10.1 ABOUT THE PROGRAM

The Energy Engineering Program at the University of the Philippines College of Engineering was instituted in 1983 with the objective of training specialists who will

- develop indigenous sources of energy;
- improve the efficiency of energy utilization, and;
- introduce appropriate energy technologies.

The program was envisioned to be multi-disciplinary, with lecturers and thesis and dissertation advisers coming from the faculty of the different departments and institutes of the college.

The curriculum was revised in 2009 and 2013 to provide a more responsive and comprehensive knowledge base that will enhance the expertise of researchers, engineers, and scientists in developing and managing applied energy technologies and in developing analytical tools for energy planning; to effectively transmit critical technical and policy-oriented knowledge to support institutions, and; to meet the demands of the dynamic and complex character of an evolving energy sector within a competitive and market-based framework.

10.2 VISION

A regional hub for energy knowledge and technology and a pro-active contributor to the country's progress toward energy security and sustainable development.

10.3 MISSION

To engage in energy research and development of regional and national relevance; to produce solutions-oriented leaders in the energy sector, and; to provide expert advice on energy issues of regional and national interest.

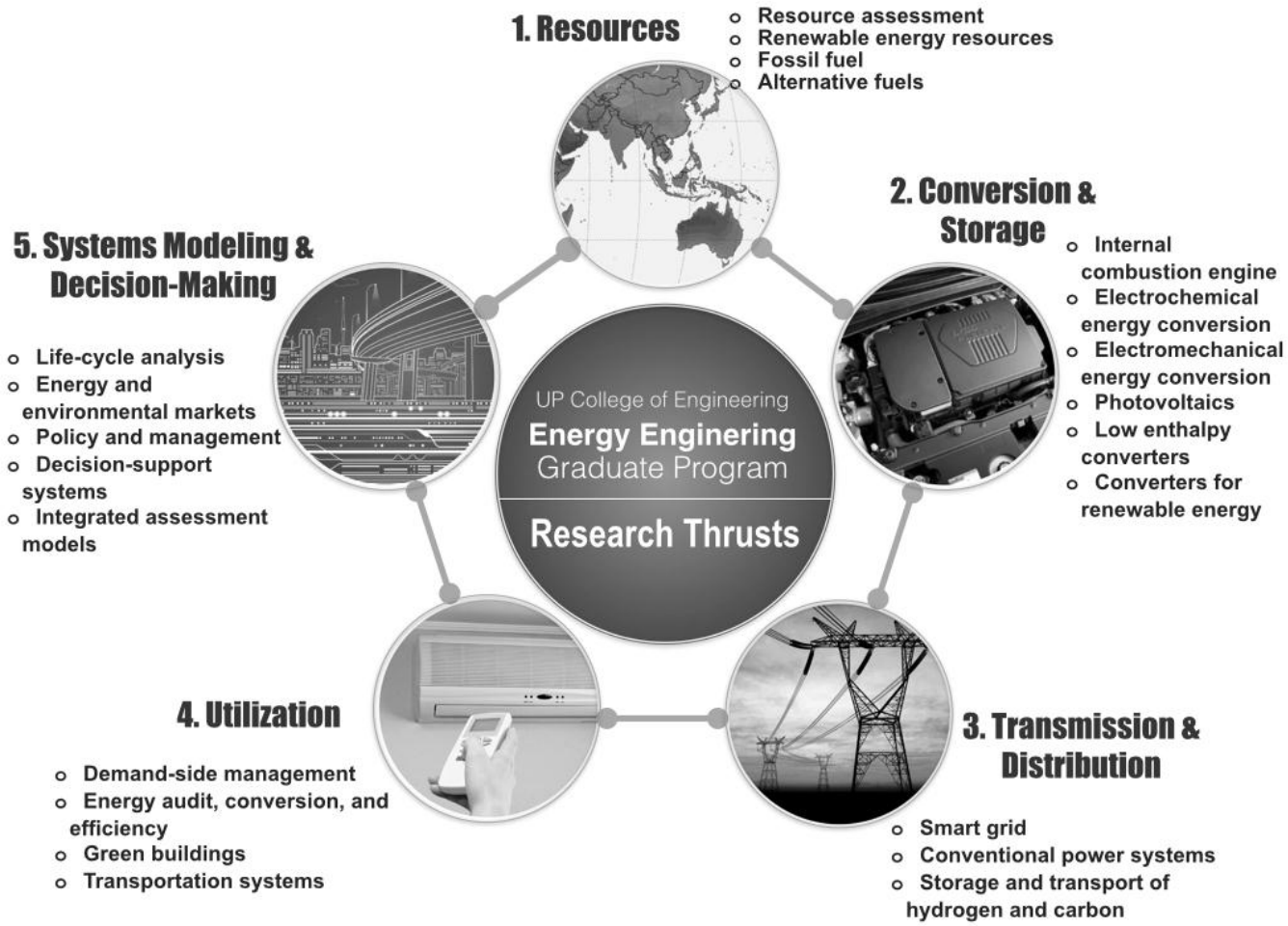
10.4 RESEARCH THRUSTS

The research thrusts of the graduate program are divided into five categories:

- Energy Resources
- Energy Conversion and Storage
- Transmission and Distribution
- Energy Utilization
- Energy Systems Modeling and Decision-Making

10.5 GRADUATE PROGRAMS

The graduate programs offered are Master of Science



in Energy Engineering (M.S. EgyE), and Doctor of Philosophy in Energy Engineering (Ph.D. EgyE).

10.5.1 Master of Science in Energy Engineering

Under the Master's program, the student may choose between the Thesis Option and the Non-Thesis Option.

In the Thesis Option, students are required to complete at least 26 units of formal graduate courses, to successfully defend Master's thesis, and to produce a pre-print paper.

In the Non-Thesis Option, the students are required to complete at least 38 units of formal graduate courses and to pass a comprehensive examination. In both options, the student should maintain a cumulative weighted average grade (CWAG) of 2.00 or better at the end of each academic year.

10.5.2 Doctor of Philosophy in Energy Engineering

The general requirements of the Ph.D. EgyE program are

