge transport as it relates to fuel cells- Fuel cell types and physical/chemical/technical characteristics - Main fuel cell components. Influence of the various operational parameters on fuel cell performance . Stack design - Thermal and water management – Fuel cell applications.

07 19 772 Material Science
Introduction - Classification of Material - Atomic Structure, and Electronic Configuration - Crystal Geometry, Structure and Defects- Bonds in Solids - Nanostructured Materials

07 19 773 Plasma Energy
Introduction – Properties and parameters – Complex plasma phenomena – Mathematical descriptions – Artificial plasma – Examples of industrial / commercial plasma – Plasma energy storage – Applications of plasma – Plasma sources.

07 19 774 Time Series and Applications
Fundamental of time series analysis. Linear stochastic Models. Stationary and Nonstationary Stochastic Models .Autocorrelation and spectral analysis. Linear Stationary Models: Autoregressive Processes (AR), Moving-Average Processes (MA), Mixed Autoregressive-Moving Average Processes (ARMA), Linear Nonstationary Models : Autoregressive Integrated Moving Average process (ARIMA). Applications. Using the Simulink Toolbox to Simulate the Linear stochastic models.

07 19 811 Advanced Ordinary Differential Equations

Qualitative theory of ordinary differential equations. Existence and uniqueness of solutions. Stability theory. Periodic solutions. Limit cycles. Applications to theory of oscillations.

07 19 812 Optimization Theory and Techniques
Unconstrained optimization. Nonlinear programming. Non-differential optimization. Applications.

07 19 813 Advanced Perturbation and Asymptotic Techniques
Introduction. Parameter Perturbations. Coordinate Perturbations. Order Symbols and Gauge Functions. Asymptotic Expansions and Sequences. Nonuniform Expansions. Straight forward Expansions and Sources of Nonuniformity. The Method of Strained Coordinates. The Method of Matched and Composite Asymptotic Expansions. Variation of Parameters and Methods of Averaging. Method of Multiple Scales. Asymptotic Solutions of Linear Equations. Applications in the Solutions of Autonomous and non autonomous Dynamical Systems. Boundary and Initial Value Problems

07 19 814 The Finite Element Method
Variation methods. Rayleigh Ritz and Galerkin formulation. The Finite Element idealization. Applications. Higher order elements and isoparametric elements. Higher degrees of freedom and curved sided elements. Discussion of convergence and error estimation. Computational aspects.

07 19 821 Solid Mechanics
Mathematical description of stress, deformation, and constitutive equations of solid mechanics; 3D stress state; plane stress problem; plane strain case; plane deformation case. Virtual work theorem for plane stress problem. Finite element formulation

07 19 822 Dynamics of Space Flight
Elements of the theory of Newtonian potential. The two-body problem. Duration of flight of the satellite between two points of an orbit. The trajectory of satellite in 3-dimensional space. The n-body problem. The application of the concept of the sphere of action in the approximate calculation of the trajectory of a small body. The limited problem of three bodies.

07 19 823 Advanced Analytical Mechanics
Basic Definitions. Two and three Dimensional Kinematics of a rigid body. Basic concepts. Theory of finite rotations of a rigid body. Principal Dynamical Quantities. The work and Potential Energy. General equation of Dynamics. Analytical Statics. Lagrange Differential Equations. Different Forms for the differential Equations of motion.

Dynamics of Relative Motion. Canonical Equations and Jacobi theorem. The Variation principles of Mechanics.

07 19 824 Advanced Dynamics of Rigid Bodies

Euler-Poison Equations. Integration by Series. Elliptic Functions. Integrable Canonical Systems. The integrable cases of Euler-Poisson Equations. The unique solutions, Analytical and algebraic integrals of Euler-Poison Equations. The motion of a rigid body in Newtonian Force Field. Dynamic stability; continuous systems

07 19 825 Wave Propagation in Continuous Media

Transverse waves on strings and membranes; longitudinal, torsional, and flexural waves in rods; compression, shear, and surface waves in elastic half-spaces; water waves: Shallow Water Waves, Deep Water, and Gravity Waves.

07 19 826 Nonlinear Systems

Introduction. Fundamental Concepts in The Theory of Stability. Autonomous Systems of Single Degree of Freedom. Phase Plane Plots. Conservative Systems. Routh-Hurwitz Criterion. Motion in the Large. Limit Cycles. Liapunov's Direct Method. Secular Terms. Lindstetd –Poincaré Method. Van der Pol's Equation. Forced Oscillations. Jump Phenomenon. Sub harmonic and Combinations Harmonics. Systems with Time dependent coefficients. Chaos.

