UNDERGRADUATE CURRICULUM

FIRST YEAR

First Semester

EEE	241	Computer Programming	(3-0)3
FE	111	General Chemistry	(3-2)4
LENG	101	Freshman English I	(4-0)4
MATH	151	Calculus I	(4-0)4
ME	101	Engineering Graphics	(2-2)3
TURK	101	Turkish Language-I	(2-0)2
TDP	101	Social Awareness Project-I	(1-0)1
GME	100	General and Professional Ethics	(2-0)2

Second Semester

EP	116	General Physics	(3-0)3
EP	120	General Physics Laboratory	(0-2)1
FE	122	Introduction to Food Science and Technology	(2-0)2
FE	132	Organic Chemistry	(3-2)4
LENG	102	Freshman English II	(4-0)4
MATH	152	Calculus II	(4-0)4
TURK	102	Turkish Language-II	(2-0)2
TDP	102	Social Awareness Project-II	(1-2)2
GOS	***	Common Elective	(non-credit)
KRY	100	Career Planning	(0-2)1

SECOND YEAR

Third Semester

FE	211	Analytical Chemistry	(3-2)4
FE	221	Material and Energy Balances	(4-0)4
FE	243	Introduction to Statistics	(3-0)3
FE	271	Food Chemistry	(3-2)4
MATH	256	Differential Equations	(3-0)3
HIST	201	Atatürk's Principles and the History of the Turkish Renovation I	(2-0)2
Non-Technical Elective			

Fourth Semester

FE	204	General Microbiology	(3-2)4
FE	212	Biochemistry	(3-0)3
FE	218	Food Systems	(3-0)3
FE	222	Fluid Mechanics	(4-0)4
FE	224	Engineering Thermodynamics	(4-0)4
HIST	202	Atatürk's Principles and the History of the Turkish Renovation II	(2-0)2
Non-Technical Elective			

THIRD YEAR

Fifth Semester

FE	301	Mass Transfer	(4-0)4
FE	305	Food Microbiology	(3-2)4
FE	311	Applied Kinetics of Biological Reactions	(3-0)3
FE	315	Instrumental Analysis	(2-2)3
FE	321	Heat Transfer	(4-0)4
Elective			
FE	024	Occupational Health and Safety	(2-0)2

Sixth Semester

FE	322	Food Production Management	(3-0)3
FE	356	Applied Mathematics in Food Engineering	(3-0)3
FE	366	Food Engineering Design I	(2-1)3
FE	376	Food Quality Control	(2-2)3
FE	382	Food Operations I	(4-0)4
FE	384	Food Operations II	(4-0)4

FOURTH YEAR

Seventh Semester

FE	401	Food Technology	(2-1)3
FE	403	Food Process Control	(3-0)3
FE	411	Food Biotechnology	(3-2)4
FE	467	Food Engineering Design II	(2-1)3
FE	483	Food Operations Laboratory	(2-2)3
FE	499	Graduation Project	(1-2)2
Elective			
ENG	499	Multi Disciplinary Project	(1-2)2

Eighth Semester

FE	400	Engineering Orientation	(4-0)4

*From the list of Elective Courses.

ELECTIVE COURSES

FE	203	Raw Materials for Food Engineering	(2-0)2
FE	231	Principles of Engineering Economy	(2-0)2
FE	245	Technical Report Writting and Presentation Skills	(2-0)2
FE	316	Fruit Juice Technology	(2-0)2
FE	318	Biochemical Genetics	(2-0)2
FE	335	Food Packaging Materials	(2-0)2
FE	345	Food Additives	(2-0)2
FE	346	Introduction to Bakery Technology and Engineering	(2-0)2
FE	347	Shelf-Life Dating of Foods	(2-0)2
FE	348	Technical Writing and Computer Use in Food Eng.	(2-0)2
FE	351	Food Toxicology	(2-0)2
FE	354	Food Gels	(2-0)2
FE	361	Enzymology	(2-0)2
FE	364	Organic and Functional Foods	(2-0)2
FE	390	Stability of Colloidal Dispersions in Food	(2-0)2
FE	416	Turkish Food and Work Safety Regulations	(2-0)2
FE	417	Minimally Processed Refrigerated Fruits and Veg.	(2-0)2
FE	423	Nanotechnology in Agriculture and Food Industry	(2-0)2
FE	424	Bionanoparticles and Their Aplications	(2-0)2
FE	425	Food Product Development	(2-0)2
FE	426	Brewing Technology	(2-0)2
FE	427	Bioprocess Engineering	(2-0)2
FE	428	Mushroom Production and Processing Technology	(2-0)2
FE	429	Drying of Fruits and Vegetables	(2-0)2
FE	430	Vegetable Processing	(2-0)2
FE	431	Technology of Soft Drinks	(2-0)2
FE	432	Fats in Food Products	(2-0)2
FE	433	Formulating and Processing of Low Calorie Foods	(2-0)2
FE	434	Microwave Foods	(2-0)2
FE	435	Chocolate Manufacturing	(2-0)2
FE	436	Milk and Milk Products Technology	(2-0)2
FE	437	Mechanical Properties of Food Materials	(2-0)2