- Completion of at least 26, 30, or 48 units of formal graduate courses
- CWAG of 1.75 or better
- Candidacy examination
- Successful defense of Ph.D. dissertation
- At least one pre-print paper.

The number of units of formal graduate courses depends on the entry-level qualification of the student: 26 units are required for those who graduated from the M.S. EgyE program of UP Diliman; 30 units are required for those who graduated from an allied Master's degree; 48 units are required for those coming directly from a B.S. degree.

The dissertation proposal is equivalent to the candidacy examination.

For the M.S. EgyE and Ph.D. EgyE curricula and course descriptions, see Sections 10.8 and 10.10 respectively.

10.6 FACILITIES

Students preparing their proposal or doing their thesis or dissertation are usually hosted by the research laboratories of their advisers. The following is the list of research laboratories and facilities that can host M.S. or Ph.D. EgyE students:

Department of Mechanical Engineering
Vehicle Research and Testing Laboratory

Department of Chemical Engineering
Fuels, Energy and Thermal Systems Laboratory
Laboratory of Electrochemical Engineering

Department of Industrial Engineering and Operations Research
Computing Laboratory

Department of Geodetic Engineering
Applied Geodesy and Space Technology
EnviSAGE Research Laboratory

Department of Mining, Metallurgical, and Materials Engineering
Advance Ceramics Laboratory, Materials for Energy

Electrical and Electronics Engineering Institute
Solar Photovoltaics Laboratory
Power Simulation Systems Laboratory
Smart Grid Research Center
Electric Power Research Laboratory

Institute of Civil Engineering
Transport and Environment Group, National Center for Transportation Studies

The administration office of the program is at Melchor Hall 327. A building to be jointly used by the Energy Engineering and Environmental Engineering Programs is under construction.

10.7 FACULTY AND STAFF

Program Coordinator

Dr. Michael Angelo A. Pedrasa
Electrical and Electronics Engineering Institute
mapedrasa@upd.edu.ph

Energy Engineering Committee

Dr. Ariel C. Blanco
Department of Geodetic Engineering
acblanco.updge@gmail.com

Dr. Rinlee Butch M. Cervera
Department of Mining, Metallurgical and Materials Engineering
rb.cervera@coe.upd.edu.ph

Dr. Louis Angelo M. Danao
Department of Mechanical Engineering
louisdanao@coe.upd.edu.ph

Dr. Joey D. Ocon
Department of Chemical Engineering
joey.ocon@gmail.com

Dr. Jordan Rel C. Orillaza
Electrical and Electronics Engineering Institute
jordan@eee.upd.edu.ph

Dr. Mili-Ann M. Tamayao
Department of Industrial Engineering and Operations Research
mamtamayao@gmail.com