07 19 831 Solid State Electronics

Electronic energy bands. Semiconductor crystals. Superconductivity. Dielectric properties. Ferroelectric crystals. Diamagnetism, paramagnetism and ferromagnetism.

07 19 832 Acoustics

Basics of oscillatory motion. Longitudinal waves. The vibrating string. Vibrating rods. Two-dimensional wave equation. Sound wave equation and its simple solution. Reflection and transmission. Absorption and attenuation of sound waves in fluids. Transmitting and receiving sound waves.

07 19 833 Electrodynamics

Time-dependent fields. Maxwell’s equations. Conservation of energy and momentum. Planar electromagnetic waves. Wave propagation. Simple radiating systems. Scattering and diffraction. Magnetohydrodynamics and the plasma physics. Dynamics of relativistic particles. Radiation by moving charges. Multipole fields. Electromagnetic properties of superconductors.

07 19 834 Quantum Theory of Solids

Excitation and exciters in solids: the electron; the phonon; the plasmon; the polariton; the polaron; the exciton. Polarization of waves. Fermion fields and Hartree-Fock approximation. Many-body techniques. Electron-phonon interactions. Superconductivity. Energy bands. Crystal symmetry. Fermi Surfaces. Semiconductor crystals. Alloys. Defects.

07 19 841 Computer Aided Geometric Design

Interpolation techniques for the curve Representation: B- Spline Representation, Smooth curve, Uniform Subdivision, Four Point Scheme Tensor Products, Tensor Product-Bezier surfaces- Surfaces of Arbitrary Topology. Bezier Techniques for the Representation of Triangular Patches. Interpolation for Surfaces. Constructing the smooth surfaces- GK Construction.

07 19 842 Computational Geometry for Design

Curves and surfaces design. Composite curves and splines. Composite surfaces. Cross-sectional design. Computing methods for surfaces design.

07 19 843 Advanced Topics in Engineering Geometry

Topics to be selected by the instructors.

07 19 844 Multi-dimensional Geometry

Linear space. Linear transformations of variables. Planes in affine space. Linear, bilinear and quadratic forms. Spaces with quadratic metric. Multi-vectors and other forms. Quadratic hyper-surfaces. Projective space.

07 19 845 Mathematic of Geodesy and Map projection

Spherical and ellipsoidal datum of the earth, geodetic co-ordinate computations in ellipsoidal and rectangular spatial co-ordinate systems, astronomical co-ordinates, co-ordinate system transformations, Gaussian and Riemannian surface theories, map projection computations.

07 19 851 Stochastic Processes

A systematic account of several principal areas in stochastic processes; branching processes. Markov chains (discrete and continuous parameter). Poisson processes. Gaussian processes. Brownian motion.

07 19 852 Random Signals and Systems

Linear and nonlinear system. Continuous and Discrete systems. The response of systems to Linear stochastic signals. Using Matlab to get the response of systems to linear stochastic signals .Gaussian processes. Stationary processes (discrete and continuous

type). Nonstationary continuous time process. Linear systems in conjunction with memory less nonlinear devices. Markov principles. . Monte Carlo simulation.

Note: Prerequisites to study 0719877 the course of Mathematical Modelling 0719743

07 19 853 Applications of system Identification Methods

The main purpose of this course is the applications of system identification methods Presented at the toolbox 'Ident' of Matlab to systems from input and output Data.
Linear Least Squares and Normal Theory. Maximum Likelihood Estimators. Models for Dynamic Systems. Estimation for Dynamic Systems. Recursive Algorithms.

Note: Prerequisites to study 0719878 the course of Mathematical Modelling 0719743

07 19 861 Mathematical Modeling and System Identification

Mathematical theories and foundations of modeling and identification techniques of systems. Applications, analysis of some selected models.

07 19 862 Fuzzy logic

Fuzzy sets – Operations on Fuzzy Sets – Linguistic variables – Fuzzy relations and operations on fuzzy relations – Fuzzy inference rules – Fuzzy logic system – Possibility theory – Applications in control systems and reliability

07 19 863 Advanced Topics in Cryptology

Review of basics of cryptography – Blind signatures – Group signatures – Proxy signatures -Trace and revoke schemes - Provable security – Quantum cryptography – Applications in communication systems and networks security

07 19 864 Advanced Queueing Systems

Networks of queues: reversibility, output theorem, tandem queues, partial balance, product-form distribution.-Matrix-analytic method: structured Markov models, matrix-geometric distribution, solution algorithms.-Queueing systems with special structures: retrial queues, queues with vacations, polling systems, discrete-time queues, applications to

07 19 865 Advanced Topics in Engineering Mathematics

Topics to be selected by the instructors.