FE	438	Process Control in Food Engineering	(2-0)2
FE	439	Food Catering	(2-0)2
FE	440	Sensory Analysis of Foods	(2-0)2
FE	441	Energy Management	(2-0)2
FE	446	Technology of Meat and Meat Products	(2-0)2
FE	447	Entrepreneurship and Innovation	(2-0)2
FE	451	Hazard Analy. and Critical Control Points (HACCP)	(2-0)2
FE	461	Enzymes in Fats and oils Industries	(2-0)2
FE	462	Biochemical Engineering	(2-0)2
FE	463	Tech. of Soft Wheat Products and Breakfast Cereals.	(2-0)2
FE	464	Total Quality Management and ISO 9000	(2-0)2
FE	465	Physical Properties of Foods	(2-0)2
FE	466	Frozen Food Technology	(2-0)2
FE	472	Sanitation in Food Processing	(2-0)2
FE	473	Preparation of Ready Can Foods	(2-0)2
FE	474	Food Packaging	(2-0)2
FE	481	Storage of Fruits and Vegetables	(2-0)2
FE	482	Vegetable Oil Technology	(2-0)2
FE	485	Food Industry Machineries, Automation and CE	(2-0)2
FE	487	Food and Nutrition	(2-0)2
FE	488	Plant Organization for Food Engineering	(2-0)2

GRADUATE COURSES

FE	503	Industrial Microbiology	(3-0)3
FE	504	Alternative Food Preservation Techniques	(3-0)3
FE	505	Advanced Organic Chemistry	(3-0)3
FE	506	Bioseparations	(3-0)3
FE	507	Chemistry of Flavors	(3-0)3
FE	508	Adv. Chemical Kinetics and Reactor Design	(3-0)3
FE	509	Enzyme Kinetics	(3-0)3
FE	510	Fund. of Analysis and Treatment of W. Water	(3-0)3
FE	511	Food Packaging	(3-0)3
FE	512	Plastic in Contact with Food	(3-0)3
FE	513	Advanced Food Microbiology	(3-0)3
FE	514	Food Lipids	(3-0)3
FE	515	Solution Chemistry of Food Components	(3-0)3
FE	516	Water Act. and Sorption Behavior of Foods	(3-0)3
FE	517	Edible Films and Coatings	(3-0)3
FE	518	Food Proteins	(3-0)3
FE	519	Physical Organic Chemistry	(3-0)3
FE	520	Principles and Practice of Genetic Eng.	(3-0)3
FE	521	Cheese Technology	(3-0)3
FE	522	Enzyme Biosensors	(3-0)3
FE	523	Microbiological Quality of Foods	(3-0)3
FE	524	Advanced Food Science: Selected Topics	(3-0)3
FE	525	Stability of Food Products	(3-0)3
FE	527	Physical Properties of Foods I	(3-0)3
FE	528	Physical Properties of Foods II	(3-0)3
FE	529	Refrigeration and Freezing of Foods	(3-0)3
FE	530	Transport Phenomena	(3-0)3
FE	531	Advances in Baking Technology	(3-0)3
FE	532	Advanced Cereal Science and Technology	(3-0)3
FE	533	Extrusion Cooking	(3-0)3
FE	534	Process Modeling and Simulation in Eng.	(3-0)3
FE	535	Food Rheology	(3-0)3
FE	536	Food Products and Heat Transfer	(3-0)3
FE	537	Computer Applications in Food Technology	(3-0)3