Dr. Karl N. Vergel
Institute of Civil Engineering
karlvergel@gmail.com

Faculty from Other Departments and Institutes

Department of Chemical Engineering

Dr. Rizalinda L. de Leon
rizalinda.deleon@coe.upd.edu.ph

Dr. Analiza P. Rollon
analiza.rollon@up.edu.ph

Prof. Ralph P. Villa
ralph.villa@upd.edu.ph

Prof. Patrick D. Ramoso
pdramoso@upd.edu.ph

Department of Computer Science

Dr. Vena Pearl Boñgolan
vabongolan@dcs.upd.edu.ph

Dr. Prospero C. Naval, Jr.
pcnaval@dcs.upd.edu.ph

Department of Geodetic Engineering

Dr. Enrico C. Paringit
paringit@gmail.com

Prof. Ma. Rosario Concepcion O. Ang
concon.ang@gmail.com

Department of Industrial Engineering and Operations Research

Dr. Eugene Rex L. Jalao
eljalao@up.edu.ph

Dr. Aura C. Matias
aura.matias@coe.upd.edu.ph

Prof. Erickson L. Llaguno
ellaguno@gmail.com

Prof. Nestor O. Raneses
nraneses@gmail.com

Department of Mechanical Engineering

Dr. Menandro S. Berana
menandro.berana@coe.upd.edu.ph

Dr. Edwin N. Quiros
edwin.quiros@up.edu.ph

Dr. Joseph Gerard T. Reyes
jogereyes@gmail.com

Prof. Ferdinand G. Manegdeg
fgmanegdeg@yahoo.com

Department of Mining, Metallurgical and Materials Engineering

Dr. Arturo B. Cortes
black_udder@hotmail.com

Institute of Civil Engineering

Dr. Maria Antonia N. Tanchuling
tonitanch@gmail.com

Electrical and Electronics Engineering Institute

Dr. Allan C. Nerves
allan.nerves@up.edu.ph

Prof. Rowaldo M. Del Mundo
rddelmunod@up.edu.ph

Prof. Miguel T. Escoto, Jr.
mikee@eee.upd.edu.ph

Lecturers

Dr. Alma Bella P. Madrazo
Mr. Renato T. Goco
Ms. Edna A. Espos

Administrative Staff

Ms. Jocelyn V. Villacentino
jo.villacentino@gmail.com

CONTACT INFORMATION

Mail:

Energy Engineering Program
Rm 327 Melchor Hall
Osmeña Avenue
University of the Philippines Diliman
Quezon City 1001

Tel:

VoIP +63-2 981-8500 local 3153

10.8 GRADUATE PROGRAMS CURRICULA

Master of Science in Energy Engineering (M.S. EgyE)

Program Checklist

Curriculum	Number of Units	
	Thesis Option	**Non-Thesis Option**
Major Courses	**16**	**22**
EgyE 201 Energy Resources, Uses and Systems EgyE 205 Energy Engineering Laboratory EgyE 211 Energy Conservation EgyE 231 Energy Economics and Systems Evaluation EgyE or other Graduate Engineering Course[1]	3 1 3 3 6	3 1 3 3 12
Applied Mathematics Courses[2]	**6**	**6**
Electives[3]	**3**	**9**
EgyE 296 Seminar[4]	**1**	**1**
EgyE 300 Thesis[5]	**6**	**N/A**
Comprehensive Examination	**N/A**	**Required**
TOTAL	**32**	**38**

Notes:

1. EgyE courses that may be taken as Major Courses:

EgyE 220 Coal Technology
EgyE 221 Solar Energy I
EgyE 222 Biomass Energy
EgyE 223 Wind, Hydro and Ocean Energy Conversion Systems
EgyE 225 Nuclear Energy
EgyE 235 Energy Technology Assessment
EgyE 236 Energy Systems Modeling
EgyE 251 Energy Planning
EgyE 272 Waste Heat Recovery and Co-generation
EgyE 273 Power Plant Technology
EgyE 297 Special Topics
EgyE 298 Special Problems
Advanced Course in Thermodynamics
Advanced Course in Heat Transfer

Other graduate courses offered by the College of Engineering and aligned with the student's research interest may be taken as Major Courses upon approval by the program adviser.

