

	D	E	G	H	I	J	K	L
1	Root Catalogue Nbr	Catalogue Nbr	Weight	Pre/Co Requisite	Contact hours (per week)	U/G Equivalent	Course Title	Course Description
3							General Chemical Engineering	General Chemical Engineering
4	849	CBE 9132	0.5	none	3 hour lecture	CBE 4432	OIL REFINING AND PROCESSING	Petroleum reservoirs and oil production processes. An introduction to petroleum refining processes, operations, feedstocks and products. Configurations of refinery processes and their evolution will be discussed in view of environmental efficiency and economic considerations. Current trends and future of the industry will be addressed.
5	852	CBE 9150	0.5	CBE 2224 or equiv	3 hour lecture		ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS	Advanced phase and reaction equilibrium with molecular and macroscopic theories of fluids. The practical applications of thermodynamics to practical problems in chemical engineering such as phase equilibria, solutions and reaction equilibria in separations and reaction engineering.
6	851	CBE 9160	0.5	none	3 hour lecture		TRANSPORT PROCESSES	This course is targeted at graduate students of engineering and applied science. Basic principles of momentum transport (viscous flow), energy transport (heat conduction, convection and radiation) and mass transport (diffusion) will be covered. A wealth of real-world engineering examples will be discussed to give students a feel for how momentum, heat and mass transport is applied in engineering practice and to develop an intuitive understanding by combining the physics and physical arguments.
7	699	CBE 9170	0.5	CBE 2291	3 hour lecture		MATHEMATICAL METHODS IN ENGG	This course is targeted at graduate students, who are interested in process modeling and simulation for various engineering processes. The course covers both analytical and numerical techniques in solving the associated algebraic as well as differential equations. Analytical methods such as eigenvalue-eigenvector and Green's function method, and fundamentals of numerical methods such as finite difference, collocation and finite element methods are discussed. All fundamental concepts are introduced with applications related to engineering. Some background knowledge in analytical methods and numerical analysis from undergraduate modules will be beneficial.
8		CBE 9173	0.5	background in Mass Transfer	3 hour lecture; 2 hours tutorial		CHEMICAL PROCESS SAFETY	This course provides an in-depth study of process safety, emphasizing on topics which enables engineers to analyze and solve safety related problems in chemical industries.
9	854	CBE 9180	0.5	none	3 hour lecture; 4 lab sessions		INSTRUMENTAL METHODS OF ANALYSIS FOR ENGINEERS	This course is targeted at engineering graduate students who are interested in getting acquainted with modern analytical instrumentation. The course is designed to give practical experience using modern analytical instrumentation and to provide the background theory and principles of operation. As such, it has both a laboratory and lecture component. In the lectures the chemical or physical principles exploited during the measurement will be presented. In the laboratory, this knowledge will be put into practice by performing experiments designed to provide examples of the usefulness of the particular instrument or technique. The course will emphasize specific applications in Chemical and Environmental Engineering. Some of the topics will be tailored to the specific interest and needs of the students enrolled.
10	708	CBE 9182	0.5	TBD	2 hour lecture; 1 hour tutorial		ENGINEERING PROPOSAL PREPARATION	The objective of this course is to learn how to prepare and evaluate proposals for academic grants and industrial contracts.
11		CBE 9185	0.5	none	3 hour lecture; 2 hours tutorial		RISK ASSESSMENT & MANAGEMENT IN ENGINEERING SCIENCE	Engineering design, manufacturing, and operation are influenced by risk and uncertainties. This course is about an introduction to qualitative and quantitative risk management in engineering systems. Various risk management concepts, tools and techniques are discussed with main emphasis on risk assessment and management.
12	509	CBE 9190	0.5	SS 2241 or SS 2143	3 hour lecture; 1 hour tutorial		STATISTICAL PROCESS ANALYSIS	This course is for engineers involved with experimental investigation and interpretation of data. Basic, applied statistical concepts are reviewed. Regression analysis techniques for fitting and discrimination of the theoretical models are discussed. Methods for design and analysis of experiments are discussed to review latest developments in the general area of Chemical Engineering. This course is normally reserved for new course offerings until a course number is permanently assigned, or a summer course which may be taught by visiting professors.
13	660	CBE 9199	0.5	TBD	3 hour lecture		SELECTED TOPICS IN CHEMICAL ENGINEERING	This course will provide an introduction of materials science and engineering topics. Four materials (metals, ceramics, polymers, composites) will be addressed, along with the structure and properties of biologic tissues and biocompatibility. Specific implant applications will also be addressed.
14		CBE 9250	0.5	CBE 4421	3 hour lecture; 1 hour tutorial		ADVANCED BIOMATERIALS ENGINEERING	
15								
16							Biomaterials & Biochemical Engineering	Biomaterials & Biochemical Engineering
17	695	CBE 9211	0.5	limited	3 hour lecture; 3 hour lab	CBE 3301	FUNDAMENTALS OF BIOCHEMICAL ENGINEERING	To introduce graduate student to the basic principles of transfer in biochemical engineering kinetics and bioreactors.
