FACULTY OF ENGINEERING

FACULTY LIST

OFFICERS OF THE FACULTY

Salem, Elie	President of the University
Nahas, George	Vice President of the University
Karam, Nadim	Vice President of the University
Najjar, Michel	Dean, Vice President for Development
Moubayed, Walid	Dean of Admissions and Registration
Bashir, Samira	Librarian

STAFF OF THE FACULTY

Wakim, Gerogina	Faculty Secretary
Saliba, Josette	Faculty Secretary
Daoud, Nassif	Laboratory Instructor
Hilal, Nina	Laboratory Instructor
Rouphael, Fadi	Laboratory Instructor
Yaacoub, Tony	Laboratory Instructor
Minkara, Rania	Laboratory Instructor
Abi-Chaar, Pierre	Laboratory Assistant
Hamati, Roula	Laboratory Assistant
Mujaes, Nabil	Laboratory Assistant
Nini, Eddy	Laboratory Assistant
Kobersy, William	Laboratory Assistant
Mansour, Wassim	Laboratory Assistant

FACULTY MEMBERS

Abche, Antoine	Ph.D., Biomedical Engineering, Rutgers, The State University of New Jersey, USA
Alamddine, Abdul-Menhem	M.S.E.S., Computer Engineering, University of Southeastern Louisiana, USA
Ayoubi, Rafic	Ph.D., Computer Engineering, University of Southwestern Louisiana, USA
Chaouk, Hamdi	Ph.D., Aeronautical Engineering, University of Sydney, Australia
Dagher, Issam	Ph.D., Electrical Engineering, University of Central Florida, USA
Fares, Nabil	Ph.D., Civil Engineering, Massachusetts Institute of Technology, Massachusetts, USA
Gerges, Antoine	MS, Civil Engineering, University of South Florida, USA

Gerges, Nagib	Ph.D., Environmental Engineering, University of South Florida, USA
Haddad, Nicola	Ph.D., Electrical Engineering, Ohio University, Athens, Ohio
Haidar, Haissam	Ph.D., Mechanical Engineering, MIT, Cambridge, Massachusetts, USA
Hamouche, Nakhle	Ph.D., Engineering Mechanics, Mississippi State University, USA
Honein, Elie	Ph.D., Mechanical Engineering, Stanford University, Stanford, California, USA
Hoz (El), Mervatt	Ph.D., Civil Engineering, The University of Sydney, Australia
Inaty, Elie	Ph.D., Optical Communications, Lavalle University, Quebec City, Canada
Issa, Georges	Diplome D'Ingenieur, Saint Joseph University, Lebanon
Issa, Ghassan	Diploma, Architecture, University of Athens, Greece
Jadayel, Oussama	Ph.D., Mechanical Engineering, University of Birmingham, UK
Karam, Elie	Ph.D., Biomedical Engineering, Rutgers, The State University of New Jersey, USA
Karam, Walid	MS, Electrical Engineering, South Dakota State University, USA
Khaldi, Mohamad	Ph.D., Electrical Engineering, Pennsylvania State University, USA
Khalil, Nariman	Ph.D., Civil Engineering, Leeds University, England
Moubayed, Walid	Ph.D., Civil Engineering, University of Houston, USA
Naja, Mohamad	Ph.D., Civil Engineering, Michigan State University, USA
Najjar, Maged	Ph.D., Electrical Engineering, Purdue University, USA
Najjar, Michel	Ph.D., Civil Engineering, Oklahoma State University, USA
Nasr, Karim	Ph.D., Mechanical Engineering, Purdue University, West Lafayette, USA
Nini, Robert	Ph.D., Civil Engineering, Ecole Centrale de Paris, France
Rai, Habib	Ph.D., Mechanical Engineering, The University of Dayton, Ohio, USA
Rizk, Joe	MS, Civil Engineering, Florida International University, USA
Saba, Riad	MS, Electrical Engineering, Oklahoma State University, USA

Salem, Salem	Public Housing Degree, Bowscentrum, Holland BS, Architecture, University of Texas, USA
Youssef, Khaled	Ph.D., Technical Sciences, Moscow Power Institute, Russia
Zakhem, Henri	Ph.D., Chemical Engineering (Food Quality Control), University of Technology of Compiègne, France

PROGRAMS OF STUDY

The Faculty of Engineering includes:

The Department of Computer Engineering

The Department of Electrical Engineering

The Department of Civil Engineering

The Department of Mechanical Engineering

The Department of Chemical Engineering

The Faculty offers two programs of study:

A three year program leading to the Bachelor of Science Degree in Engineering.

A two year program leading to the Master of Science Degree in Engineering.

In both programs, the sequence of study proceeds from an education in science fundamentals toward training designed to give the student mastery of the principles and arts central to Engineering Science.

The award of the Bachelor's Degree in Engineering indicates that the graduate is ready to begin professional practice. The graduate may apply to advanced study leading to a Master's Degree, provided he/she has obtained high grades in the undergraduate studies; final decision on acceptance to the Master's Degree program resides with the Admissions Committee of the Faculty.

The Faculty of Engineering offers the following degrees:

Engineering Faculty	**Years**	**Degree**	**Status**
All Engineering Majors	3	BS	Offered
	3+2	MS	Offered

UNDERGRADUATE PROGRAM

1. ADMISSION REQUIREMENTS

Admission to the undergraduate program in the Faculty of Engineering is normally restricted to the first year. However, in exceptional cases, and with the approval of the Admissions Committee, students transferring from other accredited institutions may be considered for admission on an individual basis provided the following requirements are satisfied:

a- Enrollment quotas are not filled.

b- The applicant attended a reputable university and obtained a minimum average of 70 in at least 20 transferable credits or, has successfully completed one year of study.

c- The applicant's Baccalaureate qualifies him/her for admission to the University.

d- The applicant satisfies the University admission requirements concerning English proficiency.

e- The Faculty Admissions Committee has evaluated the applicant's qualifications for academic success in scientific and engineering subjects and approved the transfer admission.

2. ACADEMIC RULES AND REGULATIONS

A. GRADUATION REQUIREMENTS

Refer to the Graduation Requirements in the General Section.

B. PERMISSION TO TAKE GRADUATE COURSES

A Student is permitted to take Graduate courses if he/she meets the following conditions:

1- Students who are finishing their last 20 credits of Bachelor degree and have an average in major courses of 75 or above are allowed to take a maximum of two master courses, provided that the total number of credits per semester does not exceed 15.

2- Students who are finishing their last 20 credits for the Bachelor degree and have an average in major courses of 75 or below may not take any Master courses.

C. PROMOTION TO 4TH YEAR

Students who achieve an average in major courses in their undergraduate plan of study above 75 but below 80 are accepted in a graduate program on probation.
Students who achieve an average in major courses in their undergraduate plan of study of 80 or above are accepted in a graduate program with clear standing.

D. EVALUATION CRITERIA

Refer to Scholastic Standing, General Section, I

E. DEAN'S HONOR LIST

To be placed on the Dean's honor list of the semester, a student must:

a- Be a regular full time student registered for at least 12 credits.

b- Have a semestrial major course average of 85 or above or have a semestrial general course average of 80 or above and rank in the top 10% of his/her class.

c- Have no failing, withdrawals, or incomplete grades.

d- Have no disciplinary action against him/her.

e- Be deemed worthy by the Dean to be placed on the Honor List.

F. CHANGE OF MAJOR

To transfer from any other Faculty of the University of Balamand to the Faculty of Engineering, the student must have a cumulative average of at least 70 to be eligible for consideration by the Admissions Committee of the Faculty. He/she must have obtained an average in major science courses (determined by the department) of at least 70 with no failures. The Faculty Admissions Committee grants the final approval.

3. LABORATORY CHARGES

A. SUPPLIES

Each student taking laboratory subjects must furnish, at his/her expense, the necessary notebooks, blank forms, lab coat, and similar supplies. For regular students taking prescribed laboratory work, no charge is made for normal amounts of expendable material used in connection with laboratory subject. Expendable materials are those that are necessarily consumed or rendered unfit for further use in the normal conduct of a laboratory test. If an excessive amount of expendable material is required because of carelessness on the part of the student, the cost of the additional material will be charged to the student or group responsible.

B. DAMAGES

Students will be charged for damage to instruments caused by lack of care. The amount of the charge will be the actual cost of repair, and if the damage results in total loss of the apparatus, adjustment will be made in light of the condition of the instruments. Where there is danger of costly damage, an instructor will be asked to check the set up. When a group does laboratory work, charges for breakage will be divided among the members of the group concerned. The amount of the charge will be stated at the time or as soon as it can be determined.

GRADUATE PROGRAM

The Faculty of Engineering offers a two-year graduate program leading to the Master's of Engineering degree. To earn the degree, a student must successfully complete the required course work as approved by the Departments of the Faculty of Engineering.

1. ADMISSION REQUIREMENTS

Applicants must hold a BS degree in engineering from a recognized institution of higher learning with an undergraduate average of at least 80 or its equivalent in the major courses of the field of study. The candidate's folder should contain the following documents:

a- an official application to join the graduate program,

b- official transcripts from the universities attended during the last three years,

c- 3 letters of recommendation,

d- a personal statement.

Acceptance to the graduate program of Engineering is granted upon recommendation of the Faculty Graduate Committee after reviewing the application.

The Faculty Graduate Committee may also admit students on probationary status to the graduate program after evaluation of the student file. A student admitted on probation must achieve an average of 80 or above during the first year of graduate study with a full-time load, and not have failed any courses. Failure to satisfy these requirements may result in automatic dismissal from the graduate program.

Students not admitted on probation because their undergraduate average is too low may repeat some courses to improve their average and reapply for admission to the graduate program.

2. ACADEMIC RULES AND REGULATIONS

The following is a statement of the policy on academic progress in the Faculty of Engineering.

Graduate students are evaluated at the end of each semester.

Evaluation of academic progress is based on the average of the major graduate courses taken during the evaluation period. All required courses are counted as major courses.

A. TIME LIMITATIONS

With careful planning, full-time students should be able to complete the MS program in two years. Part-time students can complete the MS degree in up to five years.

Course credits earned in the program of graduate study or accepted by transfer are valid for a maximum of six years unless the Graduate Committee of the Faculty grants an extension. Students should petition in writing to the Graduate Committee for such exceptions.

B. TRANSFER CREDITS

A maximum of 12 credits (four courses) out of 43 credits, obtained at an approved institution of higher learning, may be accepted towards the degree, provided the credits consist of work taken at the graduate level. A grade of 80 or better is required for transfer courses to be accepted. These courses must not have been credited toward any other degree at UOB. Transfer credits are granted for courses which are equivalent to a course offered at UOB.

C. PASSING-GRADE

The passing grade for all courses is 70.

D. FULL-TIME STATUS

The semester load for full-time students is no less than 9 hours. Full-time students may accept employment only with the approval of the Department. Students who are employed outside the University for more than 20 hours per week are not normally eligible for full-time status at the Faculty of Engineering.

E. EVALUATION OF ACADEMIC PERFORMANCE

E.1 ACADEMIC PROBATION

If a student enters the graduate program on probation, the conditions for its removal must be fulfilled by the end of the first semester. Starting from the second semester, a student must maintain a cumulative major average of 80 or above. Failure to do so by the end of a semester places the student under academic probation. Under such circumstances, the student may be required to take a lighter credit load, which may result in a delay in graduation.

Such students will not be allowed to take more than 12 new credits in the semester during which they are on probation and will also be required to retake the courses they had failed the next time they are offered. Such students will be encouraged by their advisor to take courses in the Summer semester.

E.2 REMOVAL OF PROBATION

A student placed on probation will be given the opportunity to achieve a cumulative major average of 80 or above in one semester in order to remove the probation.

E.3 CONTINUING PROBATION

Students placed on probation for the first time because of their failure to achieve the required cumulative average in major courses will have one semester to meet these requirements. If they fail to do so, they will be granted another semester on continuing probation. Removal of continuing probation depends upon the student achieving a cumulative average in major courses of 80 or above by the end of the second semester on probation.

A Continuing Probation is considered as a second probation.

E.4 STRICT PROBATION

A student placed on continuing probation and who fails to remove it is placed on strict probation for one semester with the following conditions:

1. The student is allowed to register for a maximum of 12 repeated credits.
2. The student registers only for courses in which the grade earned was less than 80.

To remove the strict Probation the student must:

1. Not fail any course.
2. Obtain a cumulative average of 80 or above in major courses.

E.5 DROPPING FROM THE DEPARTMENT

Students will be dropped from the Department for any of the following reasons:

a. They achieve a cumulative major average less than 70.

b. They are on Strict Probation and are not able to remove the probation by the end of the next semester.

F. APPEAL

A graduate student may petition the Dean concerning the application of any academic regulation. Petitions should be made only when a dispute cannot be resolved at the Departmental level.

DEPARTMENT OF COMPUTER ENGINEERING
BACHELOR'S DEGREE

FIRST YEAR

Semester 1

Course Code	Course Title	Credit
CSIS 200	Introduction to Computers & Programming	3
ELEN 201	Instrumentation Lab	1
ENGL 203	English Comm. Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra	3
MECH 211	Mechanical Drawing I	1
MECH 221	Engineering Dynamics	3
		17

FIRST YEAR

Semester 2

Course Code	Course Title	Credit
	English Elective	3
CPEN 211	Introduction to Digital Logic Design	3
CSIS 201	Programming Methodology	3
ELEN 202	Electrical Simulation and Design	1
ELEN 221	Circuits Analysis I	3
MATH 202	Calculus II	3
MATH 270	Differential Equations	3
		19

SECOND YEAR

Semester 3

Course Code	Course Title	Credit
CPEN 202	Logic Lab	1
CPEN 212	Logic Circuits	3
CSIS 204	Object Oriented Programming	3
ELEN 222	Signals and Systems Theory	3
ELEN 231	Electronics I	3
MATH 230	Numerical Analysis I	3
MECH 232	Thermodynamics	3
		19

SECOND YEAR

Semester 4

Course Code	Course Title	Credit
CSIS 202	Data Structures	3
CSIS 222	Computer Networking	3
CPEN 213	Microprocessors	3
CVSQ 201	Early Formation of Civilization	3
ELEN 303	Circuits Analysis Lab	1
ELEN 304	Electronics Lab	1
MATH 246	Probability for Engineers	3
		17

THIRD YEAR

Semester 5

Course Code	Course Title	Credit
	Option Elective 1 (**)	3
CPEN 305	Microcontrollers Lab	1
CPEN 307	PLC Lab	1
CPEN 314	Computer Architecture	3
CPEN 324	Programmable Logic Controllers	3
CVSQ 202	The Religious Experience	3
ELEN 341	Telecommunications	3
		17

THIRD YEAR

Semester 6

Course Code	Course Title	Credit
	Option Elective 2 (**)	3
CPEN 308	Electronics Design Automation Lab (EDA)	1
CPEN 346	Basics of Computer Security	3
CSIS 221	Operating Systems	3
CVSQ 203	Introduction to Modernity	3
ELEN 306	Telecommunications Lab	1
ELEN 326	Signal Processing	3
GENG 390	Undergraduate Project	1
		18

(*) Computer Hardware Option:

CPEN 317	Computer Hardware Design	3
CSIS 270	Database	3

(*) Information and Networking Option:

CPEN 347	Teletraffic	3
CSIS 270	Database	3

(*) Telecommunications Option:

ELEN 223	Electricity and Electromagnetism	3
ELEN340	Signal Transmission	3

(*) General/Management Option:

GENG 301	Engineering Management	3
CPEN 317	Computer Hardware Design	3

MASTER'S DEGREE IN COMPUTER ENGINEERING
HARDWARE AND SOFTWARE OPTION

FORTH YEAR

Semester 7

Course Code	Course Title	Credit
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation & Detection	3
CPEN 417	Advanced Computer Hardware	3
CSIS 375	Software Engineering	3
CSIS 320	Advanced Operating Systems	3
		15

FORTH YEAR

Semester 8

Course Code	Course Title	Credit
ELEN 401	Optimization Theory	3
CPEN 427	Advanced Hardware Applications	3
CPEN 528	Machine Vision	3
GENG 590	Master Project	3
		12

FORTH YEAR

Summer

Course Code	Course Title	Credit
CPEN 480	Field Training	4

FORTH YEAR

Semester 9

Course Code	Course Title	Credit
CPEN 551	Switching Theory	3
CSIS 332	Parallel Programming	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CPEN 452	Advanced Microcontroller Applications	3
CPEN 545	Cryptography	3
CSIS 374	Advanced Database Applications	3
ELEN 459	Engineering Image Processing	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN COMPUTER ENGINEERING
INFORMATION AND NETWORKING OPTION

FORTH YEAR

Semester 7

Course Code	Course Title	Credit
CSIS 321	Computer Networking: Architecture & Protocols	3
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation and Detection	3
ELEN 443	Digital Communication	3
		12

FORTH YEAR

Semester 8

Course Code	Course Title	Credit
CPEN 447	Advanced Teletraffic	3
CPEN 549	Intelligent Networks	3
CSIS 327	Network Programming	3
ELEN 401	Optimization Theory	3
GENG 590	Master Project	3
		15

FORTH YEAR

Summer

Course Code	Course Title	Credit
CPEN 480	Field Training	4

FORTH YEAR

Semester 9

Course Code	Course Title	Credi
CPEN 546	Wireless Networks	3
CPEN 446	Network Management & Security	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CSIS 374	Advanced Database Applications	3
ELEN 441	Information Theory and Error Correction	3
ELEN 542	Wireless Communication Systems	3
ELEN 574	Optical WDM Networks	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN COMPUTER ENGINEERING
TELECOMMUNICATIONS OPTION

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CSIS 321	Computer Networking: Architect. & Protocols	3
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation & Detection	3
ELEN 443	Digital Communication	3
		12

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
ELEN 401	Optimization Theory	
ELEN 441	Information Theory and Error Correction	3
ELEN 472	Fiber Optic Communication Systems	3
ELEN 542	Wireless Communication Systems	3
GENG 590	Master Project	3
		15

FOURTH YEAR

Summer

Course Code	Course Title	Credit
ELEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
ELEN 572	Satellite and Radar Communication	3
ELEN 574	Optical WDM Networks	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CPEN 425	Neural Networks Design	3
CPEN 446	Network Management and Security	3
CPEN 546	Wireless Networks	3
CSIS 327	Network Programming	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN COMPUTER ENGINEERING
GENERAL/MANAGEMENT OPTION

FORTH YEAR

Semester 7

Course Code	Course Title	Credit
CPEN 417	Advanced Computer Hardware	3
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation and Detection	3
ENMG 410	Engineering Economics: Analysis & Synthesis	3
GENG 402	Project Management	3
		15

FORTH YEAR

Semester 8

Course Code	Course Title	Credit
CPEN 427	Advanced Hardware Applications	3
ELEN 401	Optimization Theory	3
ENMG 430	Engineering Management	3
GENG 590	Master Project	3
		12

FORTH YEAR

Summer

Course Code	Course Title	Credit
CPEN 480	Field Training	4

FORTH YEAR

Semester 9

Course Code	Course Title	Credit
CSIS 321	Computer Networking: Architecture & Protocols	3
ELEN 443	Digital Communication	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
	Any Approved Engineering Courses	6
	Any Approved Management Courses	6

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

DEPARTMENT OF ELECTRICAL ENGINEERING

BACHELOR'S DEGREE

FIRST YEAR

Semester 1

Course Code	Course Title	Credit
CSIS 200	Introduction to Computers & Programming	3
ELEN 201	Instrumentation Lab	1
ENGL 203	English Communication. Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra	3
MECH 211	Mechanical Drawing I	1
MECH 221	Engineering Dynamics	3
		17

FIRST YEAR

Semester 2

Course Code	Course Title	Credit
ENGL 204	English Communication Skills IV	3
CPEN 211	Introduction to Digital Logic Design	3
CSIS 201	Programming Methodology	3
ELEN 202	Electrical Simulation and Design	1
ELEN 221	Circuits Analysis I	3
MATH 202	Calculus II	3
MATH 270	Differential Equations	3
		19

SECOND YEAR

Semester 3

Course Code	Course Title	Credit
CPEN 202	Logic Lab	1
CPEN 212	Logic Circuits	3
ELEN 222	Signals and Systems Theory	3
ELEN 223	Electricity & Electromagnetism	3
ELEN 231	Electronics I	3
MATH 230	Numerical Analysis I	3
MECH 232	Thermodynamics	3
		19

SECOND YEAR

Semester 4

Course Code	Course Title	Credit
CPEN 213	Microprocessors	3
CVSQ 201	Early Formation of Civilization	3
ELEN 303	Circuits Analysis Lab	1
ELEN 304	Electronics Lab	1
ELEN 324	Circuits Analysis II	3
ELEN 332	Electronics II	3
MATH 246	Probability for Engineers	3
		17