2. Applied Mathematics Courses

The student may choose from the Applied Mathematics courses offered by the College of Engineering, such as

ES 201 Advanced Mathematical Methods in Engineering I
ES 202 Advanced Mathematical Methods in Engineering II

ES 204 Numerical Methods in Engineering
IE 211 Quantitative Methods in Industrial Engineering
IE 214 Introductory Operations Research
IE 230 Statistical Design and Analysis for Engineers
EE 214 Probability and Random Processes in Electrical Engineering

Applied Mathematics courses may also be taken from the College of Science and the School of Statistics, upon the consent of the program adviser and the instructor or department offering the course.

3. Electives

Electives approved by the program adviser may be taken from graduate courses offered by the College of Engineering, upon the consent of the instructor or department offering the course, such as but not limited to

EgyE 290 Special Project
EgyE 297 Special Topics
EgyE 298 Special Problems
ChE 229 Advanced Chemical Reaction Engineering I
ChE 231 Advanced Chemical Reaction Engineering II
EE 355 Power System Planning
EE 357 Power System Dynamics and Stability
EE 358 Economic Operation of Power Systems
GmE 202 Principles of Remote Sensing
GmE 203 Principles of Geographic Information Systems
GmE 204 Applied Resources Information System
IE 241 Operations Research I
IE 242 Operations Research II
ME 224 Design of Fluid Machinery and Systems
ME 286 Combustion
ME 287 Fuels and Thermal Power

Electives may also be taken from graduate courses offered by the National Center of Public Administration and Governance, Technology Management Center, School of Economics, College of Science, and School of Urban and Regional Planning, upon approval by the program adviser and subject to the consent of the instructor or the department offering the course.

4. It is recommended that EgyE 296 Seminar is taken before enrolling in EgyE 300 Thesis.

5. EgyE 300 may be taken as a single 6 unit course or as two 3 unit courses. The prerequisite of the 6 unit course is a successful thesis proposal. If will be taken as two 3 unit courses, the prerequisite of the first 3 units is endorsement of thesis adviser. A grade of ‘Pass’ will be given upon successful presentation of the proposal. The prerequisite of the second 3 units is a grade of ‘Pass’ in the first 3 units.

Doctor or Philosophy in Energy Engineering (Ph.D. EgyE)

Program Checklist

Curriculum	Number of Units		
	B.S.	**M.S. Allied Field**	**UP Diliman M.S. EgyE**
Core Courses[1]	**19**	**13**	**9**
EgyE 201 Energy Resources, Uses and Systems	3	3	N/A
EgyE 205 Energy Engineering Laboratory	1	1	N/A
EgyE 211 Energy Conservation	3	3	N/A
EgyE 231 Energy Economics and System Evaluation	3	3	N/A
EgyE 236 Energy Systems Modeling	3	0	3[1]
EgyE 320 Energy Resource Assessment	3	3	3[1]
EgyE 332 Energy Optimization and System Dynamics	3	0	3[1]
Applied Mathematics Course[2]	**9**	**3**	**3**
Specialty Course[3]	**9**	**6**	**6**
Elective(s)[4]	**6**	**3**	**3**
EgyE 290 Special Project	**3**	**3**	**3**
Seminar	**2**	**2**	**2**
Dissertation[5]	**12**	**12**	**12**
TOTAL	**60**	**42**	**38**

Notes:

1. If any of these courses were credited towards the M.S. EgyE degree, other EgyE courses may be taken as core courses.

2. Applied Mathematics Courses

The student may choose from applied Mathematics courses offered by the College of Engineering, such as

ES 201 Advanced Mathematical Methods in Engineering I
ES 202 Advanced Mathematical Methods in Engineering II
ES 204 Numerical Methods in Engineering
IE 211 Quantitative Methods in Industrial Engineering
IE 214 Introductory Operations Research
IE 230 Statistical Design in Industrial Engineering
EE 214 Probability and Random Processes in Electrical Engineering

Applied Mathematics Courses may also be taken from the College of Science and the School of Statistics, upon the consent of the instructor or department offering the course.