FE	538	Drying and Storage of Grains and Oil seeds	(3-0)3
FE	539	Solid Mechanics and Handling	(3-0)3
FE	540	Active Food Packaging	(3-0)3
FE	541	Advanced Food Additives	(3-0)3
FE	542	Chromatographic Analysis of Foods	(3-0)3
FE	543	Experimental Enzymology	(3-0)3
FE	544	Immobilized Enzymes for Industrial Reactors	(3-0)3
FE	545	Food Waste Management, Valorization, and Sustainability in the Food Industry	(3-0)3
FE	546	Thermal Process Engineering	(3-0)3
FE	547	Functional and Nutraceutical Lipids	(3-0)3
FE	548	Minimizing Postharvest Losses	(3-0)3
FE	550	Interactions and Functionality of Proteins	(3-0)3
FE	551	Advanced Milling Engineering	(3-0)3
FE	552	Food Policy and Economics	(3-0)3
FE	555	Food Texture	(3-0)3
FE	556	Advanced Fermentation Technology	(3-0)3
FE	561	Intermediary Metabolism and Its Regulation	(3-0)3
FE	562	Advanced Food Biochemistry	(3-0)3
FE	563	Advanced Food Dehydration	(3-0)3
FE	564	Simulation Tech. in Food Dehydration	(3-0)3
FE	565	Spray Drying	(3-0)3
FE	566	Food Emulsions	(3-0)3
FE	569	Design of Experiments For Food Engineers	(3-0)3
FE	570	Response Surfaces Design and Analyses	(3-0)3
FE	572	Regression Analysis	(3-0)3
FE	575	Applied Sensory Analysis of Foods	(3-0)3
FE	581	Proc. and Nutrit. Qual. of Fruits and Vegetables I	(3-0)3
FE	582	Proc. and Nutrit. Qual. of Fruits and Vegetables II	(3-0)3
FE	583	Fats and Oils Technology	(3-0)3
FE	584	Advances in Fresh-Cut Fruits and Vegetables Processing	(3-0)3
FBE	501	Araştırma Yöntemleri ve Bilimsel Etik	(3-0)3
NAS	501	Research Methods and Scientific Ethics	(3-0)3
FE	599	MSc Thesis	(0-1) non-credit
FE	699	PhD Thesis	(0-1) non-credit
FE	700	MSc Seminar	(0-2) non-credit
FE	750	Non- Thesis MSc Semester Project	(0-2) non-credit
FE	800	PhD Seminar I	(0-2) non-credit
FE	850	PhD Seminar II	(0-2) non-credit
FE	801-899	Special Studies	(4-0) non-credit
FE	901-999	Special Topics	(4-0) non-credit

DESCRIPTION OF UNDERGRADUATE COURSES

FE 101 General Chemistry (3-2)4
Atoms, molecules and ions; chemical compounds; chemical reactions; oxidation-reduction; gases; thermochemistry; periodic properties of elements; liquids and solids; solutions; principals of chemical equilibrium; acids and base; entropy and free energy; electrochemistry.

FE 103 General Chemistry I (4-0)4
Atomic structure. Chemical bonding. Chemical equations and quantitative relations. Thermochemistry. Gases, liquids and solids. Solutions. Acids and bases. Chemical equilibrium. Chemical thermodynamics.

FE 104 General Chemistry II (3-2)4
Chemical kinetics. Ionic equilibria. Electrochemistry. Organic compounds and structures: Saturated, unsaturated, aromatic and heterocyclic compounds. Chemistry of carbohydrates and proteins, polymers and polymerization**. Recommended :** FE 103

FE 111 General Chemistry (3-2)4
Stoichiometry of chemical reactions. Thermochemistry. Periodic properties of elements. Chemical Bonding. Gases, liquids and solids. Solutions. Chemical kinetics. Chemical equilibrium. Acids and bases. Solubility and

comlex ion equilibria. Thermodynamics. Electrochemistry.