THIRD YEAR

Semester 5

Course Code	Course Title	Credit
	Option Course (*)	3
CPEN 305	Microcontrollers Lab	1
CVSQ 202	The Religious Experience	3
ELEN 307	Control Lab	1
ELEN 341	Telecommunications	3
ELEN 351	Control Systems	3
ELEN 361	Electric Machines	3
		17

THIRD YEAR

Semester 6

Course Code	Course Title	Credit
	Option Course (*)	3
CVSQ 203	Introduction to Modernity	3
ELEN 306	Telecommunications Lab	1
ELEN 308	Electric Machines Lab.	1
ELEN 325	Electrical Installation	3
ELEN 326	Signal Processing	3
ELEN 362	Power Electronics	3
GENG 390	Undergraduate Project	1
		18

(*) Biomedical Option:

BIOL 205	Principles of Biology	3
CPEN 314	Computer Architecture	3

(*) Telecommunications Option (EE Students):

CSIS 222	Introduction to Computer Networks	3
ELEN340	Signal Transmission	3

(*) Power & Control Option:

CPEN 324	Programming Logic Controllers	3
ELEN 352	Digital Control Systems	3

(*) Engineering Management/General Option:

GENG 301	Engineering Management	3
	Engineering/Management Elective	3

(*) Computer Hardware and Software Option:

CPEN 314	Computer Architecture	3
CSIS 270	Database	3

(*) Information & Networking Option:

CSIS 222	Introduction to Computer Networks	3
CPEN 347	Teletraffic	3

MASTER'S DEGREE IN ELECTRICAL ENGINEERING
BIOMEDICAL OPTION

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
BMEN 401	General Human Physiology	3
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation & Detection	3
ELEN 417	Measurement Systems	3
ELEN 459	Engineering Image Processing	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
ELEN 401	Optimization Theory	3
ELEN 462	Biomedical Instrumentation I	3
ELEN 463	Medical Imaging I	3
GENG 590	Master Project	3
		12

FORTH YEAR

Summer

Course Code	Course Title	Credit
ELEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
ELEN 562	Biomedical Instrumentation II	3
ELEN 564	Medical Imaging II	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
BMEN 460	Biomaterials	3
BMEN 461	Physiological Control Systems	3
CPEN 452	Advanced Microcontroller Applications	3
GENG 402	Project Management	3
MECH 513	Robotics	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN ELECTRICAL ENGINEERING
POWER and CONTROL OPTION

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation & Detection	3
ELEN 437	Power Systems I	3
ELEN 527	Fuzzy Logic	3
ELEN 539	Power Quality	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
ELEN 401	Optimization Theory	3
ELEN 435	Advanced Electric Machines	3
ELEN 537	Power Systems II	3
GENG 590	Master Project	3
		12

FORTH YEAR

Summer

Course Code	Course Title	Credit
ELEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
ELEN 523	Optimal Control Systems	3
ELEN 536	Power Systems Control	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CPEN 425	Neural Networks Design	3
ELEN 417	Measurement Systems	3
ELEN 431	Power Systems protection and reliability	3
GENG 402	Project Management	3
MECH 513	Robotics	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN ELECTRICAL ENGINEERING
TELECOMMUNICATIONS OPTION

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CSIS 321	Computer Networking: Architect. & Protocols	3
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation & Detection	3
ELEN 443	Digital Communication	3
		12

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
ELEN 401	Optimization Theory	
ELEN 441	Information Theory and Error Correction	3
ELEN 472	Fiber Optic Communication Systems	3
ELEN 542	Wireless Communication Systems	3
GENG 590	Master Project	3
		15

FORTH YEAR

Summer

Course Code	Course Title	Credit
ELEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
ELEN 572	Satellite and Radar Communication	3
ELEN 574	Optical WDM Networks	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CPEN 425	Neural Networks Design	3
CPEN 446	Network Management and Security	3
CPEN 546	Wireless Networks	3
CSIS 327	Network Programming	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN ELECTRICAL ENGINEERING
INFORMATION and NETWORKING OPTION

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CSIS 321	Computer Networking: Architecture & Protocols	3
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation and Detection	3
ELEN 443	Digital Communication	3
		12

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
CPEN 447	Advanced Teletraffic	3
CPEN 549	Intelligent Networks	3
CSIS 327	Network Programming	3
ELEN 401	Optimization Theory	3
GENG 590	Master Project	3
		15

FORTH YEAR

Summer

Course Code	Course Title	Credit
ELEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
CPEN 546	Wireless Networks	3
CPEN 446	Network Management & Security	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CSIS 374	Advanced Database Applications	3
ELEN 441	Information Theory and Error Correction	3
ELEN 542	Wireless Communication Systems	3
ELEN 574	Optical WDM Networks	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN ELECTRICAL ENGINEERING
GENERAL/MANAGEMENT OPTION

FOURTH YEAR
Semester 7

Course Code	Course Title	Credit
ELEN 400	Linear Systems	3
ELEN 402	Stochastic Theory and Estimation & Detection	3
ELEN 417	Measurement Systems	3
ELEN 437	Power Systems I	3
ENMG 410	Engineering Economics: Analysis & Synthesis	3
		15

FOURTH YEAR
Semester 8

Course Code	Course Title	Credit
ELEN 401	Optimization Theory	3
ENMG 430	Engineering Management	3
GENG 402	Project Management	3
GENG 590	Master Project	3
		15

FOURTH YEAR
Summer

Course Code	Course Title	Credit
ELEN 480	Field Training	4

FIFTH YEAR:
Semester 9

Course Code	Course Title	Credit
ELEN 443	Digital Communications	3
ELEN 523	Optimal Control Systems	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
	Any Approved Engineering Courses	6
	Any Approved Management Courses	6

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

COURSE DESCRIPTIONS

BMEN 401 HUMAN PHYSIOLOGY **3.0: 3 cr. E**

This course covers the human physiological systems: nervous system; cardiovascular system; respiratory system; gastrointestinal system; renal system; skeletal system; muscular system; and some special medical topics, such as exercise physiology.

BMEN 460 BIOMATERIALS **3.0: 3 cr. E**

This course provides understanding of the following topics: Mechanical and electromechanical properties of tissue; properties of biomaterials (chemical, mechanical, immunological…); biomaterial applications (artificial organs, bone/joints replacement, drug delivery…); and other specialized issues.

BMEN 461 PHYSIOLOGICAL CONTROL SYSTEMS **3.0: 3 cr. E**

This course covers the physical, mathematical and chemical bases of control organ system function and the applications of systems and control theory to biological systems; topics include cardiovascular, renal, pulmonary, pharmaco-kinetics, membrane potentials, visual and other systems. These physiological systems are covered with emphasis on the feedback control aspects.

BMEN 466 CIRCULATORY DYNAMICS **3.0: 3 cr. E**

This course covers the mechanics and fluid mechanics of circulatory system; mathematical modeling and experimental methods in circulatory dynamics; invasive and noninvasive measuring techniques. Topics include measurement of blood pressure and flow in arteries and veins, muscle mechanics, models of the heart, microcirculation, the closed cardiovascular system, and cardiac assist devices.

BMEN 467 BIOMECHANICS **3.0: 3 cr. E**

This course presents an integrated approach to the study of human movement. Fundamental mechanical principles will be reviewed, with subsequent application to the major joints and structures of various regions of the human body, resulting in an understanding of and appreciation for total body movement and the integration of biomechanics with other exercise and sport science disciplines.

BMEN 468 PHYSIOLOGICAL TRANSPORT PHENOMENA **3.0: 3 cr. E**

The course provides an introduction to transport phenomena, including the fundamentals of mass, momentum, heat transfer, and mechanical energy balances with their analogies and applications to the analysis of physiological and metabolic systems and the design of artificial tissues and drug delivery systems.

BMEN 563 BIOSIGNAL ANALYSIS **3.0: 3 cr. E**

This course covers topics of wavelet and time-frequency analysis. Applications include pulmonary and respiratory signals, ELENG, ECG, evoked potentials, MRI, X-Rays, mammograms, and other issues.

BMEN 565 PHYSIOLOGICAL MODELING **3.0: 3 cr. E**

This course covers various approaches to the design and use of mathematical models and computer simulations in the quantitative description of physiological systems. A selection will cover some of the following topics: membrane biophysics, neural modeling, cardiovascular system dynamics, respiratory mechanics, and muscle contraction, pharmacokinetics, risk extrapolation techniques, and quantitative cancer modeling.

CPEN 202 LOGIC LAB **0.3: 1 cr. E**

This laboratory provides an introduction to analysis and design of digital circuits and systems; combinational logic; sequential logic; MSI circuits; and selected topics in more advanced areas.

Co-requisite: CPEN 202.

CPEN 211 INTRODUCTION TO DIGITAL LOGIC DESIGN **3.0: 3 cr. E**

This course covers number Systems; Boolean algebra; Karnaugh maps; logic gates; combinational and sequential circuit design; adders; multiplexers; flip-flops; counters; shift registers.

Pre-requisite: CSIS 200, MATH 211.

CPEN 212 LOGIC CIRCUITS **3.0: 3 cr. E**

This course covers combinational logic design using MSI and LSI integrated circuits; sequential circuit analysis and design; state-machine design; registers; counters, and memory system analysis and design; register-transfer logic design techniques based on CPLD and FPGA technologies.

Prerequisites: ELEN 221 and CPEN 211.

CPEN 213 MICROPROCESSORS **3.0: 3 cr. E**

This course covers the microprocessor architecture and assembly language: building blocks of microprocessors, memories, input/output circuits; bus structures; software development for microprocessors; instruction sets, assembler; development tools; addressing structures; interfacing peripherals and input/output processing techniques; interface devices, interfacing input/output devices, microprocessor interrupt structures, direct memory access; 16 and 32 bit microprocessors; micro-controllers.

Prerequisite: ELEN 231 and CPEN 212.

CPEN 305 MICROCONTROLLERS LAB **0.3: 1 cr. E**

This laboratory applies the theory of both switching and dynamical control. Switching control includes Microprocessor hardware analysis, timing, and design, Microcontroller, and Programmable IC. Dynamical control includes system modeling, analysis, and control (PID, phase compensation, optimal control).

Prerequisites: CPEN 202 and CPEN 213.

CPEN 307 PLC LAB **0.3: 1 cr. E**

This lab covers the application on the uses of Programmable Logic Controller (PLC); Programming Logic, Memory organization, Relay Logic Ladder Diagram (RLLD), Instruction List Programming (ILP), State Based Design (SBD), Sequential Function Charts/Grafcet (SFC), Function Block Programming (FBP), Program Control Instructions, Timers, Counters, Data Manipulation, Sequencers; Project Design.

CPEN 308 ELECTRONIC DESIGN AUTOMATION LAB **0.3: 1 cr. E**

Electronic Design Automation (EDA) tools are used to design large-scale logic circuits with emphasis on hardware implementation using FPGA technology. Lab assignments are based on Verilog Hardware Description language, where students design, simulate, synthesize, and download to FPGA-based boards using the same commercial EDA tools for all these steps.

CPEN 314 COMPUTER ARCHITECTURES **3.0: 3 cr. E**

This course deals with the specification and design of RISC-based microprocessors, taking into account such factors as cost versus performance, details of cache and virtual memory concepts, single- and multi-cycle data path, and control unit design.

Prerequisite: CPEN 213.

CPEN 317 COMPUTER HARDWARE DESIGN **3.0: 3 cr. E**

This course covers the specification and design of RISC-based microprocessor, taking into account such factors as cost versus performance. Details of ALU, floating points units, data path (unpipelined and pipelined), control units based on state diagrams and microprogramming, and techniques for peripheral interfacing.

CPEN 324 PROGRAMMABLE LOGIC CONTROLLERS **3.0: 3 cr. E&F**

This course covers the understanding and uses of Programmable Logic Controller (PLC); Programming devices, Memory organization, LADDER diagram, Relay type instructions, Program Control Instructions, Timers, Counters, Data Manipulation, Sequencers; Project design.

CPEN 346 BASICS OF COMPUTER SECURITY **3.0: 3 cr. E**

This introductory course builds on computer network and computer system concepts to create a feel for how information and respective information systems are best secured from threats. This general goal is addressed through creating an understanding of information security management best practices based on computer security known vulnerabilities and attack vectors. Indefinitive, the students will learn and exercise securing a host, a netwrork and information using modern tools and technologies.

Prerequisite: CPEN 213.

CPEN 347 TELETRAFFIC **3.0: 3 cr. E**

This subject exposes students to theoretical and practical aspects of modern communication network design, including teletraffic engineering and network performance modeling. It covers an overview of relevant stochastic traffic modeling, traffic characterization, traffic measurement techniques, network dimensioning principles, queuing theory and its application to performance evaluation of networks. Students analyze practical examples of network dimensioning for capacity and network performance evaluation using simulation software packages.

Prerequisite: CSIS 222.

CPEN 417 ADVANCED COMPUTER HARDWARE **3.0: 3 cr. E**

A quantitative study of RISC architecture; advanced pipelining techniques and instruction-level parallelism (ILP): static vs. dynamic scheduling, Tomasulo's algorithm, hardware-based speculation, branch prediction, thread-level parallelism and multiprocessing; memory hierarchy design; storage systems.

Prerequisite: CPEN 317.

CPEN 425 NEURAL NETWORKS DESIGN **3.0: 3 cr. E**

Neural dynamics: architecture and signals, activation model, unsurprised learning, surprised learning, architectures and equilibrium. The Hopfield model and recurrent networks. The self- organizing map. Adaptive resonance theory. (Advisor Permission)

CPEN 427 ADVANCED HARDWARE APPLICATIONS **3.0: 3 cr. E**

Advanced logic design topics are covered: Synchronous vs. asynchronous state machines; timing issues such as metastability, hazards, skewing; techniques to improve performance: parallelism, pipelining techniques; high-speed digital units: fast adders, multipliers, etc; VHDL vs. Verilog hardware description languages. These concepts will be enforced through a system-level project.

CPEN 446 NETWORK MANAGEMENT & SECURITY **3.0: 3 cr. E**

This course is an introduction to network management and security. Topics include TMN concepts such as TMN definition, different TMN architectures, interfaces and reference points, as well as management protocols used in TMN such as ACSE, CMISE, SNMPv1, SNMPv2, and SNMPv3. Topics related to computer security will be also covered like encryption, digital signatures, s-http, ssl, Kerberos, and firewall.

CPEN 447 Advanced Teletraffic **3.0: 3 cr. E**

This course exposes students to source characterization of bursty sources (video, audio) through stochastic modeling of bursty traffic. The theory is illustrated through simulated results from the research literature. Students are also given computer projects to simulate bursty traffic sources. A major portion of the course is devoted to performance evaluation of networks using advanced queueing theory. The course will also treat traffic management and control in ATM networks, statistical multiplexing, dimensioning of cellular networks, and frame relay dimensioning.

Prerequisite: ELEN 443.

CPEN 452 ADVANCED MICROCONTROLLER APPLICATIONS **3.0:3 cr. E**

The course is intended to enhance your knowledge in the area of microcontrollers through an in-depth coverage of the dsPIC30F Digital Signal Controller. The emphasis will be on: efficient software design techniques, on-chip I/O subsections and advanced peripheral devices. By the end of the course, students are expected to design, build and prototype a full-blown system. Typical applications include the following areas: control, telecommunications, data acquisition, telemetry, power electronics, instrumentation, etc.

Prerequisite: ELEN 400.

CPEN 480 FIELD TRAINING **2.0: 4 cr. E**

Prior to MS graduation, students are expected to undergo a two- to four-month training program at an institution whereby they get exposed and engaged in activities related to their field of studies, thereby gaining experience and demonstrating their skills.

CPEN 481 DATABASE PROGRAMMING **3.0: 3 cr. E**

This course introduces to engineering students the database concepts. It describes the different steps involved in the process of database development. It covers data modeling with emphasis on rational model, normalization, entity-relationship modeling, application design, SQL, and the implementation for personal and multi-user databases. Client-server systems are also discussed with the associated security issues, as part of the described architecture. A detailed study of database technologies is part of the course in order to provide the student with the maximum ability to accomplish a database project.

CPEN 528 MACHINE VISION **3.0: 3 cr. E**

The purpose of this course is to introduce the students to fundamental techniques for low level and high level computer vision. Topics include image formation, early processing, boundary detection, image segmentation, texture analysis, shape from shading, photometric stereo, motion analysis via optic flow, object modeling,

shape description, and object recognition. Models of human vision, subjective contours, visual illusions, apparent motion, mental rotations, cyclopean vision.

CPEN 545 CRYPTOGRAPHY **3.0: 3 cr. E**

This course aims to introduce the students to cyptography in its algorithmic sides. The course starts with a definition of cryptosystems using simple examples (shift cipher, affine cipher, hill ciper, Vigenère cipher…). A small review of Shanon theory is then performed. Bulk encryption is detailed with a focus on Data Encryption Standard (DES) and its variants. Afterwards, public-key cryptosystems are studied (Diffie-Hellman, RSA, …). Attacks on both classes of cryptosystems are presented. The final part of the course is relative to hashing algorithms (MD4, MD5, …). At the end of the course, students will become aware of cryptography and of the strength and weakness of every cryptosystem.

Prerequisite: ELEN 402 and CSIS 375.

CPEN 546 WIRELESS NETWORKS **3.0: 3 cr. E**

Wireless technologies are constantly changing. Third generation cellular technologies, such as UMTS and EDGE, are rapidly replacing older second generation systems such as GSM and GPRS. As an indication of the rapid evolution of wireless technologies, are the plans for a fourth generation wireless technology to replace 3G before it is even universally widespread. While this course expose pertinent current and futuristic wireless systems, its main aim is to equip students with the essential principles of wireless networks at the network layers that will keep them on the cutting edge of telecommunication advancement, regardless of how the technology changes. The course features a thorough treatment of widespread cellular (GSM, GPRS, 3G-UMTS, EDGE), WLAN (Wi-Fi), WMAN (Wi-Max), and WPAN (bluetooth, UWB) systems. The course concludes with an overview of future IPv6-based 4th generation networks that promise to be homogenous and seamless.

CPEN 549 INTELLIGENT NETWORKS **3.0: 3 cr. E**

In public telecommunication networks, telephone network and wireless network, the control and services offering is one of the most important issues for successful service providing. The concept of intelligent networks has been introduced in the last 1980s to permit an easy and efficient development and deployment of services for such networks. Intelligent networks will be presented in details in this course. The underlying communication protocols (INAP) will be described. Those presentations will cover intelligent networks for both fixed and wireless telephone networks. Students must have a good knowledge of networking principles and general telecommunication concepts in order to attend this course.

Prerequisite: ELEN 443, and CSIS 321.

CPEN 551 SWITCHING THEORY **3.0: 3 cr. E**

This course covers finite-state sequential machine theory and design, state identification, state minimization in incompletely specified tables, partition theory, decomposition of machines, asynchronous machine design and test methodologies for improving testability and combinational and sequential digital systems.

Prerequisite: CPEN 417.

CPEN 552 VLSI **3.0: 3 cr. E**

The purpose of this course is to introduce students to the topic of CMOS technology in VLSI. Implementations in CMOS will be discussed starting from CMOS inverters and basic gates all the way to multiplexers, decoders, ALUs, registers, memories, sequential circuits, etc. Other topics include propagation delay, noise margins, and power dissipation. Speed, area, and power optimization are discussed. CAD Tools for layout, extraction, and simulation are used.

Prerequisite: CPEN 551.

CPEN 554 PARALLEL PROCESSING **3.0: 3 cr. E**

The design of large-scale parallel processing systems: Synchronous (SIMD) and asynchronous (MIMD) machine organizations, single stage, and multistage interconnection networks are covered. Various parallel algorithms are presented to demonstrate different techniques for mapping tasks onto parallel machines.

Prerequisite: CSIS 320.

CVSQ 201, 202, 203

Refer to Faculty of Arts & Social Sciences, Cultural Studies Program.

ELEN 201 INSTRUMENTATION LAB. **0.3: 1 cr. E**

This laboratory provides an introduction on the use of multi-meters, oscilloscopes, function generators, power supplies and other instrumentation. Applications include solenoids, resistors, capacitors, periodic signals analysis, RC, RL, and RLC circuits; balanced bridge circuit.

ELEN 202 ELECTRICAL SIMULATION AND DESIGN **0.3: 1 cr. E**

The purpose of this workshop is to provide the students with working knowledge of the use and applications of PSPICE, MATLAB, LabView, and PCB design.