3. Specialty Courses

EgyE Courses that may be taken as Specialty Courses:

EgyE 220 Coal Technology
EgyE 221 Solar Energy I
EgyE 222 Biomass Energy

EgyE 223 Wind, Hydro and Ocean Energy Conversion Systems
EgyE 235 Energy Technology Assessment
EgyE 251 Energy Planning
EgyE 272 Waste Heat Recovery and Cogeneration
EgyE 273 Power Plant Technology
EgyE 321 Solar Energy II
EgyE 322 Advanced Biomass Energy
EgyE 323 Advanced Wind, Hydro and Ocean Energy Conversion Systems
EgyE 324 Geothermal Energy
EgyE 331 Regulation and Economics of Energy Utilities

Other Specialty Courses that may be taken upon consent of the program and adviser, and the instructor or department/institute offering the course:

CE 211 Free Surface Flow
CE 212 Applied Hydrology
ChE 229 Advanced Chemical Reaction Engineering I
ChE 231 Advanced Chemical Reaction Engineering II
EE 355 Power System Planning
EE 357 Power System Dynamics and Stability
EE 358 Economic Operation of Power Systems
GmE 202 Principles of Remote Sensing
GmE 203 Principles of Geographic Information Systems
GmE 204 Applied Resource Information Systems
IE 241 Operations Research I
IE 242 Operations Research II
ME 224 Design of Fluid Machinery and Systems
ME 286 Combustion
ME 287 Fuels and Thermal Power
An Advanced Course in Thermodynamics
Advanced Course in Heat, Mass and/or Momentum Transfer

Other graduate courses suited to the student's research interest and background may be taken from the College of Engineering or from other colleges upon consent of the program adviser and instructor or department offering the course.

4. Electives approved by the program adviser may be taken from graduate courses offered by the College of Engineering, upon consent of the instructor or department offering the course, such as but not limited to

EgyE 297 Special Topics
EgyE 298 Special Problems
CE 211 Free Surface Flow
CE 212 Applied Hydrology
ChE 229 Advanced Chemical Reaction Engineering I
ChE 231 Advanced Chemical Reaction Engineering II
EE 355 Power System Planning
EE 357 Power System Dynamics and Stability
EE 358 Economic Operation of Power Systems
GmE 202 Principles of Remote Sensing
GmE 203 Principles of Geographic Information Systems
GmE 204 Applied Resource Information Systems
IE 241 Operations Research I
IE 242 Operations Research II
ME 224 Design of Fluid Machinery and Systems
ME 286 Combustion
ME 287 Fuels and Thermal Power

Electives may also be taken from graduate courses offered by the National Center of Public Administration and Governance, Technology Management Center, School of Economics, College of Science, School of Urban and Regional Planning upon approval by the program adviser and subject to the consent of the instructor or the department offering the course.

5. The first enrollment of EgyE 400 is for 3 units only. The student will get a grade of ‘Pass’ upon successful presentation of the dissertation proposal (which is also the candidacy examination). The prerequisite of the succeeding EgyE 400 units is a grade of ‘Pass’ on the first 3 units.

10.9 UNDERGRADUATE COURSE DESCRIPTIONS

Energy Engineering (EgyE)

EgyE 101 Introduction to Energy Engineering. Energy resources, conversion, uses, and conservation. Prereq: Senior standing. 3 u.

EgyE 197 Special Topics. 3 u. May be taken twice.

10.10 GRADUATE PROGRAMS COURSE DESCRIPTIONS

Energy Engineering (EgyE)

EgyE 201 Energy Resources, Uses and Systems. World, regional and national energy resources and demand. Energy data system: boundaries, framework, flow diagrams, reference energy system, input/output. Non-renewable resources: oil, natural gas, coal, nuclear. Renewable energy resources: solar, wind, hydro, biomass, geothermal, ocean. Energy use: residential, commercial, industrial, transport, etc. Energy technologies and energy issues. Prereq: COI. 3 u.

EgyE 205 Energy Engineering Laboratory. Laboratory methods in energy engineering. Prereq: COI. 1 u.

EgyE 211 Energy Conservation. Energy conservation techniques. Conservation methods in the home, in transportation, in industrial and commercial sectors. Inter-fuel substitution. Factors in the design of low-energy consumption buildings. Prereq: COI. 3 u.

EgyE 220 Coal Technology. Coal properties. Philippine coal resources and coal utilization. Coal mining. Coal cleaning and conversion technology. Environmental concerns. Prereq: COI. 3 u.

EgyE 221 Solar Energy I. Solar energy collection, storage, and utilization. Design and economics. Prereq: COI. 3 u.

EgyE 222 Biomass Energy. Biomass production. Biomass conversion including: compaction, combustion, gasification, pyrolysis, hydrolysis and fermentation. Vegetable oil extraction and transesterification. Biogas production. Energy crops. Environmental and societal aspects of biomass utilization. Prereq: COI. 3 u.