07 19 866 Advanced Topics in Engineering Mechanics

Topics to be selected by the instructors.

07 19 867 Nonlinear Optics
Introduction to Nonlinear optics, Models of the NLO Response, Nonlinear Wave Equation,Quantum Theory of Nonlinear Optics, Applications.

07 19 868 Advanced Applications of Nanotechnology
General overview on nanomaterials, nanoscience and nanotechnology, nanosensors, nanomaterials in solar cells, nanotechnology in biomedical applications, applications of nanofibers.

07 19 869 Nano materials Fabrication and Characterization
Nanoparticles synthesis, Layer-by-Layer (LbL) self-assembly, E-beam evaporation, Spin coating, Focused ion beam (FIB), Atomic force microscopy (AFM) for nanografting and nanolithography, E-beam lithography, Electrospinning, Physical Vapor Deposition (PVD)., Chemical Vapor Deposition (CVD), Atomic Layer Deposition (ALD), Optical and imaging characterization techniques.

07 19 871 Advanced Hydrogen Energy Technology
Clean methods for hydrogen production - New materials and advanced technologies for the storage of hydrogen- Fuel cell system applications - -Development of Fuel Cell models - Development of a hydrogen infrastructure for the transportation sector - Hydrogen Economy, Hydrogen safety and Standards for hydrogen energy technologies

07 19 872 Advanced Topics in Engineering Physics
Topics to be selected by the instructors.

07 19 701 M. Eng. Scientific Report in Engineering Mathematics

07 19 702 M. Eng. Scientific Report in Engineering Physics

07 19 705 M. Sc. Thesis in Engineering Mathematics

07 19 706 M. Sc. Thesis in Engineering Physics

07 19 801 Ph. D. Dissertation in Engineering Mathematics

07 19 802 Ph. D. Dissertation in Engineering Physics

Appendix

Academic Standards for Graduate Studies
Faculty of Engineering - Alexandria University

Firstly: Graduate Studies Diploma

1) Attributes of the Graduate from Diploma Programs

The Graduate should be able to:

• Apply knowledge gained from practice.
• Identify the problems associated with professional work.
• Master professional skills and use appropriate technological means in the exercise of his work.
• Communicate and lead teams.
• Assist in decision making in the light of available information.
• Employ available resources.
• Be aware of his/her role in society development and the preservation of the environment.
• Be committed to integrity and credibility and the ethics of the profession and accept rules and regulations.
• Recognize the need to develop himself/herself professionally and scientifically.

2) Intended Learning Outcomes (ILO's)

A. Knowledge and Understanding

By the end of study for the postgraduate studies Diploma, the candidate should be capable of understanding and assimilating the following:
a1. Theories, basics and specialized knowledge in the field of learning, as well as the subjects that affect his/her professional practice.
a2. Ethical and legal principles of professional practice in the field of specialization.
a3. Basics and principles of quality in professional practice in the field of specialization.
a4. Working towards conservation and preservation of the environment

B. Intellectual Skills

By the end of study for the postgraduate studies Diploma, the candidate should be capable of doing the following :

b1. Define and analyze problems in the field of specialization and sort them according to priorities.
b2. Solve specialized problems in the field of practice.
b3. Analytically read research work and subjects relevant to the field of specialization.
b4. Assess risks in professional practice.
b5. Take professional decisions in the light of available information.

C. Professional and Practical Skills

By the end of study for the postgraduate studies Diploma, the candidate should be capable of doing the following :

c1. Apply professional skills in the field of specialization.
c2. Write technical reports.

D. General and Transferable skills

By the end of study for the postgraduate studies Diploma, the candidate should be capable of doing the following :

d1. Communicate effectively.
d2. Use IT to enhance professional practice.
d3. Apply self evaluation and define personal educational needs.
d4. Use different sources to obtain knowledge and information.
d5. Work in a team and individually.
d6. Lead a team and manage time.
d7. Apply self and continuous learning.

Secondly: Master Programs

1) Attributes of the Graduate from Master Programs

• Proficiency in the application of the basics and methodologies of scientific research and the use of various scientific tools.
• Application of the analytical methods in the field of specialization.

• Application of specialized knowledge and integrating them with relevant knowledge in research studies.
• Awareness of current problems and modern visions in the area of specialization.
• Identification of research problems and finding solutions.
• Mastering a range of appropriate professional skills, and using of appropriate technological means to serve the research studies.
• Communicating effectively and the ability to lead a work team.
• Developing proposals in accordance with the conditions of the problems.
• Taking into account available resources, leading to the highest benefit from these resources in practice.
• Demonstrating awareness of his/her role in community development and conservation of the environment.
• Acting in such a way to reflect commitment to integrity, credibility and sticking to the rules of scientific research.
• Personal development in academics and research and ability for continuing education.