Prerequisites: ELEN 221.

ELEN 221 CIRCUITS ANALYSIS I **3.0: 3 cr. E**

The purpose of this course is to provide the students with basic understanding of electrical circuit theory. Topics covered include fundamental definitions and laws; resistive circuit analysis; mesh and nodal analysis; RL, RC, and RLC circuit analysis; DC/AC analysis; Thevenin and Norton theorems; phasor analysis.

Prerequisites: ELEN 201, MATH 200 and MATH 211.

ELEN 222 SIGNALS AND SYSTEMS THEORY **3.0: 3 cr. E**

This course covers simultaneously continuous-time and discrete-time signal transformations and system classifications; Linear Time Invariant system analysis (convolution and ordinary differential/difference equation); Fourier series; Fourier transform; Laplace transform; and z-transform.

Pre-requisite: ELEN 221, MECH 221, and MATH 202.

ELEN 223 ELECTRICITY & ELECTROMAGNETISM **3.0: 3 cr. E**

This course covers the governing principles and laws of charge and matter; electric fields; Gauss's law; electric potential; capacitors; dielectrics; magnetic field; Biot-Savart law; Faraday's law; Ampere's law; inductors; paramagnetism; Maxwell's equation and electromagnetic waves.

rerequisites: ELEN 221 and MATH 270.

ELEN 231 ELECTRONICS I **3.0: 3 cr. E**

This course covers the physics and operation of semiconductor diodes, bipolar junction transistors and field-effect transistors; analysis and design of simple analog wave shaping circuits; small-signal device models; introduction to difference and operational amplifiers; circuit analysis at intermediate and high frequencies.

Prerequisites: ELEN 221 and CPEN 211.

ELEN 303 CIRCUITS ANALYSIS LAB **0.3: 1 cr. E**

This laboratory provides an introduction to electrical circuit measurements; bridge circuits; steady-state and transient waveforms; frequency response; Bode plots; impedance measurement; high-pass, low-pass, band-pass and band-reject filters.

Prerequisite: ELEN 202/221.

ELEN 304 ELECTRONICS LAB **0.3: 1 cr. E**

This laboratory provides an introduction to electrical measurements, analysis and design of electronic circuits; diodes and transistor characteristics, diodes and transistor circuits, amplifier gain and impedance characteristics, frequency response, distortion, switching, operational amplifiers and their applications, mirror currents, voltage-regulator integrated circuits.

Prerequisite: ELEN 231.

ELEN 306 TELECOMMUNICATIONS LAB **0.3: 1 cr. E**

This laboratory work includes oscillators, AM, FM modulation and demodulation, detectors, phase locked loops, AM receivers, ASK, PSK modulators and receivers; effects of white noise on binary signals; signal degradation and filtering; fiber optics.

Prerequisite: ELEN 341.

ELEN 307 CONTROL LAB **0.3: 1 cr. E**

This laboratory covers feedback control implementations; PID; State Space; Frequency Analysis design; Using Analogue and MATLAB Control Toolbox.

Co requisite: ELEN 351.

ELEN 308 ELECTRIC MACHINES LAB **0.3: 1 cr. E**

This laboratory covers magnetic circuits; transformers; induction motors; reluctance motors; synchronous and DC machines.

Prerequisite: ELEN 361.

ELEN 324 CIRCUITS ANALYSIS II **3.0: 3 cr. E**

This course covers general two-port networks; transfer function; Fourier techniques in network analysis; power calculations; three-phase circuits; mutual inductance and magnetically coupled circuits; series and parallel resonance; Op-Amp circuits.

Prerequisite: ELEN 221.

ELEN 325 ELECTRICAL INSTALLATIONS **0.3: 2 cr. E**

This course exposes students to electric wires and cables; wiring systems and techniques; residential and industrial wiring in conformance with the current National Electrical Code and local codes; circuit protection devices; circuits for electric lamps; metering of current, voltage, power and energy; transformer construction and winding; windings for electric machines is covered as time permit.

Prerequisite: ELEN 303.

ELEN 325 ELECTRICAL INSTALLATIONS **0.3: 2 cr. E**

This course exposes students to electric wires and cables; wiring systems and techniques; residential and industrial wiring in conformance with the current National Electrical Code and local codes; circuit protection

devices; circuits for electric lamps; metering of current, voltage, power and energy; transformer construction and winding; windings for electric machines is covered as time permit. Prerequisite: ELEN 324.

ELEN 326 SIGNAL PROCESSING **3.0: 3 cr. E**

This course covers the principles of digital signal processing; sampling, and quantization; reconstruction of signals; mathematical tools used in the modeling, analysis and synthesis of discrete-time communication and control systems; applications to sampled-data control and quantified-data communications systems; Multirate signal processing; optimal and adaptive techniques; introduction to digital filtering, Kalman filters.

Prerequisite: ELEN 222.

ELEN 332 ELECTRONICS II **3.0: 3 cr. E**

This course covers the behavior and operating limitations of large-signal and small-signal amplifiers, differential and multistage amplifiers, feedback amplifiers, transistor and audio power amplifiers, high-frequency amplifications, stability and compensation; operational amplifiers; comparators; low frequency oscillators; active filters; tuned amplifiers and oscillators; linear power supplies; waveshaping; other integrated-circuits.

Prerequisite: ELEN 231.

ELEN 340 SIGNAL TRANSMISSION **3.0: 3 cr. E**

This course covers the principles of field theory. Topics include solution of boundary value problems in electromagnetic using both analytic and numerical techniques; transmission line concepts; Smith charts and design tools for distributed circuits; conducting and dielectric guiding structures for waves; radiation from antennas; low frequency applications.

Prerequisite: ELEN 223.

ELEN 341 TELECOMMUNICATIONS **3.0: 3 cr. E**

This course covers the principles of analog communication; linear modulation, AM, DSB, SSB, VSB; linear demodulation, envelope detection, coherent demodulation mixer and super-heterodyne receiver; angular (nonlinear) modulation, phase modulation, frequency modulation, stereo FM; angular demodulation, different types of discriminators pre-emphasis and de-emphasis; pulse modulation, PAM, PWM, PPM, and PFM; time division and frequency division multiplexing.

Prerequisites: ELEN 304 and MATH 246.

ELEN 351 CONTROL SYSTEMS **3.0: 3 cr. E**

This course covers continuous-time and design; block diagram algebra and the signal flow graph; stability analysis techniques (Routh-Hurwitz and Jury stability criterions), root locus, Nyquist, Bode, and Nicholas; Impulse transfer function; state space analysis; State Feedback Control, PID, and phase compensation design.

Prerequisites: ELEN 202/222.

ELEN 352 DIGITAL CONTROL SYSTEMS **3.0: 3 cr. E**

This course covers discrete-time systems analysis and design; analysis and design of digital control systems; signal conversion and processing; sampling; A/D and D/A conversion; Z-transform applications; state variables; Z-Domain analysis; frequency domain analysis; digital simulation and digital redesign; controller design using the root-locus; discrete equivalent and deadbeat design methods.

Prerequisites: ELEN 307/351.

ELEN 361 ELECTRIC MACHINES **3.0: 3 cr. E**

This course covers Faraday's law applied to magnetic circuits and transformers; per unit system; energy balance and electromechanical conversion processes; analysis of reluctance machines; three-phase and single-phase induction motors; synchronous motors and generators; DC motors and generators; fractional horsepower motors.

Prerequisites: ELEN 223/324/332.

ELEN 362 POWER ELECTRONICS **3.0: 3 cr. E**

This course covers the applications of power semiconductor devices; circuit analysis, signal analysis, and energy concepts are integrated to develop steady state and dynamic models of generic power converters; specific topics include AC/DC, DC/DC, DC/AC, and AC/AC conversions. These generic converters are applied as controlled rectifiers, switching power supplies, motor drives, HVDC transmission, induction heating, and others; ancillary circuits needed for the proper operation and control of power semiconductor devices are also discussed; computer simulation and application to power supplies and motor drives.

Prerequisite: ELEN 202/361.

ELEN 400 LINEAR SYSTEMS **3.0: 3 cr. E**

This course covers the concepts and theories of linear system analysis; state-space modeling and analysis; controllability, observability, and stability of linear systems; properties of transfer function matrices; minimal realization.

Prerequisite: Advisor's permission.

ELEN 401 OPTIMIZATION THEORY **3.0: 3 cr. E**

This course is an introduction to various methods of obtaining the extreme of a non-dynamic or a dynamic system and its use in system design. Linear programming, various search methods, nonlinear programming and dynamic programming are also covered. Various real-life applications are discussed and appropriate case studies are investigated.

Prerequisite: Advisor's permission.

ELEN 402 STOCHASTIC THEORY & ESTIMATION AND DETECTION **3.0: 3 cr. E**

This course covers general concepts of stochastic processes; stationarity and ergodicity; stochastic continuity and differentiation; Gaussian process; linear systems with stochastic inputs; correlation functions and power spectra; matched filtering; mean square estimation; spectral estimation; modulation; Entropy; Markov processes; queuing theory.

ELEN 415 ADVANCED ELECTRONICS **3.0: 3 cr. E**

This course covers advanced applications of integrated circuits: IC regulators, Op-Amp applications, active filters, oscillators, waveform generators, frequency multiplier and divider circuits, optoelectronic circuits, and other integrated circuits and applications.

ELEN 417 MEASUREMENT SYSTEMS **3.0: 3 cr. E&F**

This course covers the principles of measurement systems from the sensor/transducer unit to the display unit; static and dynamic characteristics; accuracy; loading effects; signals and noise; reliability, choice and economics; sensing elements: resistive, capacitive, inductive, electromagnetic, thermoelectric, elastic, piezoelectric, and electromechanical; signal conditioning; signal processing, and software; data presentation. Applications selection from force and pressure measurement systems; flow measurement systems; intrinsically

safe measurement systems; heat transfer effects in measurement systems; optical measurement systems; ultrasonic measurement systems; gas/chemical measurement systems.

ELEN 431 SPECIALTY MACHINERY **3.0: 3 cr. E**

Special purpose motors; stepper motors; servo motors; PM motors. Other motors that are used in manufacturing, robotics, and electrical systems are also covered.

ELEN 432 ADVANCED POWER ELECTRONICS **3.0: 3 cr. E**

Advanced static VAR compensation; system stability enhancement; harmonic minimization; mathematical modeling of switching power converters; advanced power converter topologies; design constraints and control methods; design-oriented analysis techniques for applications in electro-mechanical systems, power systems, transportation systems, etc.

ELEN 435 ADVANCED ELECTRIC MACHINES **3.0: 3 cr. E**

This course covers the generalized theory of machines based on coupled circuit approach using matrix methods; transformations from three-phase to two-phase dq variables; applications to dc induction, and synchronous machines and there parameters; performance in the transient and the steady state.

ELEN 437 POWER SYSTEMS I **3.0: 3 cr. E**

This course covers the three-phase power systems; matrix methods; symmetrical components; sequence; impedance diagrams; power system transformers; per unit system; transmission line parameter; steady state operation of transmission lines and power flow; computer projects included.

ELEN 441 INFORMATION THEORY AND ERROR CORRECTION **3.0: 3 cr. E**

This course deals with orthonormal expansions, effect of additive noise in electrical communications, vector channels, waveform channels, matched filters, bandwidth, and dimensionality. Optimum receiver structures, probability of error, bit and block signaling, introduction to coding techniques. Protocols for error control, signaling, addressing, fault management, and security control. Block, cyclic, and convolutional codes; circuits and algorithms for decoding; application to reliable communication and fault-tolerant computing.

Prerequisite: ELEN 443.

ELEN 443 DIGITAL COMMUNICATION **3.0:3 cr. E**

This course treats the principles of digital transmission of information in the presence of noise. The course starts with an overview of information theory and coding, analog to digital conversion, and focuses on the design and analysis principles of baseband PAM transmission systems, M-ary signaling, and various carrier systems including ASK, FSK and PSK. An introductory treatment of channel coding is also presented.

ELEN 444 COMMUNICATION SYSTEMS II **3.0:3 cr. E**

This course covers source coding and compression techniques. Students are exposed to entropy coding (DCT and arithmetic coding), predictive coding (DPCM), transform coding (DCT, Walsh-Hadamard, Karhunen-Loeve), vector quantization, statistical coding (BTC), and an overview of MPEG compression. Design issues in communication systems are also covered with special emphasis to system trade-offs, Shannon-Hartley capacity theorem, and Shannon's limit. Students are exposed to M-ary signaling, the design of binary waveforms (orthogonal, biorthogonal, and transorthogonal-simplex) for channel coding. Modulation of vector codes is also analyzed with concentration on non-coherent MFSK, QAM, MSK, DPSK, and OQPSK schemes.

Prerequisite: ELEN 443.

ELEN 446 TELECOM ELECTRONICS **3.0: 3 cr. E**

This course covers applications of operational amplifiers and other integrated circuits in current technology; wide bandwidth amplifiers; low-noise amplifiers; current mode circuits; analogue multipliers; radio frequency input circuits and impedance matching; R.F. amplifiers; micro-strip circuits; I.F. circuits; oscillators; Phase-locked loops (PLLs).

ELEN 454 DIGITAL FILTERS **3.0: 3 cr. E**

This course covers advanced methods and techniques in digital filter design; linear optimum filtering: Wiener filters, linear prediction; linear adaptive filtering, steepest descent, LMS algorithm, frequency-domain adaptive filters, square-root and order-recursive adaptive filters; introduction to nonlinear adaptive filtering.

ELEN 455 SELECETD ENGINEERING APPLICATIONS **0.3: 1 cr. E**

This advanced design laboratory includes selected applications in the topics of DSP, control, communications, measurement, and digital hardware (FPGA and CPLD chips).

Prerequisite: Advisor's approval

ELEN 459 ENGINEERING IMAGE PROCESSING **3.0: 3 cr. E&F**

In this course, an observer is helped to interpret the content of an image by improving the pictorial image information interpretation and processing of seen data for autonomous machine perception. Topics covered include: Image acquisition and storage, image transformation, image enhancement in frequency and special domains, representation and description of a seen, recognition and interpretation.

ELEN 462 BIOMEDICAL INSTRUMENTATION I **3.0: 3 cr. E**

This course covers the concepts and applications of biomedical instrumentation; basic transducers and principles; amplifiers and biomedical signal processing; origin of bio-potentials; electrodes and amplifiers; blood pressure and sound; measurement of blood flow and volume; measurements of the respiratory system parameters; clinical laboratory instrumentation; electrical Safety.

ELEN 463 MEDICAL IMAGING I **3.0: 3 cr. E**

This course covers the physical principles, design and functions of ultrasonic- and X-ray- based diagnostic imaging systems (including radiographic, fluoroscopic and computer topography); and other related issues.

ELEN 470 ELECTROMAGNETICS **3.0: 3 cr. E**

This course covers the theory and applications of plane waves and transmission lines.

ELEN 480 FIELD TRAINING **2.0: 4 cr. E**

Prior to MS graduation, students are expected to undergo a two- to four-month training program at an institution whereby they get exposed and engaged in activities related to their field of studies, thereby gaining experience and demonstrating their skills.

ELEN 472 FIBER OPTICS **3.0: 3 cr. E**

This course covers the principles of fiber optics communication systems; optics review; Light fundamentals; integrated optic wave-guides; light sources, detectors, and couplers; distribution networks and fiber components; modulation; noise; system design; measurement.

Prerequisite: ELEN 340.

ELEN 490 SELECTED ENGINEERING TOPICS **2.0: 1 cr. E**

This course consists of lectures and seminars covering recent research and advances in various fields and applications of electrical and computer engineering.

ELEN 520 NONLINEAR SYSTEM DYNAMICS **3.0: 3 cr. E**

This course covers topics related to nonlinear systems; definition of linear and nonlinear systems; introduction to approximate analysis of nonlinear systems-describing functions, Krylov and Bogliubov asymptotical method, and Tyskin locus; Forced oscillations-jump resonance; stability analysis-Liapunov criterion; Lure problem and Popov method.

Prerequisite: ELEN 400.

ELEN 522 STOCHASTIC CONTROL SYSTEMS **3.0: 3 cr. E&F**

This course covers control systems using random process; properties of Markov process; systems of covariance equivalence and of deterministic and stochastic control equivalence; dynamic programming for Markov process-principle of optimality; linear systems with quadratic cost; Kalman filtering; smoothing; predicting.

Prerequisite: ELEN 402.

ELEN 523 OPTIMAL CONTROL SYSTEMS **3.0: 3 cr. E&F**

This course covers the analysis and design of modern feedback control systems. Advanced state space analysis; State Feedback control design; Cayley-Hamilton theorem; Ackerman's formula; full order and Luenberger observer design; optimal control design (LQR); system identification; robust control.

Prerequisite: ELEN 400.

ELEN 524 INDUSTRIAL CONTROL SYSTEM DESIGN **3.0: 3 cr. E**

Teams will design and implement a real-time automatic decision-making system for a process control application. Challenges include hardware design, how to interface computer algorithms to physical variables and how to design and implement real-time software.

ELEN 525 MOBILE ROBOTS **3.0: 3 cr. E&F**

This course covers inspiration to implementation of mobile robots: Computational hardware, designing and prototyping, sensors, mechanics, motors, power, and robot programming.

ELEN 526 CONTROL SYSTEM DESIGN AND IMPLEMENTATION **3.0: 3 cr. E**

This course presents major design experience in control systems; modern control theory; specification, design, and construction of signal transducers, and design and testing of the overall system.

Prerequisite: ELEN 400.

ELEN 527 FUZZY LOGIC CONTROL **3.0: 3 cr. E&F**

A course covering the analysis and design of adaptive Fuzzy Systems; Training of Fuzzy Logic Systems Using Back-Propagation, Orthogonal Least Squares, Table Lookup Scheme, Nearest Neighborhood Clustering; Comparison of adaptive fuzzy systems with artificial neural networks; Design using Input-Output Linearization Concept; Fuzzy Adaptive Filters.

Prerequisite: ELEN 400.

ELEN 531 POWER SYSTEMS PROTECTION AND RELIABILITY 3.0: 3 cr. E

This course covers the concepts of high voltage engineering, circuits breaks and switch gear, H.V. power equipment; protection schemes; digital protection and fault diagnosis; reliability analysis.

Prerequisite: ELEN 437.

ELEN 533 RENEWABLE ENERGY 3.0: 3 cr. E

An introduction to alternative clean energy: Wind, Solar, Hydro, Biomass, and others. However emphasis will be on Solar and Wind energies that include: Power generation, conversion, distribution and utilization. Prerequisite: ELEN 437.

ELEN 534 INDUSTRIAL/COMMERCIAL POWER SYSTEMS 3.0: 3 cr. E

An introduction to power system design for commercial buildings and industrial plants; legal and economic considerations; equipment specifications and ratings; design practice; fault calculations, protection, and coordination; grounding; and illumination design.

Prerequisite: ELEN 437.

ELEN 536 POWER SYSTEMS CONTROL 3.0: 3 cr. E

This course presents the theory and applications of power flow control; economic dispatch; unit commitment; voltage-reactive power control; automatic generation of interconnected power systems; the energy control center and the role of the digital computer.

Prerequisites: ELEN 400/531.

ELEN 537 POWER SYSTEMS II 3.0: 3 cr. E

This course presents symmetrical and unsymmetrical fault studies; bus impedance and admittance methods; power system controls; transient operation of transmission lines; transient stability; computer projects included.

Prerequisite: ELEN 437.

ELEN 538 POWER SYSTEMS GENERATION AND DISTRIBUTION 3.0: 3 cr. E

This course presents the concepts of power generation and synchronization; functional and equivalent circuits for transmission lines and transformers; per unit system; balanced three-phase systems and power transfer limits; unbalanced system harmonics; symmetrical components and sequence network characteristics of transmission lines and transformers; symmetrical component fault analysis; Clarke components; switching surges; lighting surges; traveling waves; impact of surges on terminal equipment; insulation coordination; system protection; synchronization laboratory.

ELEN 539 POWER QUALITY 3.0: 3 cr. E

In this course electric power quality; measures and standard of power quality measurements; modeling of networks and components under non-sinusoidal conditions; loads which may cause power quality problems; analysis methods, harmonics in power systems; and power quality improvement are covered.

Prerequisites: ELEN 538.

ELEN 542 WIRELESS COMMUNICATION SYSTEMS 3.0: 3 cr. E

This course aims to present wireless communication systems in general. It is a graduate course that covers several aspects of wireless communication starting from the general concepts and going towards specific wireless networking protocols. Different propagation models, modulation techniques, multiple access approaches will

be deepened. Speech coding and data transmission approaches will be introduced. Examples on the GSM, DECT and satellite communication will be given. As a result, the students will have a good knowledge of the most common wireless communication systems which permits them to easily start any study in this area.