EgyE 223 Wind, Hydro and Ocean Energy Systems. Resource assessment, analysis, design, operations, utilization, and environmental and societal aspects of wind, hydro, and ocean energy systems. Prereq: COI. 3 u.

EgyE 225 Nuclear Energy. Design and economics of nuclear energy systems. Environmental and societal aspects. Prereq: COI. 3 u.

EgyE 231 Energy Economics and Systems Evaluation. Setting of objectives. Value systems analysis. Multiple criteria evaluation. Economics of energy. Technological, economic, societal and environmental factors. Prereq: COI. 3 u.

EgyE 235 Energy Technology Assessment. Methods of technology assessment. Technical, economic, environmental, social and institutional impact analyses of energy systems. Prereq: COI. 3 u.

EgyE 236 Energy Systems Modeling. Macro-economic growth models. Inter-industry/Input-Output models. Energy market models. Energy aggregation. Factor analysis. Representation of the energy sector network. Network-based energy system modeling. Specific industry models including electric power, gas, coal, and oil. Prereq: COI. 3 u.

EgyE 251 Energy Planning. Energy and development. Energy supply analysis. Energy demand analysis. Supply-demand balancing. Electric power system planning. Rural electrification planning. Prereq: COI. 3 u.

EgyE 272 Waste Heat Recovery and Cogeneration. Identification, evaluation, and recovery of waste heat. Applications and case studies. Prereq: COI. 3 u.

EgyE 273 Power Plant Technology. Fuel selection. Steam cycles. Power plant design. Control of pollutant emissions. Power economics. Prereq: COI. 3 u.

EgyE 290 Special Project. A countryside-oriented project on energy alternatives, conservation or development to be undertaken individually by the student. The output of the project shall be a device, process, system, or concrete proposals for specific action which will be of practical benefit to people in the rural communities. 3 u.

EgyE 296 Seminar. Prereq: COI. 1 u. May be taken thrice.

EgyE 297 Special Topics. Prereq: COI. 3 u. May be taken twice.

EgyE 298 Special Problems. Prereq: COI. 3 u. May be taken twice.

EgyE 300 Master's Thesis. 6 u.

EgyE 320 Energy Resource Assessment. Definition and measurement of energy stocks and flows. Fuel cycle. Exploration and production techniques. Technologies of utilization. Methods of energy resource assessment. Methods of energy demand analysis. Prereq: EgyE 201 or COI. 3 u.

EgyE 321 Solar Energy II. Physics of semiconductors and materials in photovoltaic devices. Physical models of solar cell operation. Characteristics, design, and fabrication of common types of solar cells. Approaches to increasing solar cell efficiency. Radiant energy transfer and its application to solar exchangers. Energy balances for solar exchangers. Theory, economics, and practice of solar-thermal energy applications. Prereq: COI. 3 u.

EgyE 322 Advanced Biomass Energy. Biomass production. Biomass conversion including compaction, combustion, gasification, pyrolysis, hydrolysis and fermentation. Vegetable oil extraction and transesterification. Biogas production. Energy crops. Environmental and societal aspects of biomass utilization. Prereq: EgyE 222 or COI. 3 u.

EgyE 323 Advanced Wind, Hydro and Ocean Energy Conversion Systems. Geographical, meteorological and aerodynamic analysis of wind energy potential. Hydrological and hydraulic analysis of hydro energy potential. Assessment of wave, tide, current and ocean thermal energy. Survey and classification of wind, hydro and ocean energy conversion technology. Case analysis, modeling, design, operations and performance of wind, hydro and ocean engineering systems. Prereq: EgyE 223 or COI. 3 u.

EgyE 324 Geothermal Energy. Description of geothermal energy and comparison with other forms of energy. Types and geographic locations. Design and economics of geothermal energy systems. Types of geothermal power plants. Operational, maintenance, environmental and social concerns. Direct uses of geothermal energy. Heat pump basics. Prereq: COI. 3 u.

EgyE 332 Energy Optimization and System Dynamics. Total systems design. Systems theory and application of modeling and simulation techniques in energy systems design. Optimization and system dynamics. Prereq: EgyE 236 or COI. 3 u.

EgyE 397 Special Topics. Prereq: COI. 3 u. May be taken more than once provided the topic is not the same.

EgyE 398 Special Problems. Prereq: COI. 3 u.

EgyE 400 PhD D**issertation**. 12 u.