18								
19		CBE 9260	0.5	none	3 hour lecture		ADVANCED BIOENGINEERING & BIOTECHNOLOGY	This course will introduce graduate students to advanced topics in biochemical engineering. Students will be provided with an understanding of the underlying molecular biology of industrially relevant processes and will be introduced to modern techniques and practices in biotechnology and bioengineering.
20		CBE 9265	0.5	Chem 1024			MICROALGAL SYSTEMS: BIOTECHNOLOGY AND APPLICATIONS	Microalgae are being considered with renewed interest as a source of cheap feedstock for a myriad of applications including next generation biofuels, nutraceuticals, production of clean water and for the capture of carbon dioxide. In this course, the fundamentals of microalgal systems are discussed. The basics of the biochemistry, microbiology and classes of microalgae are covered. Applications and design of microalgal systems are discussed.
21	856	CBE 9271	0.5	none	3 hour lecture	CBE 4413	NANOBIOENGINEERING	This course introduces the fundamental concepts of nanobiotechnology and the up-to-date application of nanotechnology to life science. In this course, nanofabrication and the interaction between nanostructured materials and biological system are addressed. Through introducing the vital information on application of nanotechnology, this course presents how to
22	615	CBE 9299	0.5	TBD	3 hour lecture		SELECTED TOPICS IN BIOCHEMICAL ENGINEERING	This course deals with specialized topics in the following areas: advanced microbial growth kinetics, immobilized cells and enzymes, biochemical products recovery, cell disruption, hydrodynamics and mass transfer problems in fermentation, renewable energy and chemical resources, novel microbial products, future trends in biochemical engineering.
23								
24							Environmental & Green Engineering	Environmental & Green Engineering
25	700	CBE 9371	0.5	none	3 hour lecture		GREEN ENERGY AND ENGINEERING	Overview of emerging area of green engineering and designing environmentally friendly supercritical processes. Emphasis on the student developing an individual design project to analyse a solution to a modern chemical engineering problem, where organic solvents are replaced with benign solvents.
26	654	CBE 9312	0.5	none	3 hour lecture	CEE 4405	AIR POLLUTION CONTROL	Overview of air pollution control; sources, sampling and characterization of air pollutants; equipment design principles for gaseous/particulate emission control; systems approach to air pollution control process development.
27	669	CBE 9314	0.5	none	3 hour lecture	CBE 4407	SOLID WASTE TREATMENT	Sources of solid waste and reduction at the source; physical, chemical and biological treatment of solids; design of fluidized incinerators; removal of hazardous substances from contaminated soil by chemical and biological methods.
28		CBE 9334	0.5	none			GREEN FUELS AND CHEMICALS	This course is intended to provide graduate students with advanced knowledge on Green Fuels and Chemicals.
29		CBE 9350	0.5	none	3 hour lecture		PHYSICAL PRINCIPLES OF ENVIRONMENTAL ENGINEERING	To learn the fundamentals and applications of mass, momentum, and heat transport in environmental engineering; concepts of advection, diffusion, dispersion, settling, surface transfer, kinetics and equilibrium processes in air, water and soil; quantitative applications in natural environment and treatment systems.
30	570	CBE 9361	0.5	none	3 hour lecture		BIOLOGICAL WASTEWATER TREATMENT	Analysis of aeration systems; biological reactions and energetics; biokinetic models including Monod; Analysis and design of activated sludge systems; analysis of detached growth systems anaerobic sludge digestion; sludge processing including thickening and dewatering.
31		CBE 9399	0.5	YBD	3 hour lecture		SELECTED TOPICS IN ENVIRONMENTAL AND GREEN ENGG	Course is designed to review latest developments in the general area of reaction and process systems engineering. This course is normally reserved for new course offerings until a course number is permanently assigned, or a summer course which may be taught by visiting professors.
32								
33							Reaction & Process Systems Engineering	Reaction & Process Systems Engineering
34	511	CBE 9417	0.5	none	3 hour lecture	CBE 4411	INDUSTRIAL CATALYSIS	Kinetics and mechanism of catalytic reactions with emphasis on heterogeneous catalytic reactions. Case studies of several industrial catalytic processes developed recently.
35	850	CBE 9424	0.5	Intro in Process & Dynamics	3 hour lecture; 3 hours PC lab		COMPUTER PROCESS CONTROL	The course covers more advanced topics in process control such as feedback and Feedforward, Cascade and Multivariable Control. Design of multivariable control systems using continuous State Space Methods is covered. Use of Real Time Process Control Computers for data acquisition and control are introduced.
36		CBE 9458	0.5	none	3 hour lecture		INDUSTRIAL CRYSTALLIZATION	The objective of this graduate course is to introduce and prepare students who have no or little background in crystallization with skills to conduct independent research in the various aspects of industrial crystallization. The expertise developed in this course can be applied to the crystallization of inorganic, small and large organic molecules. The course is primarily concerned with the crystallization from solution in batch and continuous systems.