Prerequisite: ELEN 402/443.

ELEN 544 SPEECH TECHNOLOGIES **3.0: 3 cr. E**

Speech is the most natural way of communication. Classical telecommunication systems have been built to carry this signal. Nowadays, speech is a major media in human-machine communication. Besides, the classical and basic studies on speech coding, new speech technologies have been developed, i.e. speech synthesis, speech recognition and speaker verification. This course presents the state of the art techniques. It starts with a brief presentation of the signal and of the most widely used coding techniques. Concatenative speech synthesis is then described in details. State of the art Speech recognition systems are also presented covering Hidden Markov Models (HMM). N-grams language models are explained.

Prerequisite: ELEN 402.

ELEN 546 ESTIMATION AND DETECTION **3.0: 3 cr. E**

As a major subject in statistical communication, this course is intended to provide solid foundation for advanced studies and research in telecommunication systems. Topics include: Bayes' decision, maximum likelihood estimator and detector, MAP estimator, linear mean-square estimation, the Karhunen-Loeve expansion, Wiener filter, Kalman filter, sampling of random signals, detection of signals in Gaussian noise, and fading in Rayleigh and Rician channels.

Prerequisite: ELEN 402.

ELEN 548 REAL-TIME TELECOM APPLICATIONS **3.0: 3 cr. E**

The course is intended to expose you in depth to the dsPIC30F DSP and show you all the features that make it a powerful processor for digital filtering applications, FFT computation, adaptive filtering, etc. A meticulous study of the processor will be covered along with many real-time teleccom applications.

Prerequisite: ELEN 326/443.

ELEN 562 BIOMEDICAL INSTRUMENTATION II **3.0: 3 cr. E**

This course covers selected topics on the design and maintenance of major medical equipment: electrocardiography, pressure and other cardiovascular measurement and life support instruments, respiratory measurement instruments, brain-parameters measurement instruments, medical lab instruments, ultrasound equipment, electro-optics, fiber optics and lasers, computers and biomedical equipment, electromagnetic interference to medical electronic equipment, battery-operated medical equipment. In-hospital visits and observation are included in the course.

Prerequisite: ELEN 462.

ELEN 564 MEDICAL IMAGING II **3.0: 3 cr. E**

This course covers the physical principles, design and functions of magnetic resonance imaging (MRI) and nuclear medicine diagnostic imaging systems; and other related issues.

Prerequisite: ELEN 563.

ELEN 571 CELLULAR COMMUNICATION **3.0: 3 cr. E**

This course focuses on cellular communication in general. Cellular communication principles will be explained to the students. The constraints and solutions for different particular cases are given. Different cellular systems will be presented: the GSM, Wireless LAN, and Bluetooth. Students must have a good knowledge of networking principles and general telecommunication concepts in order to attend this course.

Prerequisite: ELEN 443.

ELEN 572 SATELLITE AND RADAR COMMUNICATION **3.0: 3 cr. E**

This course is designed to provide students with an understanding of the working principles of satellite communications and the technologies involved. Topics covered include: introduction to satellite and radar communication, orbital aspects of satellite communication, satellite link design, multiple access methods (FDMA, TDMA, CDMA, FCMA), and systems examples (satellite TV, VSAT applications, mobile to satellite communication).

Prerequisite: ELEN 441.

ELEN 574 OPTICAL WDM NETWORKS **3.0: 3 cr. E**

This course is designed to provide students with an understanding of the working principles and challenges of optical networks. Topics covered include: Enabling technologies and building blocks, single-hope networks, multihop networks, optical access networks (like PON, EPON and WDM PON), optical metro networks (including interconnected WDM ring networks and packet communication using tunable WADM), wavelength-routed networks (including routing and wavelength assignment strategies, light path establishment: static (SLE) and dynamic (DLE), fixed and adaptive routing and wavelength assignment strategies using heuristics).

ELEN 578 ANTENNA DESIGN **3.0: 3 cr. E**

This course presents electrically small antennas; wire antennas, antenna arrays; aperture antennas (slots, horns, and parabolic reflectors); broadband antennas; high frequency methods; antenna synthesis; ground wave and ionospheric propagation; receiving antennas and antenna measurements. Students design and construct antennas in associated laboratory.

Prerequisite: ELEN 443.

ENGL 203 AND ANOTHER HIGHER LEVEL ENGLISH LANGUAGE COURSE

Refer to the Division of English Language and Literature.

MECH 513

Refer to Department of Mechanical Engineering.

MATH 200, 202, 211, 230, 246, 270

Refer to Faculty of Sciences, Department of Mathematics.

GENG 301, 390, 402, 590, 599

Refer to Faculty of Engineering Requirements.

DEPARTMENT OF CIVIL ENGINEERING
BACHELOR'S DEGREE

FIRST YEAR

Semester 1

Course Code	Course Title	Credit
CSIS 206	Principles of Programming	3
CIVE 201	Statics	3
MECH 221	Engineering Dynamics	3
ENGL 203	English Comm. Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra	3
		18

FIRST YEAR

Semester 2

Course Code	Course Title	Credit
ENGL 2xx	English Elective	3
CHEM 204	General Applied Chemistry	3
CIVE 202	Mechanics of Materials	3
MECH 222	Science of Materials	3
MATH 202	Calculus II	3
CIVE 203	Engineering Drawing 1	1
		16

SECOND YEAR

Semester 3

Course Code	Course Title	Credit
CVSQ 201	Early Formation of Civilization	3
CIVE 204	Construction Materials & Methods	3
MECH 243	Fluid Mechanics	3
MATH 246	Probability For Engineers	3
CIVE 205	Theory of Structures I	3
CIVE 206	Engineering Drawing II	1
MATH 270	Differential Equations	3
		19

SECOND YEAR

Semester 4

Course Code	Course Title	Credit
CVSQ 202	The Religious Experience	3
CIVE 207	Construction Planning & Scheduling	3
CIVE 208	Surveying	2
CIVE 209	Reinforced Concrete I	3
MECH 232	Thermodynamics	3
CIVE 210	Strength of Materials Laboratory	1
MATH 230	Numerical Analysis	3
		18

THIRD YEAR

Semester 5

Course Code	Course Title	Credit
CVSQ 203	Introduction to Modernity	3
CIVE 301	Soil Mechanics & Foundation	3
CIVE 302	Construction Estimating	3
CIVE 303	Computer Aided Design	3
CIVE 304	Reinforced Concrete II	3
CIVE 305	HVAC	3
CIVE 306	Soil Lab.	1
		19

THIRD YEAR

Semester 6

Course Code	Course Title	Credit
CIVE 307	Foundation Design	3
CIVE 308	Transportation Engineering	3
CIVE 309	Engineering Economy	3
CIVE 310	Plans & Specifications	3
CIVE 311	Sanitary Engineering	3
MECH 233	Workshop Technology	1
GENG 390	Undergraduate Project	1
		17

MASTER'S DEGREE IN CIVIL ENGINEERING
(5 Electives will define an Option)

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CIVE 401	Theory of Structures II	3
CIVE 402	Dynamics of Structures I	3
	Elective	3
	Elective	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
MECH 411	Advanced Mechanics of Materials	3
CIVE 407	Soil-Structure Interaction	3
GENG 402	Project Management	3
GENG 590	Graduate Project	3
	Elective	3
		12

FOURTH YEAR

Summer

Course Code	Course Title	Credit
CIVE 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
CIVE 501	Theory of Steel Design	3
CIVE 503	Highway Design	3
GENG 590	Graduate Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES: STRUCTURAL OPTION

Course Code	Course Title	Credit
CIVE 406	Theory of Plates & Shells	3
CIVE 408	Dynamics of Structures II	3
CIVE 502	Theory of Elasticity	3
CIVE 504	Finite Element Analysis	3
CIVE 505	Dynamics of Structures III (Earthquake Design)	3
CIVE 506	Stability of Structures	3
CIVE 507	Boundary Surveys	3
CIVE 512	Pavement Design	3
CIVE 556	Bridge Design	3

LIST OF ELECTIVES: TRANSPORTATION OPTION

Course Code	Course Title	Credit
CIVE 408	Dynamics of Structures II	3
CIVE 504	Finite Element Analysis	3
CIVE 505	Dynamics of Structures III (Earthquake Design)	3
CIVE 512	Pavement Design	3
CIVE 513	Traffic Engineering	3
CIVE 556	Bridge Design	3

LIST OF ELECTIVES: ENVIRONMENTAL OPTION

Course Code	Course Title	Credit
CIVE 418	The Sewage Treatment Plant	3
CIVE 520	Principles of Environmental Engineering	3
CIVE 521	Wastewater Engineering Design	3
CIVE 522	Water Resources & Water Quality	3
CIVE 523	Air Pollution Control	3
CIVE 524	Solid Waste Disposal	3
CIVE 525	Sanitary Landfill	3
CIVE 526	Water Supply Engineering Design	3
CIVE 527	Environmental Impact Assessment	3
CIVE 528	Environmental Economics and Management	3
CIVE 529	Environmental Water Chemistry	3

LIST OF ELECTIVES: CONSTRUCTION MANAGEMENT OPTION

Course Code	Course Title	Credit
CIVE 412	Quality Assurance & Control	3
CIVE 413	Modern Techniques in Human Resource Management	3
CIVE 415	Process Reengineering/Administrative Reform	3
CIVE 416	Management Support Systems	3
CIVE 417	Strategic Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

COURSE DESCRIPTIONS

CIVE 201 STATICS **3.0: 3 cr. E**

Composition and resolution of forces, free-body diagrams, analysis of forces acting on structures and machines, shear and bending moment diagrams, friction, centroid, and moment of inertia.

CIVE 202 MECHANICS OF MATERIALS **3.0: 3 cr. E**

Introduction - Concept of stress; stress and strain. Axial loading; torsion; Pure bending; Transverse loading-Shear stress; Transformation of stress and strain; Deflection of beams; Columns.

Prerequisites: CIVE 201 and MATH 200.

CIVE 203 DRAWING I **0.3: 1 cr. E**

Concepts and practices in lettering, geometric construction, multi-view and auxiliary projections, sections and connections, dimensioning, and isometric and oblique pictorials. Emphasis on freehand sketching skills.

CIVE 204 CONSTRUCTION MATERIALS & METHODS **3.0: 3 cr. E**

Materials and methods used in the construction industry. Physical and mechanical properties of construction materials; Portland cement concrete, asphalt, wood, ferrous metals, non-ferrous metals; proportioning of concrete mixtures including admixtures.

CIVE 205 THEORY OF STRUCTURES I **3.0: 3 cr. E**

Analysis of statically determinate structures: Elastic deformations; deflection of beams by Moment-Area Theorems, Conjugate-Beam Method. Deflections by Energy Methods, Virtual-Work Method, Castigliano's Second Theorem. Influence Lines and Criteria for Moving Loads; Statically Indeterminate Structures: Method of Consistent deformations; Slope-Deflection Method; Moment-Distribution Method.

Prerequisites: CIVE 201/202.

CIVE 206 DRAWING II (AutoCad) **0.3: 1 cr. E**

Concepts and practices in lettering, geometric construction, multi-view and auxiliary projections, sections and connections, dimensioning, and isometric and oblique pictorials. Emphasis on freehand sketching skills.

Prerequisite: CIVE 203.

CIVE 207 CONSTRUCTION PLANNING & SCHEDULING **3.0: 3 cr. E**

Basic elements of management of civil engineering projects; roles of all participants in the process: owners, designers, contractors and suppliers; emphasis on contractual aspect of the process, project estimate, planning and controls. Planning, scheduling and control of construction projects; management functions, network techniques (CPM), resource scheduling, construction financing and cost/schedule relations.

Prerequisite: English Proficiency Level: ENGL 102.

CIVE 208 SURVEYING **2.2: 2 cr. E**

Principles of surveying, instruments, basic measuring procedures, error analysis, traverse, leveling and mapping. Principles and practice in measuring distances, elevation differences and angles; construction surveys, traverses, topographic surveys and subdivision of land, mass diagram, cut and fill calculations. Boundary surveys, area computations and profile surveys.

Prerequisite: MATH 200.

CIVE 209 REINFORCED CONCRETE I **3.0: 3 cr. E**

Strength and deformation of reinforced concrete according to the provisions of the ACI Building Code; Beams in flexure and shear; Bond and development of bars; Deflection; One way ribbed and solid slabs; Short columns.

Prerequisites: CIVE 205.

CIVE 210 STRENGTH OF MATERIALS LABORATORY **0.3: 1 cr. E**

Concrete Constituents and Mix Design; Slump Test; Determination of Density of Hardened Concrete; Compressive Strength of Concrete Cubes and Cylinders, Flexural Tensile Strength of Concrete; Splitting Tensile Strength of Cylindrical Concrete Specimens; Determination of Static Modulus of Elasticity in Compression; Tensile Strength of Steel Bars; Standard Method for Resistance to Plastic Flow of Bituminous Mixtures using Marshall Apparatus.

Prerequisite: CIVE 202, Corequisite: CIVE 209

CIVE 301 SOIL MECHANICS & FOUNDATIONS **3.0: 3 cr. E**

Soil explorations and testing, foundations for buildings, piles and footings, bracing of open trenches, sheet piling, and laboratory testing of soils. Stability of slopes, earth pressure, steady seepage.

Prerequisites: CIVE 202/209.

CIVE 302 CONSTRUCTIONS ESTIMATING **3.0: 3 cr. E**

An overview of the construction estimating process is presented. Topics covered include preparation of quantity take off, bill of quantities, detailed estimates for all different construction trades, i.e., materials and labor, along with pricing of bids. The student learns how to transfer estimates into the construction process and project management control tools. To emphasize the importance of computer application in estimating, the student designs several estimating spreadsheets. Familiarity with spreadsheet programs is an asset.

Prerequisite: CIVE 207.

CIVE 303 COMPUTER-AIDED DESIGN **2.1: 3 cr. E**

Applications of interactive computer graphics to design of common Civil Engineering problems; Introduction to the stiffness method; Frame analysis, beam and arbitrary shaped slabs.

Prerequisites: CSIS 200, CIVE 203/209.

CIVE 304 REINFORCED CONCRETE II **3.0: 3 cr. E**

Design of reinforced concrete building and floor slab systems. Moment curvature relationship for beams and columns, bi-axially loaded columns, slenderness effects, interaction diagrams, shear and torsion in members. Extensive use of microcomputers.

Prerequisite: CIVE 209.

CIVE 305 HEATING, VENTILATING and AIR CONDITIONING (HVAC) **3.0: 3 cr. E**

Environmental comfort parameters. Heat transfer in building sections. Estimating heating, cooling and ventilation loads and the choice of appropriate systems. Selection of equipment, design and layout of distribution ducts, pipes, and outlets.

CIVE 306 SOIL MECHANICS LABORATORY **0.3: 1 cr. E**

Soil properties and behavior, soil classifications, hydraulics of soil moisture, consolidation and settlement, strength characteristics, soil stabilization.

Corequisite: CIVE 301.

CIVE 307 FOUNDATION DESIGN **3.0: 3 cr. E**

Geotechnical engineering applications to the analysis, design construction of shallow foundations and earth retaining structures.

Prerequisites: CIVE 301/304.

CIVE 308 TRANSPORTATION ENGINEERING **3.0: 3 cr. E**

The role of transportation in society and the engineer's role in planning, design and operation of transportation systems; consideration of system constraints, costs and basic design criteria. Theory and practice in highway design according to AASHTO criteria; design of vertical and horizontal cross-section. Introduction to traffic elements including intersection design and analysis of roads and intersections service levels.

Prerequisite: CIVE 208.

CIVE 309 ENGINEERING ECONOMY **3.0: 3 cr. E**

The course introduces the student to the fundamental concepts of engineering economy covering: economic analysis of projects, operations analysis, as well as the evaluation of alternatives, namely , benefit/cost ratio, present and annual worth, internal rate of return, and utility study. The course discusses retirement and replacement analysis, depreciation methods, and risk analysis.

CIVE 310 PLANS & SPECIFICATIONS **3.0: 3 cr. E**

Plans, specification and writing and interpretation, and contract documents related to the construction industry.

Prerequisite: CIVE 206.

CIVE 311 SANITARY ENGINEERING **3.0: 3 cr. E**

Sources and quantities of water supply and methods of collection, treatment and distribution. Quantities, treatment and disposal of wastewater. Quality parameters, criteria and international standards for drinking water and wastewater pollution control.

Prerequisite: MECH 243.

CIVE 401 THEORY OF STRUCTURES II **3.0: 3 cr. E**

Approximate analysis of continuous beams and frames. Parametric studies of some basic structures including towers, buildings and bridges. Analysis of beam, truss and frame structures using the direct stiffness method. Two topics selected from nonlinear truss analysis, energy methods, Timoshenko beam-columns, structural optimization, influence lines, arches, cable structures and others (content varies by year).

CIVE 402 DYNAMICS OF STRUCTURES I **3.0: 3 cr. E**

Dynamic modelization. Equations of motions of structures modeled as single degree of freedom and as multi-degree of freedom systems. Response analysis of structures subjected to harmonic, periodic, impulsive and general types of excitations.

CIVE 404 HYDRAULICS **3.0: 3 cr. E**

Design and analysis of hydraulic projects using modern computational procedures; student team projects involving steady and unsteady flow in pipelines, pipe networks, bridge and culvert hydraulics, flood-plain delineation, water supply canals, structures and channel modification, design of drainage elements such as storm water networks, sewerage networks, water supply networks, grates and inlets, and introduction to scour analysis.

Prerequisite: CIVE 311.

CIVE 405 PRESTRESSED CONCRETE **3.0: 3 cr. E**

Introduction to Materials and Systems of Prestressing; Basic Concepts of Prestressing: Basic-Concept Method, Load-Balancing Method, Pressure-Line Method; Prestress Losses; Composite Construction; Ultimate Flexural Strength Analysis and Design; Shear Design; Continuous Prestressed Concrete Beams.

CIVE 406 THEORY OF PLATES & SHELLS **3.0: 3 cr. E**

Basic theory of plates, bending of rectangular and circular plates, geometry of shells, stresses and deformations of various shell structures, numerical applications, finite element modeling.

Prerequisite: CIVE 401 or MECH 411.

CIVE 407 SOIL-STRUCTURE INTERACTION **3.0: 3 cr. E**

Fundamentals of geotechnics applied to design and analysis of deep soil-structure systems; ,single pile, pile groups under axial load; sheet piles, tiebacks, caissons and piers; effect of lateral loads; computer software implementation.

CIVE 408 DYNAMICS OF STRUCTURES II **3.0: 3 cr. E**

Basic seismology, earthquake characteristics and effect of earthquakes on structures, building configurations, seismic design and analysis of structures using the Uniform Building Code (UBC). Details of seismic resistant concrete structures. N.B.: Design Project is Obligatory for Passing.

Prerequisite: CIVE 402.

CIVE 409 HYDROLOGY **3.0: 3 cr. E**

Descriptive hydrology: hydrologic cycle, precipitation, stream flow, evaporation, and transpiration. Quantitative hydrology: hydrograph analysis, hydrographs of basis outflow, storage routing. Probability concepts in hydrology. Flood frequency, rainfall frequency, stochastic hydrology, and introduction to groundwater hydrology.

Prerequisite: CIVE 311.

CIVE 410 APPLIED HYDRAULICS **3.0: 3 cr. E**

Complete and detailed design of drainage, sewerage, water supply, and irrigation networks using StormCad, SewerCad, WaterCad and Epanet softwares. Design also includes open channel flow and river analysis with scour analysis for bridges over waterways using HEC-RAS software. Pond design with PondPack SOFTWARE AND Pump design with surge analysis using Hammer software are also included. Detailed derivation of the continuity equation, Navier-Stokes equations, and energy equation are included.

Prerequisite: CIVE 404/409.

CIVE 412 QUALITY ASSURANCE AND CONTROL 3.0: 3 cr. E

The course introduces the student to the concept of engineering quality assurance and control. It also expands the knowledge of the students in areas related to quality standards and their applications in engineering. The latest technology of total quality management is introduced and several techniques and tools used to ensure quality on construction sites as well as in engineering design firms are discussed. The course discusses quality management concept, statistical quality control techniques, quality control specifications and standards, ISO 9000/14000, benchmarking, JIT program, and quality function deployment-house of quality.

CIVE 413 MODERN TECHNIQUES IN HUMAN RESOURCE MANAGEMENT 3.0: 3 cr. E

Human resource management is considered one of the main topics of micro-management. Managers in engineering firms need to know some leadership skills and managerial techniques that can help them develop their abilities in communicating, directing, and achieving the objectives of their companies. The course emphasizes the modern approach of total quality management in performance appraisal, leadership skills, the motivation and rewards systems, team formation, and inter-group communication. Comparison is made with the conventional approach. Techniques for resource allocation, resource leveling, and decision-making are discussed and the Need Theories are stressed.