GME100 General and Professional Ethics (2-0)2
History of Ethic, Professionalism and Codes of Ethics, Understanding Ethical Problems, Theories of Ethical Risks, Safety, and Accidents, The Rights and Responsibilities of Engineers, Ethic and Institutions, Managment and Ethic, Ethic and Globalization, Ethical Issues in Engineering Practice

FE 122 Introduction to Food Science and Technology (2-0)2
Scope, definition and historical development of Food Science and Technology. Principles of biological and physical sciences related to the human food system. Structure and properties of food materials. Unit operations in food processing. Food legislation. Environmental considerations.

FE 132 Organic Chemistry (3-2)4
To acquaint students introduction to Organic Chemistry with principal classes and functional groups of organic compounds. Also, to acquaint students a new mechanistic approach to the study of chemical reactions and survey of organic compounds. The course emphasizes fundamental properties of organic compounds. Laboratory work includes the application of the methods of organic chemistry in the preparation of typical compounds and study of their properties.

FE 203 Raw Materials for Food Engineering (2-0)2
General aspects on raw materials used in food industry. Marketing and trading rules. Geographical source and global suppliers. Quality and grading. Species. Physical and chemical properties of raw materials. Preservation. Defects and control rules. Raw materials in cereal, legume, nut, seed, fruit, vegetable, oil, dairy, meat, beverage etc. industries. Certifications, specifications and standardizations.

FE 204 General Microbiology (3-2)4
The nature of microbial word. Microbial classification. Organization in the eucaryotic and procaryotic cells. Relations between structure and function in procaryotic cells. Bacterial spores. Microbial growth. Microbial metabolism and nutrition. Culture media and preservation. Conventional and new culturing methods. Effects of environment on microbial cells. Microbial control. Molds and yeasts. Microbial genetics and viruses.

FE 211 Analytical Chemistry (3-2)4
Fundamental principles and theories of analytical chemistry. Data evaluation. Quantitative analysis by gravimetry. Theory of titrimetric methods of analysis. Aqueous solution chemistry. Quantitative analyses by volumetry.

FE 212 Biochemistry (3-0)3
The molecular components of cells. Biological functions of proteins: Enzymes, kinetics and inhibition. Storage of metabolic energy. Pathways of cellular energy metabolism. Biosynthesis of macromolecular precursors. Replication, transcription and translation of genetic information. Mutations.

FE 218 Food Systems (3-0)3
Engineering Properties of biological materials in food systems. Physical, thermal, mechanical, rheological, electrical, optical properties and water retention characteristics. Use of these properties as they are necessary in the evaluation, synthesis and design of biological systems. Use of biopolymers in food systems. Colloidal food systems and functionality of food components as emulsifiers, stabilizers, texturizers, gelling and foaming agents.

FE 221 Material and Energy Balances (4-0)4
Basic unit conversion techniques. Definitons and measurements of basic terms in material and energy balances. Material balances for processes without or with chemical reactions. Properties of gas mixtures. Heat capacity, enthalpy calculations and the use of charts and tables. Energy Balances for processes with and without chemical reactions. Psychrometric chart. Simultaneous use of material and energy balances.

FE 222 Fluid Mechanics (4-0)4
Nature of fluids. Fluid statics. General molecular transport equations. Viscosity and Boundary layer theory. Newtonian and non-Newtonian fluid behavior. Overall and Mechanical energy balances. Bernoulli equation. Shell momentum balances. Design equations for laminar and turbulent flow in pipes. Pumps and flow measuring devices. Flow around submerged objects. Dimensional analysis. Application of Equation of continuity, and Equation of motion to fluid flow systems.

FE 224 Engineering Thermodynamics (4-0)4
Basic concepts of thermodynamics. Properties of pure substances. The first law of thermodynamics. The second law of thermodynamics. Entropy. Second law analysis of engineering systems and availability. Refrigeration cycles.

FE 231 Principles of Engineering Economy (2-0)2
Usuary price of money, techniques of interest calculations. Evaluation of investments in food processing industries. Criteria of project evaluations: Present value, rate of return, benefit /

cost ratio, pay-back period. Minimum cost and breakeven analyses. Depreciation , accounting.

FE 242 Introduction to Food Engineering (2-0)2
Scope, definition and historical development of Food Engineering. Principles of biological and physical sciences related to the human food system. Structure and properties of food materials. Preservation techniques and engineering aspects of food processing from harvest till packaging and dispatch.