37	538	CBE 9450	0.5	none	3 hour lecture; 3 hour PC lab		ADVANCED CHEMICAL REACTION ENGINEERING	Characteristic functions in a real reactor. Experimental determination. Moments of a pulse. Segregated flow. Micro and Macro fluids. The fluidized bed reactor. The contact time distribution functions. The grid and free-board. The fixed bed reactor. Stability and parametric sensitivity. Numerical methods. Physical and chemical process in a catalyst. Masses and thermal effects in catalyst particles.
40		CBE 9455	0.5	none	3 hour lecture		ADVANCED POLYMERIZATION ENGINEERING	This graduate course assumes no previous knowledge of polymers or polymerization. Students will be exposed to emerging areas of polymer and nanoscience with a focus on the basics and advanced concepts in polymer synthesis, kinetics and reactor engineering. Existing and emerging polymer manufacturing processes will be examined with a focus on sustainability.
41	512	CBE 9461	0.5	CBE 3310	3 hour lecture		ADVANCED PROCESS CONTROL	Topics in Digital and Modern Process Control are covered. Discrete control theory, real-time process control concepts with a strong laboratory component, state space methods and design of multi-variable control algorithms. Process identification and statistical process control are introduced.
42	853	CBE 9464	0.5	none	3 hour lecture		PROCESS INTENSIFICATION AND INNOVATION	To expose the students to new trends of improving process efficiency and sustainability using new technologies that result in significant reductions in the size of production equipment, lower capital and operating cost, and less waste generation. This will include the use of secondary and oscillatory flows, high gravity fields, and miniaturization concepts for enhancing overall heat and mass transfer rates in chemical, thermal, and electronics applications.
43		CBE 9499	0.5	TBD	3 hour lecture		SELECTED TOPICS IN REACTION AND PROCESS SYSTEMS ENGG	Course is designed to review latest developments in the general area of reaction and process systems engineering. This course is normally reserved for new course offerings until a course number is permanently assigned, or a summer course which may be taught by visiting professors.

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44								
45							Particle Technologies & Fluidization	Particle Technologies & Fluidization
46	848	CBE 9544	0.5	none	2 hour lecture; 1 hour tutorial	CBE 4404	PHARMACEUTICAL MANUFACTURING PROCESSES	The objective of this course is to introduce upper year chemical/biochemical engineering students to pharmaceutical manufacturing. An overview of the pharmaceutical industry and its regulations will be presented followed by the basic concepts of the major manufacturing methods and their component unit operations.
47		CBE 9550	0.5	none	3 hour lecture		ADVANCED PARTICLE AND FLUIDIZATION ENGINEERING	Design of fluidized bed reactors and their various components.
48	650	CBE 9551	0.5	CBE 9511	3 hour lecture		ADVANCED DESIGN IN FLUIDIZED BED REACTORS	The objective of this course is to learn how to design fluidized bed reactors and their various components.
49		CBE 9552	0.5	none	3 hour lecture		INDUSTRIAL THREE-PHASE REACTOR SYSTEMS	This course extends the discussion of reactor theory presented in CBE 315a/b and presents the important features of certain multiphase reactors.
50	677	CBE 9561	0.5	none	3 hour lecture		ADVANCED HIGH VELOCITY FLUIDIZATION TECHNOLOGY	Fluidization regimes, turbulent fluidized bed reactors, circulating fluidized bed reactors (hydrodynamics, heat transfer, modelling), fluid catalytic cracking, fluidized bed combustion, gasification and incineration, downer reactors, measurement techniques.
52		CBE 9587	0.5	none	3 hour lecture		FINE POWDER TECHNOLOGIES AND APPLICATIONS	This course is intended to provide graduate students with advanced knowledge on fine powder technologies and their applications.
53		CBE 9591	0.5	TBD	3 hour lecture		SELECTED TOPICS IN PARTICLE TECHNOLOGIES & FLUIDIZATION	Course is designed to review latest developments in the general area of particle technologies and fluidization engineering. This course is normally reserved for new course offerings until a course number is permanently assigned, or a summer course which may be taught by visiting professors.
54								
55							Project Courses	Project courses
56	500	CBE 9981	0.5		determined by advisor		MENG PROJECT AND REPORT - Part I	M.Eng Project and Report. Student must complete both Part I and II. Must be enrolled consecutively (usually the last 2 terms).
57	500	CBE 9982	0.5		determined by advisor		MENG PROJECT AND REPORT - Part II	Student must present a seminar, and also submit a formal technical report as outlined in our M.Eng Report Guide.
58								
59							Seminar Milestone	
60	901		0.5		1 hour seminar		M.E.Sc. SEMINAR	Students are required to attend, participate and present one seminar in the weekly M.E.Sc seminar series for the entire period during their graduate studies. (minimum 75% attendance of all seminars required to satisfy milestone requirement)
61	902		0.5		1 hour seminar		Ph.D. SEMINAR	Students are required to register, attend, participate and present two seminars in the weekly M.E.Sc seminar series for the entire period during their graduate studies. (minimum 75% attendance of all seminars required to satisfy milestone requirement)