CIVE 415 PROCESS REENGINEERING/ADMINISTRATIVE REFORM 3.0: 3 cr. E

Reengineering is a radical new way of remaking a company's business process with the objective of heading to competitive dominance. The student learns how to redesign the business process of firms by focusing on organization architecture, current management systems, corporate values and culture, process workflow, and planning and control systems. He will be able to design the hard processes as well as the soft processes in the firm.

CIVE 416 MANAGEMENT SUPPORT SYSTEMS 3.0: 3 cr. E

Management theory and practice have undergone radical changes in the past two decades. Information technology has added a new dimension to modern management. The purpose of this course is to introduce the student to the information systems and technologies available to managers. By looking at these management systems from the managerial perspective, the DSS, EIS, ES, TPS, and OAS fundamentals are introduced. The manner in which they can be constructed and used to help managers make rational decisions is elaborated. This course blends the topics of management and engineering information systems in pursuit of providing competent and innovative managers.

CIVE 417 STRATEGIC MANAGEMENT 3.0: 3 cr. E

Strategic planning plays an important role in shaping present activities and envisioning future trends of successful companies. The course introduces the student to basic concepts of strategy, with emphasis in engineering firms. Topics such as organizational mission, environmental assessment, setting of goals and objectives, strategy implementation, and strategy formulation are covered. The student learns how to select corporate-level grand strategy types and those of the business units types, evaluate the SWOT of his firm as well as the competitor firms, map the organizational dimensions for strategy implementation, match between the strategy and structure of the firm, and transform the strategy into action plans.

CIVE 418 THE SEWAGE TREATMENT PLANT BASICS OF THE TREATMENT PROCESS AND CHOICE OF TREATMENT LEVEL VIS-À-VIS REUSE 3.0: 3 cr. E

The course illustrates the general concepts of the biochemical activities that set up the treatment process. It covers topics like degradation of organic substances as a microbial humification process, immobilization\ mobilization of nutrients, fate of industrial pollutants, and properties of the final effluent and sludge produced. The course prepares students to act as consultant engineers in judging the kind and level of treatment needed, the management of the on-land application of treated effluent and digested sludge, and the adoption of environmentally sound application practices.

CIVE 501 THEORY OF STEEL STRUCTURES 3.0: 3 cr. E

AISC Load and resistance factor design (LRFD) of tension members, columns, beams, beam-columns, built-up and composite members, connections (welded and bolted). Materials specifications (ASTM) for conventional and high performance steel grades.

Prerequisite: CIVE 401.

CIVE 502 THEORY OF ELASTICITY 3.0: 3 cr. E

This course deals with solving problems within the framework of linear theory of elasticity. First, problems in Cartesian coordinates are considered and solutions by polynomial and Fourier methods are presented. Second, the elasticity problem is formulated in polar coordinates and several problems are solved. Finally, some problems in three-dimensional elasticity are presented solved.

Prerequisite: MECH 411.

CIVE 503 HIGHWAY DESIGN 3.0: 3 cr. E

Theory and practice in highway design according to AASHTO criteria; highway classification and design criteria, location studies, complete design of vertical and horizontal alignment, cross section, pavement, intersections and highway drainage elements, and design of noise barriers.

Prerequisite: CIVE 308.

CIVE 504 FINITE ELEMENT ANALYSIS 2.2: 3 cr. E

Introduction to basic theory and techniques; one- and two-dimensional formulations for solid mechanics applications; direct and general approaches; computer implementation, programming and projects.

Prerequisite: CIVE 401 or MECH 411.

CIVE 505 DYNAMICS OF STRUCTURES III (EARTHQUAKE DESIGN) 3.0: 3 cr. E

Special topics in structural dynamics, including problems in wave propagation, response of structures to waves, dynamics of foundations, soil-structure, and fluid-structure interaction.

Prerequisite: CIVE 408.

CIVE 506 STABILITY OF STRUCTURES 3.0: 3 cr. E

Buckling of discrete and continuous elastic structural systems using equilibrium analysis and energy methods. Flexural buckling of beam-columns and frames. Lateral buckling of beams. Role of shear deformation in the buckling of built-up beams and beam-columns. Basic postbuckling analysis and the study of imperfection sensitivity. Stability criteria. Elastoplastic buckling of perfect and imperfect columns. Evaluation of design code provisions.

Prerequisite: CIVE 401.

CIVE 507 BOUNDARY SURVEYS **3.0: 3 cr. E**

Land surveying, registration laws, history, survey systems, legal principles, boundary calculations, boundary descriptions, and evidence interpretation.

CIVE 508 OCEAN ENGINEERING **3.0: 3 cr. E**

Incompressible fluid mechanics and applications to analysis of wave motions, circulations, and other free surface flows in coastal and offshore regions; wave spectra, water-level fluctuations, tides, tsunamis, oscillations, and storm surges; wind-generated waves, beaches, wave forces on coastal and offshore structures.

CIVE 509 MECHANICS OF WATER WAVES **3.0: 3 cr. E**

Irrotational theory for deep- and shallow-water waves, reflection, refraction, diffraction, attenuation. Water waves of finite amplitude. Shallow-water theory, tides, long-waves theory, conoïdal and solitary waves. Wave generation by wind. Wave breaking and reflection.

Prerequisite: CIVE 508.

CIVE 510 MODELING OF COASTAL ENGINEERING PROBLEMS **3.0: 3 cr. E**

Mathematical modeling, differential equations of wave motion, dimensionless presentations and scaling, initial and boundary conditions, analytical solutions, numerical solutions, computer applications on selected problems.

Prerequisite: CIVE 509.

CIVE 511 COASTAL & PLATFORMS DESIGN **3.0: 3 cr. E**

Applications of principles of ocean and coastal engineering to coastal protection structures, breakwaters, seawalls. Wave forces on offshore platforms: fixed and floating.

Prerequisite: CIVE 510.

CIVE 512 PAVEMENT DESIGN **3.0: 3 cr. E**

To provide a good understanding of pavement design and the stresses that are produced in pavement layers under wheel loads, temperature changes, and climatic effects. In addition, special design topics such as airport design will be presented.

Prerequisite: CIVE 503.

CIVE 513 TRAFFIC ENGINEERING **3.0: 3 cr. E**

This course aims at providing the student with a clear and thorough presentation of the theory and applications of Traffic Engineering. It aims at providing an understanding of the basic principles, and the ability to apply those principles. These include the traffic operations (characteristics of the driver, the pedestrian, the vehicle, and the road), traffic data collection (traffic terms and accidents) with application (traffic lights and interchanges, and level of service), and the transportation planning (the process, forecasting travel demand, evaluating transportation alternatives, and the transportation system management).

CIVE 520 PRINCIPLES OF ENVIRONMENTAL ENGINEERING **3.0: 3 cr. E**

Man and environment. Sources of environmental pollution. Water pollution and its control. Principles of water and wastewater treatment. Air pollution and its control. Solid wastes and noise problems. Environmental Impact Assessment studies. Case studies.

CIVE 521 WASTEWATER ENGINEERING DESIGN **3.0: 3 cr. E**

sources and characteristics of wastewater. Collection works design. Theory and application of commonly used processes. Design of sludge treatment and disposal facilities. Process combinations to produce treatment systems. Case studies.

Prerequisite: CIVE 520.

CIVE 522 WATER RESOURCES AND WATER QUALITY **3.0: 3 cr. E**

Sources and use of water. Characteristics of water and wastewater. Water quality criteria and standards. Methods of evaluating water quality. Problems arising in the resources, the distribution and home plumbing systems and from water treatment. Water quality management planning. Regulatory concepts and practices. Water supply in Lebanon.

Prerequisite: CIVE 520.

CIVE 523 AIR POLLUTION CONTROL **3.0: 3 cr. E**

Sources and nature of air pollutants and their effects. Air quality standards. Legislation and regulatory trends. Statistical analysis of data. Design principles of air pollution control structures and equipment. Acid deposition. Global warming, climate change, greenhouse gases. Case studies from selected Industries.

Prerequisite: CIVE 520.

CIVE 524 SOLID WASTE DISPOSAL **3.0: 3 cr. E**

Generation of solid wastes. Onsite handling, storage and processing. Collection, transfer and transport of solid Wastes. Processing Techniques and Equipment. Recovery of resources, conversion Products and Energy. Disposal methods for solid wastes and Residual Matter: Sanitary Landfill, incineration, composting, and other techniques.

Prerequisite: CIVE 520.

CIVE 525 SANITARY LANDFILL **3.0: 3 cr. E**

Disposal of solid wastes on land. Effect of leachate on groundwater pollution. Theory and current practice regarding design, construction, and monitoring of sanitary landfill. Landfill operation and economic analysis. Control Laws and Regulations.

Prerequisites: CIVE 520/524.

CIVE 526 WATER SUPPLY ENGINEERING DESIGN **3.0: 3 cr. E**

Concepts in engineering, concepts in engineering design, concepts in branch design, phases of engineering designs, case studies. water characteristics, quality criteria and standards need for treatment, water treatment plant hydraulics and sludge disposal, storage and distribution system design, intake and transmission system design, computer applications for design, economical considerations in water supply engineering design.

Prerequisite: CIVE 520/522.

CIVE 527 ENVIRONMENTAL IMPACT ASSESSMENT **3.0: 3 cr. E**

Concepts of environmental impact assessment. Planning and management of impact studies. Methods of impact identifications-matrices, network and checklists. Description of environmental setting. Environmental indices and indicators for describing the affected environment. Prediction and assessment of impacts on the air, soil, water, noise, visual, socioeconomic, biological and cultural environment. Decision methods for evaluation of alternatives. Public participation in environmental decision making. Case studies.

Prerequisite: CIVE 520.

CIVE 528 ENVIRONMENTAL ECONOMICS AND MANAGEMENT 3.0: 3 cr. E

Introduction to environmental economic problems; Modeling the Market Process and Failure. Conventional and Economic Solutions to environmental problems. Environmental decision making. Environmental risk analysis. benefits and costs assessment and analysis for environmental decision making. Case studies of major environmental problems and policy solutions.

Prerequisite: CIVE 520.

CIVE 529 ENVIRONMENTAL WATER CHEMISTRY 3.0: 3 cr. E

Theory and practice of water chemistry; Chemistry concepts and properties for natural and treated waters; Principles of chemical kinetics; Composition of natural waters; Solubility; water softening; Metal-ion complexation; Principles of redox equilibria; nutrient cycles; iron and manganese chemistry; chlorine chemistry; sorption processes; Trace metal cycling; Organic structures and nomenclature; properties of organic compounds; fate of organic pollutants; natural organic matter; Pollution (drinking water contamination, marine pollution, and wastewater treatment).

CIVE 530 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY 3.0: 3 cr. E

Chemistry of organic and inorganic contaminants in the environment. Natural chemical cycles in the biosphere, geosphere, hydrosphere and atmosphere, and consequences of anthropogenic disturbances. Chemical equilibrium and kinetics. Fundamentals of aquatic, atmospheric and soil chemistry. The fate of hazardous, refractory and heavy metal pollutants in the environment. Introduction to microbial taxonomy, ecology and growth kinetics of microorganisms. The microbes of public health importance in water, soil and air, including their detection, occurrence, transport, and survival in the environment. Introduction to the application of different processes to remove contaminants in natural and engineered systems.

CIVE 531 ENVIRONMENTAL SAMPLING AND ANALYSIS 3.0: 3 cr. E

This course is designed to introduce the student to the principles of environmental chemistry and methods for the analysis of environmental samples. The principles of a given analysis should be understood before any analysis should be undertaken, so the course will include a review of chemical principles relevant to the analyses performed in the lab. These chemical principles will be taught using examples from treatment processes and the behavior of materials in the environment, as well as from laboratory analyses. The analyses performed in the lab are all commonly used in environmental work, for monitoring ambient air and water conditions, effluent discharges, or the performance of treatment processes. Topics will be oriented to describe treatment processes in industrial water and in municipal wastewater. Mass balances and kinetics are emphasized. Six hours of lecture and laboratory a week for one semester.

CIVE 555 SPECIAL TOPICS IN ENGINEERING 3.0: 3 cr. E

Stairways; Flat slabs; Design of concrete water tanks: Rectangular and circular; Concrete domes; Corbels and deep beams; Wind Load provisions; Design of shear walls.

CIVE 556 BRIDGE DESIGN 3.0: 3 cr. E

AASHTO LRFD Bridge Design Specifications and AASHTO Standard Specifications for Highway Bridges for short span cast-in-place reinforced concrete slabs and precast prestressed planks, medium span prestressed concrete I-girders and box girders, and cast-in-place post tensioned box-girders and voided slabs. Design of substructure elements (abutment and piers). Computer Application using software program. Overview of long span segmental and cable stayed bridges.

Prerequisite: CIVE 401 and CIVE 405.

CIVE 590 TRAINING **4 cr. E**

CSIS 206
Refer to Faculty of Sciences, Department of Computer Science.

CVSQ 201, 202, 203
Refer to Faculty of Arts & Social Sciences, Cultural Studies Program.

ENGL 203, Elective
Refer to the Division of English Language and Literature.

GENG 390, 402, 590, 599
Refer to Faculty of Engineering requirements.

MATH 200, 202, 211, 230, 246, 270
Refer to Faculty of Sciences, Department of Mathematics.

MECH 221, 222, 232, 233, 243, 411
Refer to Department of Mechanical Engineering.

DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR'S DEGREE

FIRST YEAR

Semester 1

Course Code	Course Title	Credit
CIVE 201	Statics	3
CSIS 206	Principles of Programming	3
ENGL 203	English Communication Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra	3
MECH 212	Instrumentation & Experimentation I	1
MECH 211	Mechanical Drawing I	1
		17

FIRST YEAR

Semester 2

Course Code	Course Title	Credit
ENGL 2xx	English Elective	3
MECH 222	Science of Materials	3
CIVE 202	Mechanics of Materials	3
MATH 202	Calculus II	3
MECH 221	Engineering Dynamics	3
CHEM 204	General Applied Chemistry	3
		18

SECOND YEAR

Semester 3

Course Code	Course Title	Credit
MECH 231	Circuit Fundamentals	3
MATH 230	Numerical Analysis	3
MECH 232	Thermodynamics	3
CVSQ 201	The Formation of Civilization	3
MATH 246	Probability for Engineers	3
MECH 233	Workshop Technology	1
MECH 234	Mechanical Drawing II	1
ELEN 201	Electrical Instrumentation Lab	1
		18

SECOND YEAR

Semester 4

Course Code	Course Title	Credit
MATH 270	Differential Equations	3
MECH 241	Comp. Tech. in Mech. Eng.	3
ELEN 222	Signals & Systems Theory	3
CVSQ 202	The Religious Experience	3
MECH 242	Engineering Vibrations	3
MECH 243	Fluids Mechanics	3
MECH 244	Instrumentation & Experimentation II	1
		19

THIRD YEAR

Semester 5

Course Code	Course Title	Credit
MECH 311	Mechanical Design I	3
CVSQ 203	Introduction to Modernity	3
GENG 301	Engineering Management	3
MECH 313	Electromechanical Systems	3
MECH 314	Gas Dynamics	3
MECH 315	Mechanics of Machines	3
		18

THIRD YEAR

Semester 6

Course Code	Course Title	Credit
MECH 321	Heat Transfer	3
MECH 322	Automatic Controls	3
MECH 323	CAD/CAM	3
MECH 324	Steam & Gas Turbines	3
MECH 325	Instrumentation & Experimentation III	1
	Elective	3
GENG 390	Undergraduate Project	1
		17

DEPARTMENT OF MECHANICAL ENGINEERING
BACHELOR'S DEGREE (AEROSPACE SPECIALTY)

FIRST YEAR

Semester 1

Course Code	Course Title	Credit
AERO 211	Aircraft Basic Science	3
CIVE 201	Statics	3
ENGL 203	English Communication Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra	3
MECH 211	Mechanical Drawing I	1
MECH 212	Instrumentation and Experimentation I	1
		17

FIRST YEAR

Semester 2

Course Code	Course Title	Credit
ENGL 2xx	English Elective	3
AERO 221	Airframe Workshop	1
CIVE 202	Mechanics of Materials	3
CSIS 206	Principles of Programming	3
MATH 202	Calculus II	3
MECH 221	Engineering Dynamics	3
MECH 222	Science of Materials	3
		19

SECOND YEAR

Semester 3

Course Code	Course Title	Credit
AERO 231	Aircraft Dynamics & Control	3
AERO 233	Human Factors and Av. Legislation	3
CPEN 211	Intro. Digital Logic Design	3
CVSQ 201	Early Formation of Civilization	3
MECH 231	Circuit Fundamentals	3
MECH 232	Thermodynamics	3
MECH 234	Mechanical Drawing II	1
		19

SECOND YEAR

Semester 4

Course Code	Course Title	Credit
AERO 232	Aerodynamics of Flight	3
AERO 234	Fundamentals of Aircraft Structures	3
AERO 242	Aircraft Instruments & Systems	3
AERO 244	Aero-Engines Workshop	1
ELEN 231	Electronics I	3
MATH 270	Differential Equations	3
MECH 244	Instrumentation & Experimentation II	1
		17

THIRD YEAR

Semester 5

Course Code	Course Title	Credit
AERO 311	Production Planning & Control	3
AERO 316	Fundamentals of Aircraft Design	3
CVSQ 202	The Religious Experience	3
GENG 390	Design Project	1
MECH 314	Gas Dynamics	3
MECH 315	Mechanics of Machines	3
MECH 325	Instrumentation & Experimentation III	1
		18

THIRD YEAR

Semester 6

Course Code	Course Title	Credit
AERO 341	Quality Assurance in Aviation	3
AERO 342	Computational Techniques in Aviation	3
AERO 343	Helicopter Fundamentals	3
AERO 344	Aircraft Propulsion Systems	3
CVSQ 203	Introduction to Modernity	3
MECH 242	Engineering Vibrations	3
		17

MASTER'S DEGREE IN MECHANICAL ENGINEERING
AEROSPACE OPTION

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
AERO 411	Advanced Aerodynamics	3
AERO 413	Advanced Aircraft Structures	3
MECH 412	Mechanics Of Composite Materials	3
	Elective	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
AERO 421	Gas Turbine Propulsion Systems	3
AERO 422	Aircraft Design II	3
MECH 517	Finite Element Methods in Mech. & Aero Eng.	3
GENG 590	Master Project	3
	Elective	3
		15

FOURTH YEAR

Summer

Course Code	Course Title	Credit
AERO 480	Industrial Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
AERO 423	Gas Turbine Combustors	3
AERO 414	Heat Transfer in Aeronautics	3
AERO 424	Aircraft Maintenance Techniques	3
AERO 514	Aero-Elasticity	3
MGMT 310	Management of Organizations	3
MGMT 323	Managing Organizational Behavior	3
MRKT 310	Marketing Management	3
ISYS 320	Information Resources Management	3
GENG 402	Project Management	3
MECH 411	Advanced Mechanics of Materials	3
MECH 412	Mechanics of Composite Materials	3
MECH 413	Internal Combustion Engines	3
MECH 414	Process Control Systems	3
MECH 415	Turbomachinery	3
MECH 423	Advanced Manufacturing Processes	3
MECH 511	Computational Fluid Dynamics	3
MECH 515	Turbulence and Transport Phenomena	3
MECH 518	Advanced Gas Dynamics	3

LIST OF ELECTIVES: MANAGEMENT OPTION

Course Code	Course Title	Credit
MGMT 310	Management of Organizations	3
MGMT 323	Managing Organizational Behavior	3
MRKT 310	Marketing Management	3
ISYS 320	Information Resources Management	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN MECHANICAL ENGINEERING

Thermo-Fluids Option
Manufacturing Option
Management Option
(5 Electives will define an Option)

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
MECH 411	Advanced Mechanics of Materials	3
MECH 412	Mechanics of Composite Materials	3
MECH 413	Internal Combustion Engines	3
	Elective	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
MECH 421	Refrigeration and Air Conditioning	3
MECH 422	Mechanical Design II	3
MECH 423	Advanced Manufacturing Process	3
GENG 590	Master Project	3
	Elective	3
		15

FOURTH YEAR

Summer

Course Code	Course Title	Credit
MECH 480	Industrial Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
MECH 517	Finite Element Methods in Mech. & Aero Eng.	3
	Elective	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES: THERMO-FLUIDS OPTION

Course Code	Course Title	Credit
AERO 421	Gas Turbine Propulsion Systems	3
MECH 414	Process Control Systems	3
MECH 415	Turbomachinery	3
MECH 426	Plumbing Engineering	3
MECH 428	Special Topics in Thermal Sciences	3
MECH 511	Computational Fluid Dynamics	3
MECH 512	Solar Energy	3
MECH 514	Fracture Mechanics	3
MECH 515	Turbulence and Transport Phenomena	3
MECH 518	Advanced Gas Dynamics	3

LIST OF ELECTIVES: MANUFACTURING OPTION

Course Code	Course Title	Credit
MECH 414	Process Control Systems	3
MECH 425	Mechatronics	3
MECH 427	Facility Planning and Quality Control	3
MECH 513	Robotics	3
MECH 514	Fracture Mechanics	3
MECH 517	Finite Element Methods in Mech. & Aero Eng.	3

LIST OF ELECTIVES: MANAGEMENT OPTION

Course Code	Course Title	Credit
MGMT 310	Management of Organizations	3
MGMT 323	Managing Organizational Behavior	3
MRKT 310	Marketing Management	3
ISYS 320	Information Resources Management	3
GENG 402	Project Management	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

COURSE DESCRIPTIONS

CIVE 201, 202
Refer to Department of Civil Engineering.