FE 243 Introduction to Statistics (3-0)3
Basic definitions. Probability. Hypothesis of statistics. Hypothesis tests. Regression analysis. Analysis of Variances. Multiple range test. Special application to food engineering and food sensory analysis data.

FE 245 Technical Report Writting and Presentation Skills (2-0)2
Preparation of written and oral scientific reports, proposal writings. Useful tips, tricks and techniques for improving report writing skills and presentation techniques and producing free-hand sketches, knowledge in preparing visual aids and designing art, CAD concept and familiarise of object realism and animation techniques for public presentation tasks.

FE 271 Food Chemistry (3-2)4
Food chemistry supplement, enzymes in food industry, carbohydrates, lipids, protein, meat, flour, milk and milk products, fruit and vegetables, food additives.

FE 299 Summer Practice (Non-Credit)
Laboratory lay-out and instrumentation, analytical methods (gravimetric, volumetric and spectroscopic), microbial analysis of specific foods, chemical and microbial investigation of water used in the production, quality control of raw materials and products (20 working days).

FE 301 Mass Transfer (4-0)4
Principles of diffusion; mass transfer in turbulent flow; mass transfer theories; general principles of stage-wise and continuous contacting operations; applications to gas absorption, distillation, extraction and leaching.

FE 305 Food Microbiology (3-2)4
Introduction to food microbiology. Factors effecting microbial growth in foods. Source of microorganisms contaminating with foods. Groups of microorganisms important in food microbiology. Indicator microorganisms. Food spoilage. Food preservation. New food preservation methods. Conventional and new microbial counting methods. Food poisonings. Microorganisms used in food fermentation and their beneficial uses. Microbial enzymes and their uses in food industry. Food safety.

FE 311 Applied Kinetics of Biological Reactions (3-0)3
Rate of a chemical reaction. Kinetics of biological reactions. Kinetics of biomass production, substrate utilization and product formation in cell cultures. Kinetics of microbial death and enzyme inactivation. Analysis of biological reactors. Kinetics of free and immobilized enzymes and their applications in industry.

FE 315 Instrumental Analysis (2-2)3
Instrumental techniques based upon the absorption and separation methods. Laboratory work includes the applications of the related methods.

FE 316 Fruit Juice Technology (2-0)2
Production methods of fruit juice concentrates, storage and reconstitution of concentrated fruit ,juices, discussion of related subjects appearing in recent issues of technical journals.

FE 318 Biochemical Genetics (2-0)2
The chemistry of gene, structure and function, regulation of gene expression, gene mutation, restriction and modification of DNA, recombination, integration and excision, genetic engineering. Procaryotic and eukaryotic molecular genetics are given equal weight.

FE 321 Heat Transfer (4-0)4
Principles of convective, conductive and radiative heat transfer. Shell balances concerning heat transfer. Heat transfer coefficient correlations. Boiling and condensation. Thermal design of heat exchangers. Transient heat transfer. Chilling and freezing of foods Heat transfer to non-Newtonian fluids.

FE 322 Food Production Management (3-0)3
Food manufacturing systems in steady state: production planning, inventory control and operation scheduling. Principles of total quality management system. ISO 9000: Quality Management System standard. Food safety management systems. Prerequisite programs for food processing. HACCP plan and implementation. Principles of ISO 22000: Food Safety Management System standard. Documentation system. Quality and safety audit system. Legal Restrictions and engineering ethics.

FE 335 Food Packaging Materials (2-0)2
Food packaging materials, selection of materials. Effects of some factors on the structure of

materials. Corrosion and coating. Some special properties of food packaging materials.

FE 346 Introduction to Bakery Technology and Engineering (2-0)2
The materials of baking. Formulations and procedures in baked products. Engineering aspects of baking processes. Technical functions in bakery operations.

FE 347 Shelf Life Dating of Foods (2-0)2
The major food processing principles, basic food preservation and degradation modes. The scientific principles involved in predicting shelf-life of foods, open dating in relation to pack date, sell date or use by date shelf-life of some food systems, basic information needed to implement open-dating.