2) Intended Learning Outcomes (ILO's)

A. Knowledge and Understanding

By the end of study for the Master program, the candidate should be capable of understanding and assimilating the following:
a1. Theories, basics and specialized knowledge in the field of learning, as well as other related subjects.
a2. Effect of research studies on the environment on the Environment.
a3. Scientific development in the field of specialization.
a4. Ethical and legal principles of scientific research in the field of specialization.
a5. Basics and principles of quality in research in the field of specialization.
a6. Basics and ethics of scientific research.

B. Intellectual Skills

By the end of study for the Master program, the candidate should be able to do the following :
b1. Define and analyze information in the field of specialization, and rely on them to solve problems.
b2. Solve specialization problems with missing parameters and variables.
b3. Link diverse knowledge to solve professional problems.

b4. Perform a research study and/or write a scientific thesis about a research problem.
b5. Assess risks in professional practice in the field of specialization.
b6. Plan for performance development in the field of practice.
b7. Make professional decisions in different practical contexts.

C. Professional and Practical Skills

By the end of study for the Master program, the candidate should be able to do the following :

c1. Master the basic as well as the latest professional skills in the field of specialization.
c2. Write and evaluate technical and professional reports.
c3. Evaluate methods and tools for problem solving and research.

D. General and Transferable skills

By the end of study for the Master program, the candidate should be able to do the following:

d1. Communicate effectively.
d2. Use IT to enhance research practice.
d3. Apply self evaluation and define personal educational needs.
d4. Use different sources to obtain knowledge and information.
d5. Set rules for research and suitable performance indices.
d6. Work in a team and lead a team.
d7. Efficiently manage time.
d8. Apply self and continuous learning.

Thirdly: PhD Programs

1) Attributes of the Graduate from the Ph.D. Program

The Graduate should be able to:

• Master the basics and methodologies of scientific research.
• Work continuously towards the addition of knowledge in the field of specialization.
• Apply critical analytical and experimental methodology in the field of specialization and related areas.
• Combine specialized knowledge with related knowledge, deducing and developing

relationships between them.
• Demonstrate profound awareness of current problems and modern theories in the field of specialization.
• Identify practical problems and find innovative solutions to solve them.
• Master scientific skills in the field of specialization.
• Orient himself/herself towards developing procedures, tools and new methods to be applied in the field of specialization.
• Use of appropriate technological means to pursue his/her profession.
• Communicate effectively and lead a team to work in different professional contexts.
• Suggest ways to make decisions in light of available information.
• Employ available resources efficiently, while developing them and working on finding new resources when proposing solutions.
• Be aware of his role in community development and environmental conservation.
• Act to reflect the commitment to integrity, credibility, and the rules of scientific research.
• Commit to development and transfer of knowledge and experience to others.

2) Intended Learning Outcomes (ILO's)

A. Knowledge and Understanding

By the end of study for the PhD program, the candidate should have knowledge and understanding of the following:
a1. Theories, basics and recent knowledge in the field of learning, as well as other related subjects.
a2. Basics, methodologies and ethics of scientific research and its different tools.
a3. Ethical and legal principles of scientific research in the field of specialization.
a4. Basics and principles of quality in studies and research in the field of specialization.
a5. Knowledge related to environmental studies and research, and methods of conserving and preserving the environment.

B. Intellectual Skills

By the end of study for the PhD program the candidate should be able to do the following:
b1. Define and analyze information in the field of specialization, and rely on them to solve problems and deduce from them.

b2. Propose solutions for specialization problems based on the available information.
b3. Carry out research studies adding to the available knowledge.
b4. Write research papers.
b5. Assess risks in research.
b6. Plan for performance development in the field of practice.
b7. Support practical decisions in the field of specialization.
b8. Be creative and innovative.
b9. Carry out discussions and dialogue based on evidence and proof.

C. Professional and Practical Skills

By the end of study for the PhD program, the candidate should be able to do the following:

c1. Master the basic as well as the latest professional skills in the field of specialization.
c2. Write and evaluate technical and professional reports.
c3. Evaluate methods and tools available in the field of practice.
c4. Use technology to benefit specialized research studies.
c5. Plan for performance and research development.

D. General and Transferable skills

By the end of the study for the PhD program, the candidate should be able to do the following:

d1. Communicate effectively.
d2. Use IT to enhance specialized research.
d3. Transfer knowledge and evaluate information and performance.
d4. Continuously learn and self-evaluate.
d5. Use different sources to obtain knowledge and information.
d6. Work in a team and act as a team leader.
d7. Manage scientific meetings and apply time management.