CSIS 206
Refer to Faculty of Sciences, Department of Computer Science.

CVSQ 201, 202, 203
Refer to Faculty of Arts & Social Sciences, Cultural Studies Program.

ENGL 203, Elective
Refer to the Division of English Language and Literature.

ELEN 201, 222
Refer to Department of Electrical Engineering.

GENG 390, 402, 590, 599
Refer to Faculty of Engineering Requirements.

MECH 211 MECHANICAL DRAWING I **0.3: 1 cr. E**
Concepts and practices in lettering, geometric construction, multi-view and auxiliary projections, sections and connections, dimensioning, and isometric and oblique pictorials. Emphasis on freehand sketching skills.

MECH 212 INSTRUMENTATION AND EXPERIMENTATION I **0.3: 1 cr. E**
General considerations for safe operation within a mechanical engineering laboratory environment. Presentation of general measurement theory, and concepts of accuracy and precision. Criteria behind "confidence" in measurements, significant notation, data processing professional data presentation methodologies and various available tools. Various measurement reporting methods. Applying learnt methodologies and techniques to various experimental cases, and the exposure of students to different experimental equipment.

MECH 221 ENGINEERING DYNAMICS **3.0: 3 cr. E**
Kinematics and kinetics of particles: Force, acceleration, work, energy and momentum. Two dimensional kinematics and kinetics of rigid bodies, translational and rotational motions. Vibrations.

MECH 222 SCIENCE OF MATERIALS **3.0: 3 cr. E**
Material classification. Atomic structures. Crystal structure solidification. Crystalline imperfections. Phase diagrams. Engineering alloys. Electrical and Mechanical properties of metals. Polymeric ceramic and magnetic materials. Corrosion. Composite materials.

Prerequisite: English Proficiency Level: ENGL 101.

MECH 231 CIRCUITS FUNDAMENTALS **3.0: 3 cr. E**
The purpose of this course is to provide the students with basic understanding of electrical and electronics circuit theory. Topics covered include: fundamental definitions and laws; essential circuit analysis techniques applied to resistive circuits, RL, RC and RLC circuits; diodes circuits; transistor circuits; introduction to difference and operational amplifiers.

Prerequisites: MATH 200/211.

MECH 232 THERMODYNAMICS **3.0: 3 cr. E**

Basic concepts and definitions. Properties of pure substance. Heat. Work. First Law of Thermodynamics. Second Law of Thermodynamics. Entropy. Reversibility and Irreversibility. Power and refrigeration cycles.

MECH 233 WORKSHOP TECHNOLOGY **0.3: 1 cr. E**

Drilling, milling, grinding, lath work, welding, molding, heat treatments, forging, electric workshop technologies.

MECH 234 MECHANICAL DRAWING II **0.3: 1 cr. E**

Architectural drawings of residential/commercial/ industrial buildings meeting local specifications. electrical and mechanical views, sectioning, hatching and assembling of mechanical machines and equipment.

Prerequisite: MECH 211.

MECH 241 COMPUTATIONAL TECHNIQUES IN MECH. ENG. **3.0: 3 cr. E**

The purpose of this course is to enhance students computational capacities by exposing them to problems in mechanical engineering problems that are best solved or analyzed numerically. Applications from mechanics, thermo-fluids, heat transfer, and design are all considered. Special emphasis is put on pre- and post processing and the importance of appropriate presentation and animation.

Prerequisite: CIVE 202, MT 202, CSIS 206.

MECH 242 ENGINEERING VIBRATIONS **3.0: 3 cr. E**

Linear single degree of freedom systems, transient and steady vibrations, linear undamped multi-forced degree of freedom systems. Lagrange Equation.

Prerequisite: MECH 221.

MECH 243 FLUID MECHANICS **3.0: 3 cr. E**

Fluid properties, fluid statics and manometry, kinematics, basic conservation equations of continuity, momentum and energy. Incompressible flows. Viscous effects in pipes and restrictions, Laminar and Turbulent Flows. Dimensional Analysis and Similitude.

MECH 244 INSTRUMENTATION AND EXPERIMENTATION II **0.3: 1 cr. E**

This lab course, the second in a series, is designed to consolidate theories gained in other courses taken up to the second year and build lab competencies through practical experiments. Typical experiments are in the areas of thermodynamics, Fluid Mechanics, Mechanics, Dynamics, Vibrations, etc. Special emphasis is exercised on modern data acquisition techniques as well as data presentation and reporting. Prerequisite: MECH 212.

MECH 311 MECHANICAL DESIGN I **3.0: 3 cr. E**

The course clarifies the role of design, and design activities and tools in the production of goods. It reviews such concepts as factor of safety, stress and strain, and deflection. The course explains static and fatigue failure theories and their applications. It also covers the design for strength of pressure vessels, columns, shafts, and other structural and machine elements. Design of weldments and bolted joints is also included.

Prerequisite: CIVE 202.

MECH 313 ELECTROMECHANICAL SYSTEMS **3.0: 3 cr. E**

This course deals with induced force, induced voltage in a conductor, DC machinery fundamentals. Equivalent circuit, DC generators, DC motors, single phase and three phase transformers, autotransformers, induced motors, speed control of induced motors, synchronous generators and motors.

Prerequisite: MECH 231.

MECH 314 GAS DYNAMICS **3.0: 3 cr. E**

This course is divided in two parts: the Boundary Layer Theory and Compressible Flows. Boundary Layer Theory introduces the Navier Stokes Equations, Prandtl's approximations and practical methods of solution of viscous flows. Part 2 is directed at one dimensional compressible flow in nozzles and pipes including shock wave analysis and real effects such heat transfer and friction.

Prerequisite: MECH 232/243.

MECH 315 MECHANICS OF MACHINES **3.0: 3 cr. E**

Degrees of Freedom. Linkages and their kinematic analysis. Cam synthesis, kinematic requirements, and graphical and analytical design. gears and gear trains. Introduction to synthesis. Force analysis of machinery and balancing.

Prerequisite: MECH 221.

MECH 321 HEAT TRANSFER **3.0: 3 cr. E**

The course introduces the principles of thermal conduction, convection and radiation. It is also concerned with the design and analysis of Heat Exchangers and outlines the basic principles of computational modeling in Heat Transfer.

Prerequisites: MECH 232/243

MECH 322 AUTOMATIC CONTROLS **3.0:3 cr. E**

This course deals with introduction to design and analysis of feedback control systems, properties and advantages of feedback systems, time-domain and frequency-domain performance measures, stability and degree of stability. It also covers root locus method, nyquist criterion, frequency-domain design, and state space methods.

MECH 323 CAD/CAM **1.2: 3 cr. E**

The course explains terminology used in CAD/CAM. It also explains the concepts, the mathematics and the building blocks that are the basis of CAD and CAM packages. Mathematical details relating to curve and surface generation, display and manipulation are also covered. Basic CAD and CAM data file structures, and exchange formats are included in the course. The interface between CAD and CAM is demonstrated through the design and manufacture of sample parts on laboratory CNC tool.

Prerequisite: MECH 234.

MECH 324 STEAM AND GAS TURBINES **3.0: 3 cr. E**

This is an advanced thermodynamics course in which students are introduced to the thermal design and analysis of Gas and Steam Turbine cycles and their variations as implemented by the power generation and aviation industries.

Prerequisite: MECH 314.

MECH 325 INSTRUMENTATION AND EXPERIMENTATION III 0.3: 1 cr. E

This lab course, the third in a series, is designed to consolidate theories gained in other courses taken up to the third year and build lab competencies through practical experiments. Typical experiments are in the areas of Gas Dynamics, Heat Transfer, Power and Refrigeration Systems, Automatic Controls, Manufacturing Systems, etc. Special emphasis is exercised on modern data acquisition techniques as well as data presentation and reporting.

Prerequisite: MECH 244.

MECH 411 ADVANCED MECHANICS OF MATERIALS 3.0: 3 cr. E

Theories of stresses and strains. Material behavior for general anisotropic, orthotropic and isotropic materials. Formulation of elasticity and boundary conditions. Plane stress and plane strain. Navier equations. Calculus of variations and its application to elasticity. Energy formulation. Unsymmetrical bending and shear center. Torsion of beams of noncircular cross-sections. Beams on elastic foundations. Curved beams.

MECH 412 MECHANICS OF COMPOSITE MATERIALS 3.0: 3 cr. E

Anisotropic elasticity and laminate theory, analysis of various members of composite materials, energy methods, Failure Analysis. Applications using software packages.

MECH 413 INTERNAL COMBUSTION ENGINES 3.0: 3 cr. E

This course covers the fundamentals of how the design and operation of internal combustion engines affect their performance, fuel requirements, and environmental impact. Fluid flow, thermodynamics, combustion, heat transfer, friction, and fuel properties, relevant to engine power, efficiency, and emissions are also studied. Examination of design features and operating characteristics of different types of internal combustion engines: spark-ignition and diesel running two or four-stroke cycles.

MECH 414 PROCESS CONTROL SYSTEMS 3.0: 3 cr. E

The course builds upon the foundation developed in previous course in Control System Theory. It covers advanced topics in analysis of process control systems such as Feedback control; Modeling and computer simulation of control systems; Discrete time models; Process control techniques; State Space methods applied to process control systems; Logic programming and devices.

MECH 415 TURBOMACHINERY 3.0: 3 cr. E

The course provides a brief overview and historical background about the development turbomachinery and related applications. It details the fundamental principles of thermodynamics and fluid mechanics applied to turbomachines, introduces the concept of turbomachiney characteristic curves and terminology, covers dimensional analysis related to turbomachinery, as well as theoretical analysis of hydraulic pumps, hydraulic turbines, air compressors, and gas and steam turbines.

MECH 421 REFRIGERATION & AIR CONDITIONING 3.0: 3 cr. E

The course guides the student towards the understanding of the basic thermodynamic cycles, psychrometrics, ventilating, heating load, cooling load, duct design, and hydraulic pipe design.

MECH 422 MECHANICAL DESIGN II 3.0: 3 cr. E

The course teaches the design, analysis, and selection of mechanical machine elements such as gears, bearings, brakes, springs, and power transmission sub-systems. It also covers the selection (spec-ing) of hydraulic and pneumatic parts, and electric motors. It teaches the analysis and synthesis of hydraulic and pneumatic circuits.

MECH 423 ADVANCED MANUFACTURING PROCESSES **2.2: 3 cr. E**

The course covers manufacturing engineering subjects such as concurrent engineering, design for manufacturing and assembly (DFM, DFA), BOM, MRP, ERP, Just-In-Time manufacturing systems, Automation, Flexible manufacturing, Group Technology, total quality control (TQC), statistical process control (SPC), Gantt charts, BOM, and CAM. The course also offers an introduction to manufacturing processes including CNC. The course also seeks – through the participation of students- to identify potential research themes in manufacturing.

MECH 425 MECHATRONICS **3.0: 3 cr. E**

Sensors and transducers, signal conditioning, measurement systems, pneumatic and hydraulic actuation systems, mechanical and electrical actuation systems, dynamic responses of systems, system transfer, frequency response, adaptive control, microprocessors, PLC, communication systems, fault finding.

MECH 426 PLUMBING ENGINEERING **3.0: 3 cr. E**

The Course guides the student towards the understanding of the different domestic water and drainage systems in buildings. It covers water treatments, domestic cold and hot water systems, pumps, drainage and venting systems, storm water, septic tanks, sump pits, and an overview on fire fighting.

MECH 427 FACILITY PLANNING & CONTROL **3.0: 3 cr. E**

Strategy, Process and schedule design, activity relationship and space requirements, personnel requirements, statistical process control, Deming's and Crosby's approach, Probability models for quality control, sampling and interface, normal distribution, control charts for variables and attributes.

MECH 428 SPECIAL TOPICS IN THERMAL SCIENCES **3.0: 3 cr. E**

This course covers some of the topics of particular interest to the thermal engineer but not covered in other courses such as mass transfer, boiling and condensation, as well as two phase flows and heat transfer. Applications include numerical modeling, computer exercises and lab experiments.

MECH 511 COMPUTATIONAL FLUID DYNAMICS **2.2: 3 cr. E**

Basic theory of CFD, flow modeling, mesh generation and convergence criteria. Finite-volume discretization of 2-dimensional flow equations. Pre-processing, boundary conditions and solutions. Post processing criteria. Hands-on experience using CFD computer packages. Compressible flow applications and comparisons with theories.

MECH 512 SOLAR ENERGY **3.0: 3 cr. E**

The course provides a brief overview and historical background about the development solar energy and related applications. It outlines the fundamental principles of solar energy, as well as thermodynamic analyses applied in solar energy field. It reviews the optics of solar radiations, and covers the radiation characteristics of materials. As an application to the theory, the course covers flat and curved solar collectors, water heating using solar energy, and solar ponds.

MECH 513 ROBOTICS **3.0: 3 cr. E**

The course deals with the basic components of robotics systems, kinematics for manipulators, selection of coordinate frames, homogeneous transformations, solutions to kinematics equations, lagrangian equations and manipulator dynamics, motion planning, position, velocity and force control, controller design, digital simulations.

MECH 514 FRACTURE MECHANICS **3.0: 3 cr. E**

Energy in elastic solids. Fracture mechanics versus mechanics of materials. Atomic model of fracture. Linear elastic fracture. Modes of fracture. Stress concentration. Griffith approach and energy release rate. Instability and the R curve. Stress analysis and stress intensity factor and its relation to the energy release rate. Crack tip plasticity. Plane stress/plane strain. Mixed mode fracture. Introduction to elastic/plastic fracture. Introduction to fatigue. Fracture in design.

MECH 517 FINITE ELEMENT METHODS IN MECH & AERO ENG. **3.0: 3 cr. E**

Introduction to Finite Element theories and techniques. FE formulations in 1 and 2 dimensions in solid mechanics, fluid mechanics, gas dynamics and heat transfer. Computer implementation, programming and projects.

Prerequisite: MECH 411.

MECH 518 ADVANCED GAS DYNAMICS **3.0: 3 cr. E**

Turbulence concepts, numerical approaches and applications, iterative and direct matrix methods, numerical implementation of turbulence model.

MECH 580 INDUSTRIAL TRAINING **4 cr.**

MGMT 310, 323, MRKT 310, ISYS 320

Refer to Faculty of Business & Management, Department of Business Administration.

COURSE DESCRIPTIONS (AEROSPACE SPECIALTY)

AERO 211 AIRCRAFT BASIC SCIENCE **3.0: 3 cr. E**

This course provides students with an introductory treatment of the aerodynamic theory of aircraft, including flight dynamics, basic design issues, instrumentation in addition to important maintenance requirements and regulations.

AERO 221 AIRFRAME WORKSHOP **1.2: 1 cr. E**

This is a practical course which introduces students to the basic workshop practices involved in handling airframes. Working with hand tools, machine tools and special tools appropriate to aircraft is emphasized in addition to introducing them some elementary manufacturing techniques.

AERO 231 AIRCRAFT DYNAMICS AND CONTROL **3.0: 3 cr. E**

Concepts of classical mechanics with the aerodynamic conclusions and derivations applied flying objects, range and endurance derivations for different types of aircraft, rates of climb, landing, best speeds for climb and speeds for best angle of climb, special performance problems, mechanics of some maneuvering operations, introduction to concepts of stability and control.

AERO 232 AERODYNAMICS OF FLIGHT **3.0: 3 cr. E**

This course deals with the dynamics of inviscid incompressible air flows, mathematical development of wing theory, analytical and experimental techniques in predicting performance of finite wings and thin airfoil sections, importance of boundary layer theory is emphasized.

AERO 233 HUMAN FACTORS AND AVIATION REGULATION **3.0: 3 cr. E**

This course instills in students an appreciation of the importance of human related issues in the aeronautical industry. Aspects of physiology, psychology, fatigue and sleep patterns are all discussed in addition to interpersonal professional relationships, work environments, attitudes and habits. These are analyzed in relation to flight decks, maintenance stations, dispatch units, administrations. The course also seeks to introduce students to the concepts of aviation laws and regulations, their sources, applicability and administrative control.

AERO 234 FUNDAMENTALS OF AIRCRAFT STRUCTURES **3.0: 3 cr. E**

Analysis of statically indeterminate structures. Thermal stresses and plasticity, applications in plane stress systems. Analysis of complex frameworks; structural airworthiness. Analysis of thin walled tube with all loading conditions. Multi cell tubes.

AERO 242 AIRCRAFT INSTRUMENTS AND SYSTEMS **3.0: 3 cr. E**

Aircraft electrical, mechanical and hydraulic systems; propulsion control systems; radar radio aids, cockpit displays; guidance and communication systems; electronic surveillance and counter measures. Flight testing, video displays, crash recorders.

AERO 244 AERO-ENGINES WORKSHOP **1.2:1 cr. E**

Aircraft electrical, mechanical and hydraulic systems; propulsion control systems; radar radio aids, cockpit displays; guidance and communication systems; electronic surveillance and counter measures. Flight testing, video displays, crash recorders.

AERO 311 PRODUCTION PLANNING AND CONTROL **3.0: 3 cr. E**

General outline of Production Planning and control, standard terminology, Maintenance philosophies and concepts, Planning method and standards, Production forecasting, Materials Routing, Production method and standards, Manpower planning, Production scheduling and control, Production performance analysis, Computer applications in aircraft maintenance engineering.

AERO 312 BASIC AVIONICS AND NAVIGATION SYSTEMS **3.0: 3 cr. E**

General theories of dead reckoning and radio navigation. Gyroscopic flight and navigation systems, Radio navigation systems, VORs, DMEs, NDBs and ADFs, Global Positioning and Satellite Navigation Systems.

AERO 316 FUNDAMENTALS OF AIRCRAFT DESIGN **3.0: 3 cr. E**

Design of minor and major components of aircraft structures, demonstration sessions on A/C models, importance of aerodynamics and solid mechanics in the design of various A/C components, a number of projects are assigned in the course.

AERO 341 QUALITY ASSURANCE IN AVIATION **3.0: 3 cr. E**

This course provides students with an appreciation of quality assurance programs, quality management and quality control philosophies, in order to prevent unnecessary loss or damage to aircraft or property, or injury to human life in parallel with improving the efficiency of an aviation business. The course includes topics relating to tasks and features of QAP, evaluation concept and quality verification inspections, personnel evaluation, special functions of QAP, QA documentation, management and implementation of QAP, statistical methods in QC, ISO9001, and the 5S concept.

AERO 342 COMPUTATIONAL TECHNIQUES IN AVIATION **3.0: 3 cr. E**

The purpose of this course is to enhance students computational capacities by exposing them to problems in aeronautical engineering problems that are best solved or analyzed numerically. Applications from flight mechanics, aerodynamics, thermo-fluids, heat transfer, and design are all considered. Special emphasis is put on pre- and post processing and the importance of appropriate presentation and animation.

AERO 343 HELICOPTER FUNDAMENTALS **3.0: 3 cr. E**

The objectives of this course are to provide an introductory treatment of the aerodynamic theory of rotary wing aircraft, including basic performance, control, and basic rotor dynamics, history of helicopter flight, fundamentals of rotor aerodynamics, blade element analysis, rotating blade motion, basic helicopter performance, conceptual design of helicopter.

AERO 344 AIRCRAFT PROPULSION SYSTEMS **3.0: 3 cr. E**

This course deals with the basic principles of aircraft propulsion. It starts with the basic theory of thrust generation, and distinguishes between propeller and jet driven aircraft. It introduces students to piston engines and propeller power-plants as used on light aircraft and then progresses towards gas turbine engines of the various types. Of particular importance is the thermodynamics performance analyses as well as thrust calculations for the different engines.