FE 348 Technical Writing and Computer Use in Food Engineering (2-0)2
Introduction to writing styles and types of presentations, grammar use, subject verb-agreements, punctuations, full and formal report writing styles, illustrations and tables making. Reference, writings, presentation delivering and visual aids and animation techniques use, use of spreadsheets to solve Engineering problems, use of statistical package for analysis of data, familiarization with software related to food industry. Copyright and permissions. Student presentations

FE351 Food Toxicology (2-0)2
General principles of toxicology; Disposition of toxic compounds; Metabolism of foreign compounds; Toxic compounds in foods: natural toxic constituents of foods, food additives, industrial chemicals, formed during food processing and microbial toxins; Pesticides and environmental pollutants; Food intolerance and toxic responses; Cancer and diets; Emerging food safety.

FE 354 Food Gels (2-0)2
The mechanism of gel formation. Characteristics of food gels: agar, alginates, casein, egg protein gel, gelatin, mixed polymer gels, muscle proteins, pectin, whey proteins. Commercial production of gels. Use of gels in food industry.

FE 356 Applied Mathematics in Food Engineering (3-0)3
Mathematical formulation of chemical and food engineering problems. Application of ordinary and partial differential equations to uniform and non-uniform systems. Interpretation of food engineering data.

FE 361 Enzymology (2-0)2
Enzyme nomenclature and classification, structures, isolation and purification techniques.

FE 364 Organic and Functional Foods (2-0)2
General aspects on organic and functional foods. Botanical, physical and chemical criterias and properties. Processing of organic and functional foods. Quality control methods. Certifications and specifications. Preservation methods. Regulations. Marketing properties.

FE366 Food Engineering Design I (2-1)3
Basic principles of designing a food factory. Feasibility survey. Preliminary and detailed cost estimations. Optimization of operating conditions and design of equipment used in food industry. Special examples from food plants. (Students will perform literature and feasibility survey of assigned food factories in groups by discussing and evaluating with their advisor weekly)

FE 376 Food Quality Control (2-2)3
General principles of quality control. Attributes and their measurement, development of grades and standards quality. Applications to the various food products. Methods of analysis: Cereal products, fruit and vegetable products, meat and meat products, dairy products and chocolate.

FE 382 Food Operations I (4-0)4
Methods of heat sterilization in containers, sterilization of the food outside the container, pasteurization by heat processing. Food dehydration. Food freezing. Food storage, variably in storage conditions, maintenance and control of storage conditions.

FE 384 Food Operations II (4-0)4
Raw material handling; mechanical size reduction; Mixing; supercritical fluid extraction and mechanical expression; filtration; membrane separation and reverse osmosis; settling and sedimentation; centrifugal separation; crystallization; freeze concentration; evaporation; extrusion; novel non-thermal food processes.

FE 390 Stability of Colloidal Dispersions in Food (2-0)2
Thermodynamics and kinetics of adsorption. Structure of adsorbed protein layers. Competitive adsorption of surface active materials. Colloidal stability: electrostatic stability, electric double layer, DLVO theory, steric stabilization. Concentrated dispersions. Colloidal particles in food: casein micelles.

FE 399 Summer Practice (Non-Credit)
Industrial management and organization (type of organization, plant layout, laboratory layout and

instrumentation, raw material source, production planning and control, sales and purchasing department), factors influencing the selection of plant, assembly line end related studies, safety rule, regulations and employer-employee relations in the plant, (20 working days).

FE400 Engineering Orientation (4-0)4
Engineering applications, Internship proctices. Innovation, Project development and management. New system and product design. Research development and technology management. Business planning commer cialization. Technology foresight and forcasting.Technology assesment. Process analysis principles af business. Business and administration diciplines safety. Comminication in business life.

FE401 Food Technology (2-1)3
Integrating principles of food chemistry and food engineering unit operations through discussions of processing of cereals, fruit and vegetables, dairy, meat, poultry, seafoods, fats and oils, etc. Properties of raw materials and their relationship to current processing methods. Developing an awareness of current processing methods in the food industry. Understanding the concepts and principles of food processing. Preparation of a processing technology for a specific food product including all steps, equipments, alternative technologies, control points, by-products, raw material and finished product properties etc. (Students will complete flow diagram of assigned food process in groups by discussing and evaluating with their advisor weekly)

FE 403 Food Process Control (3-0)3
Introduction to process control systems and automation. Basic concepts and application areas, instrumentation, sensors, transducers, data logging and control equipments. Algorithms and computer control systems. Fuzzy system. Development of mathematical models for control systems. Control systems (on-off, ratio control, modulating, open loop, closed loop, feedforward, feedback, adaptive, inferential etc.). Continuous, batch, dynamic and static systems. Application of process control and automation on single and multi-variable processes. Food plant process control and automation applications. Enterprise Resource Planning (ERP) systems.