AERO 345 MODERN DEVELOPMENTS IN AVIATION **3.0: 3 cr. E**

The course deals with the most modern developments in aeronautical engineering. It covers the fundamentals of human factors concepts, an introduction to aircraft maintenance engineering human factors, automation, composite materials for the modern aircraft and the fly-by-wire technology.

AERO 401 AERODYNAMICS I **3.0: 3 cr. E**

This course is given to Mechanical Engineers specializing following the graduate aerospace option. This course deals with the dynamics of inviscid incompressible air flows, mathematical development of wing theory, analytical and experimental techniques in predicting performance of finite wings and thin airfoil sections, importance of boundary layer theory is emphasized.

AERO 402 AIRCRAFT STRUCTURES I **3.0: 3 cr. E**

This course is given to Mechanical Engineers specializing following the graduate aerospace option. Analysis of statically indeterminate structures. Thermal stresses and plasticity, applications in plane stress systems. Analysis of complex frameworks; structural airworthiness. Analysis of thin walled tube with all loading conditions. Multi cell tubes.

AERO 403 MECHANICS OF FLIGHT **3.0: 3 cr. E**

This course is given to Mechanical Engineers specializing following the graduate aerospace option. Concepts of classical mechanics with the aerodynamic conclusions and derivations applied flying objects, range and endurance derivations for different types of aircraft, rates of climb, landing, best speeds for climb and speeds for best angle of climb, special performance problems, mechanics of some maneuvering operations, introduction to concepts of stability and control.

AERO 405 AIRCRAFT DESIGN I **3.0: 3 cr. E**

This course is given to Mechanical Engineers specializing following the graduate aerospace option. Conceptual, preliminary and detail design of aircraft. Design of minor and major components of aircraft structures, demonstration sessions on A/C models, importance of aerodynamics and solid mechanics in the design of various A/C components, a number of projects are assigned in the course.

AERO 406 AIRCRAFT SYSTEMS ENGINEERING **3.0: 3 cr. E**

This course is given to Mechanical Engineers specializing following the graduate aerospace option. Aircraft electrical, mechanical and hydraulic systems; propulsion control systems; radar radio aids, cockpit displays; guidance and communication systems; electronic surveillance and counter measures. Flight testing, video displays, crash recorders.

AERO 411 ADVANCED AERODYNAMICS **3.0: 3 cr. E**

Dynamics of inviscid, compressible airflows, treatment of normal and oblique shock waves, transonic drag, critical mach number, Prandtl-Meyer expansion flow around convex corners, supersonic airfoil sections, supersonic intakes, friction and heat transfer on compressible flows-shock waves and boundary layer interactions.

AERO 413 ADVANCED AIRCRAFT STRUCTURES **3.0: 3 cr. E**

Analysis of plates & shells; optimum structures, Structural dynamics; Structural fatigue, principles & practices. Introduction to aero elasticity; static & dynamic.

AERO 414 HEAT TRANSFER IN AERONAUTICS **3.0: 3 cr. E**

The course introduces the principles of thermal conduction, convection and radiation as they are applied in the field of aeronautics. It is also concerned with the design and analysis of Heat Exchangers and outlines the basic principles of computational modeling in Heat Transfer.

AERO 421 GAS TURBINE PROPULSION SYSTEMS 3.0:3 cr. E

This advanced course on gas turbine engines is concerned with the identification of the suitability different engines to different flight missions. Details of engine performance during different phases of flight are discussed. In addition, the course seeks to give students insight into the workings of engines at off-design conditions.

AERO 422 AIRCRAFT DESIGN II 3.0: 3 cr. E

Significance of various engineering courses and their interactions in the design process are cleared out, design of an aircraft satisfying certain requirements as the best compromise of several trials and modifications, weight estimation, methods of improvement, minor and major projects in the design of light and large airplanes are assigned to students' teams. A graduate from this course plays the role of an architect and a designing aircraft structural engineer.

Prerequisite: AERO 421.

AERO 423 GAS TURBINE COMBUSTORS 3.0:3 cr. E

Stoichiometry and stoichiometric analysis, complete versus incomplete combustion, enthalpies of formation, flame speeds and flame temperatures, gas turbine combustor design and sizing.

AERO 424 AIRCRAFT MAINTENANCE TECHNOLOGY 1.2: 3 cr. E

A practical course dealing with the general Maintenance Concept, production planning and control of aircraft checks, ground handling, fuselage and airframes, main landing gear, tires and wheels, nose landing gear, braking system, flying controls, aircraft fuel system, engine construction and maintenance, engine fuel system, propeller maintenance utility system, aircraft instruments maintenance and repairs electrical system maintenance and repairs metallic aircraft structural repairs, painting.

AERO 514 AERO-ELASTICITY 3.0: 3 cr. E

Fluid-structure interaction, steady and unsteady aerodynamic loadings, static and dynamic aero-elasticity, flutter and forced vibration analysis, applications to aircraft, rotorcraft and turbomachines.

DEPARTMENT OF CHEMICAL ENGINEERING
BACHELOR'S DEGREE

FIRST YEAR

Semester 1

Course Code	Course Title	Credit
CHEM 202	Basic Chemistry	3
CHEM 203	Basic Chemistry Lab	1
ELEN 201	Instrumentation and Measurements Lab	1
ENGL 203	English Comm. Skills III	3
MATH 200	Calculus I	3
MATH 211	Linear Algebra	3
MECH 221	Engineering Dynamics	3
		17

FIRST YEAR

Semester 2

Course Code	Course Title	Credit
	Technical English	3
CHEM 242	Organic Chemistry I	3
CHEN 212	Chemical Engineering I	3
CHEN 232	Thermodynamics for Chemical Engineers	3
CSIS 200	Introduction to Computers & Programming	3
MATH 202	Calculus II	3
		18

SECOND YEAR

Semester 3

Course Code	Course Title	Credit
CHEM 244	Organic Chemistry II	3
CHEM 245	Organic Chemistry Lab I	1
CHEN 213	Chemical Engineering Lab	1
CVSQ 201	Early Formation of Civilization	3
ELEN 291	Electric Circuits Fundamentals	3
MATH 270	Differential Equations	3
MECH 222	Science of Materials	3
		17

SECOND YEAR

Semester 4

Course Code	Course Title	Credit
	Option Elective	3
CHEM 247	Organic Chemistry Lab II	1
CHEN 312	Mass Transfer	3
CVSQ 202	The Religious Experience	3
ELEN 222	Signals and Systems Theory	3
MATH 246	Probability for Engineers	3
MECH 243	Fluids Mechanics	3
		19

THIRD YEAR

Semester 5

Course Code	Course Title	Credit
	Option Elective	3
CHEM 262	Physical and Chemical Kinetics	3
CHEN 303	Unit Operation Lab	1
CHEN 313	Transport Processes & Unit Operation	3
ELEN 351	Control Systems (Process Control)	3
MATH 230	Numerical Analysis	3
MECH 314	Gas Dynamics	3
		19

THIRD YEAR

Semester 6

Course Code	Course Title	Credit
	Option Elective	3
CHEN 307	Chemical Process Control Lab	1
CHEN 323	Plant and Environmental Safety	3
CHEN 336	Separation Processes	3
CVSQ 203	Introduction to Modernity	3
GENG 390	Undergraduate Project	1
MECH 321	Heat Transfer	3
		17

ELECTIVES FOR MS OPTIONS

General Option

Course Code	Course Title	Credit
CHEN 329	Plant Economics	3
CHEN 325	Chemical Reactions and Reactor Design	3
CHEN 246	Chemical Engineering Instrumentation	3

Petroleum Option

Course Code	Course Title	Credit
CHEN 211	Fundamentals of Geology	3
CHEN 311	Petroleum Fluids	3
CHEN 321	Fundamentals of Petroleum Engineering	3

Food Material Option

Course Code	Course Title	Credit
BIOL 201	General Biology I	3
BIOL 261	Microbiology	3
CHEM 248	Introduction to Biochemistry	3

MASTER'S DEGREE IN CHEMICAL ENGINEERING
General Option

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CHEN 412	Catalytic Processes	3
CHEN 417	Chemical Instrumentation and Measurement	3
CHEN 418	Polymers and Polymer Engineering	3
ELEN 401	Optimization Theory	3
	Elective	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
CHEN 422	Surface and Colloid Chemistry	3
GENG 590	Master Project	3
MECH 511	Computational Fluid Dynamics	3
	Elective	3
		12

FOURTH YEAR

Summer

Course Code	Course Title	Credit
CHEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
CHEN 511	Chemical Reactor Design	3
CHEN 512	Advanced Transport Phenomena	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
	Approved course(s) in Engineering Management	
CHEN 514	Air-Pollution Problems and Control	3
CHEN 515	Dynamics of Particulate Systems	3
CHEN 516	Fuel Cell Technology	3
CHEN 517	Chemical-Process Dynamics and Control	3
ELEN 422	Advanced Control Systems	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN CHEMICAL ENGINEERING

Petroleum Option

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CHEN 411	Reservoir Engineering	3
CHEN 412	Catalytic Processes	3
CHEN 418	Polymers and Polymer Engineering	3
CHEN 431	Oil Field Development	3
ELEN 401	Optimization Theory	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
CHEN 422	Surface and Colloid Chemistry	3
CHEN 432	Natural Gas Engineering	3
GENG 590	Master Project	3
MECH 511	Computational Fluid Dynamics	3
		12

FOURTH YEAR

Summer

Course Code	Course Title	Credit
CHEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
CHEN 511	Chemical Reactor Design	3
CHEN 512	Advanced Transport Phenomena	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CHEN 451	Drilling Engineering	3
CHEN 513	Subsurface Production Engineering	3
CHEN 514	Air-Pollution Problems and Control	3
CHEN 515	Dynamics of Particulate Systems	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

MASTER'S DEGREE IN CHEMICAL ENGINEERING

Food Processing Option

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
CHEN 412	Catalytic Processes	3
CHEN 418	Polymers and Polymer Engineering	3
CHEN 441	Food Sanitation	3
CHEN 442	Chemistry of Food and Bioprocessed Materials	3
ELEN 401	Optimization Theory	3
		15

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
CHEN 422	Surface and Colloid Chemistry	3
CHEN 443	Food Microbiology	3
GENG 590	Master Project	3
MECH 511	Computational Fluid Dynamics	3
		12

FOURTH YEAR

Summer

Course Code	Course Title	Credit
CHEN 480	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
CHEN 541	Quality Control in Food and Bioprocessing	3
CHEN 542	Food Preservation	3
GENG 590	Master Project (Reactivation)	0
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES

Course Code	Course Title	Credit
CHEN 517	Chemical-Process Dynamics and Control	3
CHEN 545	Processing Dairy Products	3
CHEN 546	Food Safety and Public Health	3
CHEN 547	Lactation, Milk, and Nutrition	3

N.B. Student may choose Thesis Option GENG 599, 6 cr. This option will replace GENG 590 and one Elective.

COURSE DESCRIPTIONS

BIOL 201, 202, 261

Refer to Faculty of Sciences, Department of Biology.

CHEM 202, 203, 242, 244, 245, 247, 248, 262

Refer to Faculty of Sciences, Department of Chemistry.

CHEN 211 FUNDAMENTALS OF GEOLOGY 3.0: 3 cr. E

This course provides an introduction to Earth geology. Topics include plate tectonics, the makeup of continents and mountain building. Heat flow, magnetism, gravity, rock deformation, earthquakes and the earth's interior. Surface processes including weathering, erosion, transport and deposition. Landforms, rivers, groundwater, glaciers, ocean processes, and volcanoes. Minerals and rocks.

CHEN 212 CHEMICAL ENGINEERING I 3.0: 3 cr. E

This course provides an introduction to the discipline of chemical engineering. An introduction is provided to the first principles of chemical engineering, as well as environmental, health, safety and ethical issues in chemical engineering practice. An overview is provided of the chemical engineering profession, career choices, the course of study, and a survey of the chemical industry, e.g., polymer, pharmaceutical, food processing, electrochemical, biotechnology, process control, energy, and petroleum refining.

CHEN 213 CHEMICAL ENGINEERING LAB 0.3: 1 cr. E

Experiments covering fundamental material and energy balances, momentum and energy transport operations, and thermodynamics. Computer applications that investigate chemical engineering fluid flow, heat transfer, and thermodynamics.

CHEN 232 THERMODYNAMICS FOR CHEMICAL ENGINEERS 3.0: 3 cr. E

This course presents the basic concepts and definitions; properties of pure substance; heat; work. First Law of Thermodynamics. Second Law of Thermodynamics. Entropy. Reversibility and Irreversibility. Power and refrigeration cycles.

CHEN 246 CHEMICAL ENGINEERING INSTRUMENTATION 3.0: 3 cr. E

This course presents the theory of optical, electro-analytical, and chromatographic methods of analysis, including electronic aspects of modern instrumentation; fundamentals principles and methods used in measurement and control of process variables such as pressure, temperature and flow rate; as well as chemical transducers and statistical methods of data handling.

CHEN 303 UINT OPERATION LAB 0.3: 1 cr. E

This laboratory covers experiments in the area of unit operations which include fluid-flow phenomena through various media such as: friction in conduits, filtration, pressure drop in packed towers, fluidization of solids, and spray drying; heat and mass transfer such as: heat transfer in two heaters and a cooler, climbing film evaporation, multiple effect evaporation, absorption, extraction, distillation and rotary drying of solids.

CHEN 307 CHEMICAL PROCESS CONTROL LAB 0.3: 1 cr. E

This course is intended to provide laboratory application of fundamental principles of chemical process dynamics and feedback control. This includes open-loop dynamics of typical chemical engineering processes

such as distillation, fluid flow, chemical reactors and heated stirred tanks. Closed-loop experiments will involve control loop design, controller tuning, multivariable, and computer control.

Prerequisite: ELEN 351.

CHEN 311 PETROLEUM FLUIDS **3.0: 3 cr. E**

This course covers properties of natural gases; properties of crude oils; fluid phase behavior; vapor-liquid equilibria; equations of state theory and applications; petroleum fluid characterization; petroleum product specifications; surface separations; H2O/hydrocarbon phase behavior; introduction to PVT phase behavior simulation software

CHEN 312 MASS TRANSFER **3.0: 3 cr. E**

This course covers topics on diffusion, convective and interfacial mass transfer, and its application to continuous contact operations; design of equilibrium-stage separation processes including distillation, gas-liquid absorption and stripping, liquid-liquid extraction, and humidification.

CHEN 313 TRANSPORT PROCESSES & UNIT OPERATION **3.0: 3 cr. E**

The course covers the principles of unit operations with emphasis on distillation, absorption, extraction, and fluid-solid systems. Property prediction of multi-component fluids. Cases will cover principles of heat-exchanger design, multi-component fractionation, absorption, stripping and extraction.

CHEN 321 FUNDAMENTALS OF PETROLEUM ENGINEERING **3.0: 3 cr. E**

This course provides and overview of petroleum engineering systems including: uses of petroleum products, exploration, exploitation subjects such as drilling, production, reservoir and formation evaluation, transportation and refining; design of the reservoir management plan; performance prediction; marketing; government regulation.

CHEN 323 PLANT AND ENVIRONMENTAL SAFETY **3.0: 3 cr. E**

The course is designed to acquaint students to topics including chemical plant and environmental accident analysis; review of hazard evaluation procedures including fault tree, hazard and operability studies and human error analysis; safety equipment design; EPA criteria and ethical considerations.

CHEN 3251 CHEMICAL REACTIONS AND REACTOR DESIGN **3.0: 3 cr. E**

This course covers the principles of chemical reactions, emphasizing chemical equilibrium and rate of reaction. It and proceeds to the theory and practice of heat and mass transfer, and important considerations in the design of chemical reactors.

CHEN 329 PLANT ECONOMICS **3.0: 3 cr. E**

Design of equipment, systems and plants; discussion of factors important in chemical plant design such as: economics, cost estimation, profitability, process selection, materials of construction, process control, plant location and safety. Introduction to optimization and computer-aided design. Principles are illustrated with short industrial-type problems. Recommended background: thermodynamics; heat, mass and momentum transfer; inorganic and organic chemistry; chemical kinetics and reactor design.

CHEN 336 SEPARATION PROCESSES **3.0: 3 cr. E**

This course covers concepts on the thermodynamics of equilibrium separation processes such as distillation, absorption, adsorption, crystallization, filtration, membrane processes, extraction, and drying. Multi-staged separations. Principles and processes of some of the less common separations.

CHEN 411 RESERVOIR ENGINEERING **3.0: 3 cr. E**

This course covers the fundamentals of oil and gas reservoirs; reservoir volumetrics; material balance; Darcy's law and equation of continuity; diffusivity equation; streamlines; well models and testing; decline curve analysis; natural water influx; properties of reservoir rocks and homogeneous and multiphase fluid flow in reservoirs; capillary phenomena, relative permeability, compressibility, and fluid saturation distribution.

CHEN 412 CATALYTIC PROCESSES **3.0: 3 cr. E**

This course consists of a process-oriented survey of catalytic technology; catalyst selection and design; catalytic processes, engineering and economics in the petroleum, chemical, and pollution control industries. This course also examines the detailed structures and reactivities of solid catalysts like zeolites, solid state inorganics, supported metals and metal-support interactions, carbon catalysts, anchored catalysts and others.

CHEN 417 CHEMICAL INSTRUMENTATION AND MEASUREMENT **3.0: 3 cr. E**

This course covers the principles of chemical measurement systems from the sensor/transducer unit to the display unit; static and dynamic characteristics; accuracy; loading effects; signals and noise; reliability, choice and economics; sensing elements; signal processing, and software; data presentation. Applications selection from pressure measurement systems; flow measurement systems; heat transfer effects in measurement systems; optical measurement systems; ultrasonic measurement systems; gas/chemical measurement systems.

CHEN 418 POLYMERS AND POLYMER ENGINEERING **3.0: 3 cr. E**

The course covers the chemistry of polymers, addition and condensation polymerization; the physical and mechanical properties, polymer rheology, production methods; and the applications of polymers in the chemical industry.

CHEN 422 SURFACE AND COLLOID CHEMISTRY **3.0: 3 cr. E**

This course examines the factors underlying interfacial phenomena, with an emphasis on the thermodynamics of surfaces, structural aspects, and electrical phenomena. Some applications are studied in the areas of emulsification, detergency, foaming, fluidization, sedimentation, nucleation, wetting, adhesion, flotation, and electrophoresis.

CHEN 431 OIL FIELD DEVELOPMENT **3.0: 3 cr. E**

This course studies the properties of petroleum fluids and reservoir rocks; geophysical environment and exploration methods; drilling and completion methods; well testing; producing mechanisms; evaluation methods.

CHEN 432 NATURAL GAS ENGINEERING **3.0: 3 cr. E**

This course covers the properties of natural gases and condensate systems; gas flow in porous media; gas reservoir engineering; gas field development; gas condensate reservoirs; natural gas transportation and storage.

CHEN 441 FOOD SANITATION **3.0: 3 cr. E**

This course covers hygienic practices, requirements for sanitation programs, and modern sanitation practices in food processing facilities. Topics include need for food safety training, cause of food borne illness; biological food contamination; chemical and physical contamination; purchasing and receiving; storing foods; preparing, cooking, and serving food; cleaning and sanitizing; hazard analysis critical control points (HACCP) and facilities self-inspection.

CHEN 442 CHEMISTRY OF FOOD AND BIOPROCESSED MATERIALS 3.0: 3 cr. E

The course focuses on the properties of biological molecules (e.g., proteins, enzymes lipids, carbohydrates and pigments) found in foods and pharmaceuticals. The course also presents basic elements of molecules, such as structure and reactive groups, in regard to how they affect the properties of foods and pharmaceuticals; and reactions such as Maillard browning and lipid oxidation in regard to mechanisms, products and controlling processes.

CHEN 443 FOOD MICROBIOLOGY 3.0: 3 cr. E

This course covers food relevant microorganisms and their metabolic activities; sources of microbial contamination during food production, processing and storage; microbial spoilage; pathogens; physical and chemical destruction of microorganisms in foods and the kinetics involved; conversions of raw foods by microorganisms into food products.

CHEN 451 DRILLING ENGINEERING 3.0: 3 cr. E

This course presents the concepts on methods and equipment, well kicks and blowouts, drilling fluids, pressure losses in circulating systems, penetration rate, rotary drilling techniques, formation damage, and drilling costs.

CHEN 480 SUMMER TRAINING 4.0: 0 cr. E

Eight weeks of training in a field related to chemical engineering.

CHEN 511 CHEMICAL REACTOR DESIGN 3.0: 3 cr. E

This course deals with interpretation of rate data and development of performance equations for single and multiple reactor systems; design of ideal reactors. Course topics include: deviations from ideal reactor behavior; transport effects in reacting systems; steady state multiplicity and stability analysis; optimization of reactors; analysis of heterogeneous reactors; computer solution simulation for an industrial chemical reaction system.

CHEN 512 ADVANCED TRANSPORT PHENOMENA 3.0: 3 cr. E

This course covers the fundamental theory of mass, momentum and energy transport/balance in porous media; incompressible and compressible fluid flow; applications to fluid drag, piping system design, filtration, packed beds and settling. The course places some emphasis on enhanced oil recovery processes, in situ energy extraction, and other processes relevant to energy production.

CHEN 513 SUBSURFACE PRODUCTION ENGINEERING 3.0: 3 cr. E

This course covers the advanced theories and techniques of tubing and packer design; hydraulic fracturing and acidizing; oil and gas well performance; vertical lift and choke performance; systems analysis; production operations.

CHEN 514 AIR-POLLUTION PROBLEMS AND CONTROL 3.0: 3 cr. E

This course presents advanced concepts on air-pollutant identification and control technology; estimation of pollutant transport, dispersion, and conversion; design of control units using computer simulation applications.

CHEN 515 DYNAMICS OF PARTICULATE SYSTEMS 3.0: 3 cr. E

This course analyzes systems of discrete particles which grow in size or in some other characteristic variable (e.g., age, molecular weight); reaction engineering and population balance analyses are discussed for batch and continuous systems; steady state and transient system dynamics are covered. Application topics may be selected from crystallization, latex synthesis, polymer molecular weight distribution, fermentation/ ecological systems and gas-solid systems.

CHEN 517 CHEMICAL-PROCESS DYNAMICS AND CONTROL 3.0: 3 cr. E

This course provides the tools for designing a strategy for operating a plant and the hardware (sensors, control valves, computer controllers) to make it work. This course focuses on the applications of dynamic process responses based on the principles of material and energy balances, fluid flow, heat transfer, separation processes, and reaction kinetics. The course also covers the elements of a feedback control system including sensors, control valves, and computer-based controllers (feed forward control, cascade control, dead time compensation, and de-couplers)

CHEN 541 QUALITY CONTROL IN FOOD AND BIOPROCESSING 3.0: 3 cr. E

This course covers the principles of quality control in the food and bioprocessing industries; regulations and process control to maintain safety and quality; evaluation of physical, microbiological, chemical, sensory, and stability testing for food and bioprocessed materials; risk assessment, hazard analysis and critical control point, process control, water quality, waste water analysis and reduction; cleaning and sanitation and compliance inspection.

CHEN 542 FOOD PRESERVATION 3.0: 3 cr. E

This course covers the methods employed in food preservation; emphasis on thermal, freezing, drying and fermentation processes and corresponding physical, chemical, and organoleptic changes in product; relationship of these preservation techniques to development of an overall processing operation.

CHEN 545 PROCESSING DAIRY PRODUCTS 3.0: 3 cr. E

This course covers unit operations in dairy processing. Topics include formulation, processing, packaging and evaluation of fluid milk and manufactured products.

CHEN 546 FOOD SAFETY AND PUBLIC HEALTH 3.0: 3 cr. E

This course covers issues and developments related to the relationship between food safety and public health, including emerging food-borne pathogens; virulence and pathogenicity; food-borne toxins; epidemiological techniques used in the investigation of food-borne disease; rapid detection methods; and quantitative microbial risk assessment in food safety.

CHEN 547 LACTATION, MILK, AND NUTRITION 3.0: 3 cr. E

This course focuses on issues related to the nutritional properties of milk as a high-quality food with nutritional diversity; principles of physiology, biochemistry and cell biology in the mammary gland; procedures of milk production and milk collection for milk quality and nutrition; impacts of biotechnology and food safety on dairy production.

CPEN 391 DIGITAL CIRCUITS FUNDAMENTALS 3.0: 3 cr. E

This course is for non-electrical/computer engineering students. It covers the basics of number systems; Boolean algebra; Karnaugh maps; logic gates; combinational and sequential circuit design; adders; multiplexers; flip-flops; counters; shift registers; combinational logic design; sequential circuit analysis and design; registers; counters, and memory system analysis and design; overview of microcontrollers technologies.

Pre-requisite: CSIS 200, MATH 211.

CSIS 200

Refer to Faculty of Sciences, Department of Computer Science.

CVSQ 201, 202, 203
Refer to Faculty of Arts & Social Sciences, Cultural Studies Program.

ELEN 201, 222, 291, 351, 401, 422, 571
Refer to Department of .Electrical Engineering.

ENGL 203, ELECTIVE
Refer to the Division of English Language and Literature.

GENG 301, 390, 402, 590, 599
Refer to Faculty of Engineering Requirements.

MATH 200, 202, 211, 230, 246, 270
Refer to Faculty of Sciences, Department of Mathematics.

MECH 221, 222, 243, 314, 321, 511
Refer to Department of Mechanical Engineering.

MASTER'S DEGREE IN ENGINEERING MANAGEMENT
(5 Electives will define a Concentration)

FOURTH YEAR

Semester 7

Course Code	Course Title	Credit
ENMG 410	Engineering Economics: Analysis and Synthesis	3
ENMG 430	Engineering Management II	3
	Elective	3
	Elective	3
		12

FOURTH YEAR

Semester 8

Course Code	Course Title	Credit
ENMG 420	Financial Engineering	3
ENMG 432	Modern Techniques in Human Resource Management	3
ENMG 450	Management Support Systems	3
ENMG 590	Applied Research Project (Master Project)	3
	Elective	3
		15

FOURTH YEAR

Summer

Course Code	Course Title	Credit
ENMG 593	Field Training	4

FIFTH YEAR

Semester 9

Course Code	Course Title	Credit
ENMG 435	Operations Management	3
ENMG 460	Strategic Decisions and Risk Analysis	3
	Elective	3
	Elective	3
		12

LIST OF ELECTIVES: OPERATIONAL MANAGEMENT CONCENTRATION

Course Code	Course Title	Credit
ENMG 528	Investment Strategies	3
ENMG 530	Management of Organizations	3
ENMG 532	Managing Organizational Behavior	3
ENMG 535	Project Management	3
ENMG 541	Product and Services Development	3
ENMG 546	Supply Chain Design and Management	3
ENMG 547	Strategic Marketing	3
ENMG 580	Quantitative Methods	3
ENMG 581	Game Theory and Strategic Thinking	3

LIST OF ELECTIVES: PROJECT MANAGEMENT AND QUALITY CONTROL

Course Code	Course Title	Credit
ENMG 535	Project Management	3
ENMG 536	Leadership and Professional Responsibility	3
ENMG 539	Strategic Management	3
ENMG 590	Quality Assurance and Control	3
ENMG 591	Quality Control and Reliability Design	3
ENMG 592	Process reengineering/Administrative Reform	3
ENMG 595	Legal Issues for Engineering Managers	3
ENMG 596	System Engineering	3
ENMG 597	Environmental Strategies for Projects Development	3

N.B. Student may choose Thesis Option ENMG 599, 6 cr. This will replace ENMG 590 and one Elective.

COURSE DESCRIPTIONS

ENMG 410 ENGINEERING ECONOMICS: ANALYSIS and SYNTHESIS 3.0: 3 cr. E

This course will introduce you to engineering economics, which is the rigorous application of economics and decision theory to the evaluation of engineering alternatives in planning, developing, constructing, and managing engineering projects. The course reflects the perspective that, eventually, the economy and the economic environment are of significant concern to the engineer. The course examines time value of money, the tax consequences accruing relating to the project, as well as the advantages of utilizing financial leverage provided by various methods of raising required capital.

ENMG 420 FINANCIAL ENGINEERING 3.0: 3 cr. E

This is an introduction into a rapidly developing area of mathematics known as financial engineering. The goal of the course is to provide students with a solid understanding of the tools and techniques for pricing, "hedging", and other analysis. The course will also emphasis on applications, risk management, using derivatives for risk management, and using option modeling in firm decision making. Students will get to know how to use financial Engineering tools-derivative instruments- such as forwards, futures, options, swaps, and related instruments to manage risk and create solutions to financial problems, as well as modern techniques for measuring financial risk

ENMG 430 ENGINEERING MANAGEMENT 3.0: 3 cr. E

This course examines a wide variety of tools, techniques, methods, etc. These methods have particular relevance for improving productivity and competitiveness for many different enterprises and organizations. Hence the main objective of this course is to improve understanding of operational problems and their strategic importance in manufacturing and service organizations. The course starts by looking at different types of operation environments and their links with strategy. It goes on to tackle the planning and control of operations, tools and techniques which are helpful in ensuring optimal use of resources and interfaces with quality management, technology management and distribution management.

ENMG 432 MODERN TECHNIQUES IN HUMAN RESOURCE MANAGEMENT 3.0: 3 cr. E

The purpose of this course is to provide an overview of human resource management, with particular emphasize on the modern approach of total quality management in performance assessment, leadership skills, the motivation and reward systems. The course aims at providing the following benefits: (1) Understand human resource management from a systemic, strategic perspective. (2) Describe the field of "human resource management" and understand its relevance to managers and employees in work organizations. (3) Recognize basic human resource management tools such as performance appraisal forms, and understand some of the technical details of human resource management practices, and (4) Analyze business challenges involving human resource systems.

ENMG 435 OPERATIONS MANAGEMENT 3.0: 3 cr. E

This course focuses on business processes, procedures, analytic methods and strategies used to transform various inputs into finished goods and services. The main course aim is to familiarize students with the problems and issues confronting operations managers, and provide them with language, concepts, insights and tools to deal with these issues in order to gain competitive advantage through operations. Operational issues include designing, acquiring, operating, and maintaining the facilities and processes; purchasing raw materials; controlling and maintaining inventories; and providing the proper labor needed to produce a good or service so that customers' expectations are met.

ENMG 450 MANAGEMENT SUPPORT SYSTEMS 3.0: 3 cr. E

The primary objective of this class is to develop an understanding of the role advanced managerial support systems play in the organization. It involves understanding the information needs of the different levels of management and the types of decision making tasks associated with them, and examining current issues surrounding the development and application of these systems. This course is designed to explore the business use of decision support systems by managers and other knowledge workers and the intersection of these increasingly popular systems with the Internet and digital knowledge resources. Topics include managerial support and decision making, knowledge management, executive decision support, and group decision making.

ENMG 460 STRATEGIC DECISION AND RISK ANALYSIS 3.0: 3 cr. E

Decision and risk analysis is a core course in disciplines of Systems Engineering, Industrial Engineering, Management Science, and Operations Research. This course will develop student knowledge of basic decision analysis concepts, the value of using decision analysis methods to aid in practical decision making problems, and an understanding the contextual considerations in decision making. This course is a study of analytic techniques for rational decision making that addresses uncertainty, conflicting objectives, and risk attitudes.

ENMG 480 FIELD TRAINING 2.0: 4 cr. E

ENMG 528 INVESTMENT STRATEGIES 3.0: 3 cr. E

This course expose students to a wide range of investment philosophies so as to give them a sense of what drives investors in each philosophy, how they attempt to put these philosophies into practice and what determines ultimate success. it expose students to what will be useful to any player in the investments industry, whether a portfolio manager, a corporate financial officer or a private investor. The course will also discuss the structure of the investments industry, in particular the connection between the institutions and the nature of the decision problem faced by practitioners. Students will be provided by sufficient information that will allow them to make their own judgment on the investment strategy that seems to best fit specific goals, views of how markets work.

ENMG 530 MANAGEMENT OF ORGANIZATIONS 3.0: 3 cr. E

This course help students to develop rational management tools for working within an organization by understanding and analyzing some management techniques, concepts of organization, and analytical skills that are useful for effective organizations A key focus is team management skills: how to organize groups for maximum effectiveness, how to motivate group members, and how to promote and reward team success. Management of Organization is appropriate for students who seek to understand some of the theoretical concepts of administration as well as applied techniques of the management function.

ENMG 532 MANAGING ORGANIZATIONAL BEHAVIOR 3.0: 3 cr. E

This course will provide students with the opportunity to develop their understanding of how formal organizations evolve and develop, what contextual and environmental factors affect their evolution, how the behavior of people within the organization interacts with that evolution and help to explain why some of these things happen in the way that they do. Drawing on a range of theories concerning organizational behavior and management practice, it will explore some of the issues around: the nature of power inequalities within organizations, the temporal nature of management theories and allow the student to challenge some traditional 'management thinking' as they are applied into practice.

ENMG 535 PROJECT MANAGEMENT **3.0: 3 cr. E**

This course is for students who have an interest in project management and interest in self-management for improving interpersonal skills. The course will explore the dimensions and elements of project management; concepts, methodologies, strategies, and structures. Attention will also be given to cost controls, teamwork, and quality management. Upon completion of the course, students will be aware of the roles and the techniques that project managers use for producing well controlled and effective project life cycle.

ENMG 536 LEADERSHIP AND PROFESSIONAL RESPONSIBILITY **3.0: 3 cr. E**

This course is designed to teach three primary components of leadership: Group behavior, hard skills and logistical aspects of leadership and professional responsibility. This course considers: 1. the role of business in society, on a local, national, and global basis, 2. economic and ethical aspects of acting as a business professional and the responsibilities that these imply, 3. several models or themes of "leadership" and their application to business.

ENMG 539 STRATEGIC MANAGEMENT **3.0: 3 cr. E**

The theme of this course is the development and implementation of strategic missions, plans, objectives and tactics, with emphasis in engineering firms. Students will set up strategic plans and engage in strategic management. The students learn how to select corporate-level ground strategy types and those of business unit types, evaluate the SWOT of his firm as well as the competitor firms, map the organizational dimensions for strategy implementation, match between the strategy and the structure of the firm, and transform the strategy into action plans and develop an understanding of how an entire organization functions. The primary learning objective for this course is to improve students' ability to understand and reason through strategic organizational issues.

ENMG 541 PRODUCT AND SERVICES DEVELOPMENT **3.0: 3 cr. E**

The focus of Product Design and Development is integration of the marketing, design, and manufacturing functions of the firm in creating a new product. The course is designed to prepare both business and engineering students to contribute in the development of strategies and tasks relevant to new product introductions. The skills developed will enable you to analyze and develop product strategies regardless of your specific functional role. This course will use cases, lectures, specialized assignments, and guest speakers to give students the necessary skills for designing and implementing effective launch strategies and effective business plan for preparation and presentation.

ENMG 546 SUPPLY CHAIN DESIGN AND MANAGEMENT **3.0: 3 cr. E**

The course introduces students to the concept of supply chain, why it is important, and the challenges implicit in managing supply chains. The course will aid the student in understanding the impact of supply chain management on success and profitability, and the influence of an integrated supply chain on major functional activities such as product design, information systems, manufacturing planning, inventory management, human resource development, financial planning, forecasting, sales, and quality management. The emphasis will be on modeling, analysis and implementation issues.

ENMG 547 STRATEGIC MARKETING **3.0: 3 cr. E**

The focus of Strategic Marketing is developing an understanding of customers, the markets they comprise, and the industries that serve them. The course provides a framework for examining key strategic marketing issues faced by modern businesses. As such, it immerses students in the environment in which decisions must be made and businesses must operate. The material covered in Strategic Marketing provides the foundation for preparing marketing feasibility auditing. It also identify internal and external factors that must be considered

in developing longer-term strategies, setting realistic marketing and financial objectives, and organizing for successful implementation of strategies.

ENMG 580 QUANTITATIVE METHODS 3.0: 3 cr. E

This course explores the capabilities and limits of manipulating and analyzing large data sets using various forecasting techniques to make managerial decisions. The course also aims to assist students in using intermediate level statistical methods and tools to gather, analyze, report and use quantitative management information. The course also assists students in bringing together fundamentals of statistics as a source of techniques; textbooks and other statistical materials as a source of structure; Excel as a source of technical assistance; and, problems, scenarios and databases as a source of management information.

ENMG 581 GAME THEORY AND STRATEGIC THINKING 3.0: 3 cr. E

Game theory is the science of strategic interaction. The ultimate goal of this course is to enhance the student's ability to think strategically in complex, interactive situations. The course give a practical yet rigorous introduction to game theory, which is a branch of economics devoted to the study of strategic situations. It covers decisions under uncertainty, unilateral decisions, decision tree, and expected utility with objective and subjective probability. Applications cover managerial decisions such as labour negotiation, litigation, pricing and similar topics, with emphasis on optimal choices and how to restructure situations to encourage optimal outcomes of all parties.

ENMG 590 QUALITY ASSURANCE & CONTROL 3.0: 3 cr. E

This is a practical course in quality management, quality standards and their application in engineering. The course provides a set of tools that can be used in any business to define, monitor, and control quality. Statistical quality control techniques, quality control specifications and standards, benchmarking, and quality function deployment will be covered.

ENMG 591 QUALITY CONTROL AND RELIABILITY DESIGN 3.0: 3 cr. E

This course aims to provide a comprehensive coverage of theory and practices on methods of achieving high quality and reliability in products and processes that are necessary for business, engineering or other types of organizations in order to stay competitive in a market economy. This course covers current advances in quality control. The emphasis of the course is on continuous quality improvement based on reliable designs. It will concentrate on advanced quality control topics including but not limited to, process, capability analysis, philosophies of reliability management, advanced statistical process control, quality costs, and automated quality control.

ENMG 592 PROCESS REENGINEERING/ ADMINISTRATIVE REFORM 3.0: 3 cr. E

The student learns how to redesign the business process of the firm by focusing on organization architecture, current management systems, corporate values and culture, process workflow, and planning and control systems. Ability to design the hard process as well as the soft process in the firm.

ENMG 595 LEGAL ISSUES FOR ENGINEERING MANAGERS 3.0: 3 cr. E

This course is designed to provide the career-engineering manager with a general understanding and knowledge of business law and the legal environment. The course will explore the engineering manager's own role in the legal environment as well as the relationships between engineering managers and other engineering managers, employees, project owners, prime contractors, subcontractors, and the general public. It will cover generally the laws of the constitution, contracts, sales, business organizations, agency and employment, property, government regulation, government contracting, and litigation.

ENMG 596 SYSTEM ENGINEERING **3.0: 3 cr. E**

This course covers concepts of systems engineering. The objective is to provide the advanced knowledge and tools for transforming an operational need into a well-defined system configuration, through an iterative process of analysis, system integration, synthesis, optimization and design. This course is designed to assist students in knowledge essential for the management of new and modified complex system development. The emphasis of this course is on requirements engineering, functional modelling for design, formulation and analysis of alternatives. Methods and software tools for systems engineering design are introduced.

ENMG 597 ENVIRONMENTAL STRATEGIES FOR PROJECTS DEVELOPMENT (PRINCIPLES OF ENVIRONMENTAL ENGINEERING) **3.0: 3 cr. E**

Man and environment, sources of environmental pollution. Water pollution and its control. Principle of water and wastewater treatment. Air pollution and its control. Environmental Impact assessment studies. Applications for all types of projects.

FACULTY OF ENGINEERING REQUIREMENTS

GENG 301 ENGINEERING MANAGEMENT **3.0: 3 cr. E**

Comprehensive and systematic approach to management policies, procedures, principles and practices, planning, organizing, directing, and controlling in engineering management, engineering economics. Market supply and demand. Marketing strategies. Machine and human management.

GENG 390 UNDERGRADUATE PROJECT **0.3: 1 cr. E**

Research work in the related engineering field. Applied using computer packages.

GENG 402 PROJECT MANAGEMENT **3.0: 3 cr. E**

An overview of project: management, definition, planning, implementation, completion, management information systems, rules, responsibility and authority, organizational behavioral skills, case study (leadership effectiveness, management of conflicts, time management, project control), contract managers. Project management software package and application. Financial management. Quality control.

GENG 405 ENGINEERING ETHICS **3.0: 3 cr. E**

With the rapidly changing nature of technology, new complex ethical issues are emerging. The engineering ethics course is designed to help students face ethical dilemmas and deal with them more effectively through developing a critical thinking process, giving them the ability to explore resources, strategies, and options for handling conflicts. The course covers classical ethics theory, then builds on a historical survey of ethical cases to reach a methodology of dealing with contemporary ethical problems faced in the industry, while giving an overview of Codes of Professional Engineering Conduct (Professional Society Codes).

GENG 590 GRADUATE PROJECT **0.4: 3 cr. E**

An approved graduate design project.

GENG 599 ENGINEERING THESIS **0.8: 6 cr. E**

An approved graduate research thesis.