FE 411 Food Biotechnology (3-2)4
Main aspects of biotechnology. Transport phenomena in bioprocesses. Bioreactor design and down stream processing in bioprocesses. Special topics on fermented foods: SCP, Beer, Wine, Distilled spirits, Yogurt, Cheese, Fermented meat products, Pickles, Vinegar, Mushroom, Tea, Table Olives, Traditional fermented foods, and Bread. Nanotechnology applications

FE 416 Turkish Food and Work Safety Regulations (2-0)2
Study of Turkish laws and regulations which apply to food production, consumption and inspection. The safety culture, workplace hazards, work accidents, worker health, work safety regulations and standards, relation of laws and regulations to food engineering.

FE 417 Minimally Processed Refrigerated Fruits and Vegetables (2-0)2
This course covers the scientific, technical and practical aspects involved with the manufacture, storage, distribution and marketing of minimally processed refrigerated (MPR) fruits and vegetables. Quality parameters, safety aspects, physiology and microbiology of fresh-cut fruits and vegetables. Major unit operations of MPR fruits and vegetables. Enzymatic effects on flavor and texture of fresh-cut produce. Preservation methods. Application of packaging and modified atmosphere. Use of edible coatings. Biotechnology and fresh-cut produce industry. Process design, facility, and equipment requirements. Regulatory and labelling issues. Future economic and marketing considerations.

FE 423 Nanotechnology in Agriculture and Food Industry (2-0)2
An introduction to nanotechnology. Nanotechnology in food industry: food processing, food packaging and food safety. Nanotechnology in agriculture: precision farming, smart delivery systems. Other developments in the agriculture and food sectors due to nanotechnology. New environmental and health risks posed by nanofoods and nano agriculture. Nano-specific regulations required to ensure food safety.

FE 424 Bionanoparticles and Their Aplications (2-0)2
Bionanotechnology: a historical perspectives, nanotechnology and bionanotechnology, Nanoimages in bionanotechnology. Opportunities for bionanotechnology in food and food industry. Significance of nano-size, succesful aplications of bionanotechnology, potential risks. Microemulsions, biocomposites, proteins to nanodevices.

FE 425 Food Product Development (2-0)2
Principles of food product development: target market evaluation, concept development and presentation, formulation, manufacturing, packaging, product costs, pricing, safety, and marketing.

FE 426 Brewing Technology (2-0)2
Malting process. Mashing process. Hops technology. Fermentation. Finishing processes. Packaging. Beer quality.

FE 427 Bioprocess Engineering (2-0)2
Stoichiometry of microbial growth and product formation. Engineering principles for bioprocesses. Operating Bioreactors. Selection and control of bioreactors. Product recovery and purification. Applications to non-conventional biological systems.

FE 428 Mushroom Production and Processing Technology (2-0)2
Compost preparation, design for production room, production techniques and mushroom processing.

FE 429 Drying of Fruits and Vegetables (2-0)2
Introduction to food drying. Drying of fruits, vegetables and their derivatives. Quality changes during drying. Selection of dryer type. Recent advances in food drying.

FE 430 Vegetable Processing (2-0)2
Crop production, harvesting and storage. Preservation methods of vegetables: thermal processing, freezing, chilling. Packaging. Factors affecting the quality. Plant equipment and cleaning.

FE 431 Technology of Soft Drinks (2-0)2
The various types of soft drinks. Principles of formulation. The role of ingredients. Processing of soft drinks. Quality assurance and control. The microbiology of soft drinks.

FE 432 Fats in Food Products (2-0)2
Physical chemistry of fats. Fats in cream and ice-cream. Butter and allied products. Anhydrous milk-fat products and applications in recombination. Fats in spreadable products. Fats in bakery and kitchen products. Milk fat in sugar and chocolate confectionery.

FE 433 Formulating and Processing of Low Calorie Foods (2-0)2
Categories and commercial types of low-calorie foods. Physical, chemical and sensory of low calorie foods. Low-calorie and no-calorie sweeteners. Reducing fat content. Engineered fats. Fat replacers and substitutes. Health effects and markets for low-calorie foods.

FE 434 Microwave Foods (2-0)2
Fundamentals of microwave heating. The microwave oven. Packaging food products for the microwave oven. New product development. Nutritional and microbiological considerations of microwave foods.

FE 435 Chocolate Manufacturing (2-0)2
Traditional chocolate making. Chocolate ingredients. General aspects of the chemistry of flavor development in chocolate. Fermentation, drying, and roasting. Mixing and refining. Blending, conching, tempering, molding, and packaging. Chocolate flow properties and bulk chocolate handling. Recipes, and quality control.

FE 436 Milk and Milk Products Technology (2-0)2
General information about milk and milk products. Production and storage of yogurt, butter, cheese and ice-cream. Quality control and nutritional aspects of dairy products.

FE 437 Mechanical Properties of Food Materials (2-0)2
Definition, analysis and measurement of mechanical properties of food materials. Flow behavior, dynamic viscoeleastic and solid behavior of food materials and relationships to food rheology, food texture and processing. Influence of time, composition and processing. Textural classification of foods and instrumental techniques for their study. Relation between instrumental and sensory measures of food texture.

FE 438 Process Control in Food Engineering (2-0)2
The Laplace transform. Response of first order systems. Physical examples of first order systems. Response of first order systems in series. Second order and transformation lag. Control systems. Controllers and final control elements. Block diagram of fermentor control systems. Transient response of simple control systems. Stability.

FE 439 Food Catering (2-0)2
Principles of planning, organizing, controlling and preparing a catered function. Menu planning, formulating healthy and specific diets, food preparation and cooking. Receiving and handling food deliveries. Cleaning and maintain hygienic conditions, waste removal and storage conditions for foods.

FE 440 Sensory Analysis of Foods (2-0)2
The sensory techniques used in evaluating the taste, smell, flavor, color and texture of foods as well as the evaluation of consumer acceptance. This includes methods for measuring these qualities (e.g. Simple Difference Tests, Descriptive Analysis, Acceptance & Preference Tests, Consumer Tests, Qualitative Methods, Bias & Context Effects in Ratings). Statistical methods for analyzing results.

FE 441 Energy Management (2-0)2

Production and consumption of domestic and world energy reserves. Recent advances and projection in the energy sector of Turkey and the world. Structure of Turkish industry and energy consumption. Rules for energy saving and energy management. Definition, aim, and methods of calculation of material and energy balances. Results obtainable from psychrometric charts and evaluation of results. Calorimetric and elemental analysis of fuels; possibilities to improve their heating values. Principles of control and automation in energy systems.

FE 446 Technology of Meat and Meat Products (2-0)2
Introduction to meat technology, freezing, thermal processing dehydration, salting and curing, acid fermentation, srnoking, size reduction.

FE 447 Entrepreneurship Innovation (2-0)2
Entrepreneurship and Economy, Invention for Entrepreneurship, Success of Entrepreneur, Conversion of New Concept into Project, Plan for Production , Investment, Financial Support and Financial Providers, Rights for İntellectual Property, Certification, Types of Companies, Entrepreneurship Around the World, New Developments in Entrepreneurship, Advises for Young Entrepreneurs

FE 451 Hazard Analysis and Critical Control Points (HACCP) (2-0)2
Food safety management systems. Pre-requisite programs: Training, operational, and environmental controls. Basic principles of HACCP: Hazard and risk analysis, critical control points, monitoring system, and HACCP plan. Some examples on food processing. Integrating of HACCP with quality management systems. Legal restrictions about food safety management systems.

FE 461 Enzymes in Fats and oils Industries (2-0)2
The use of enzymes in fats and oils industries. Enzymes used for modification of fats and oils, reactions in the processing of fats and oils, production of structured lipids.

FE 462 Biochemical Engineering (2-0)2
Production, purification and separations of biochemicals. Culturing and immobilization techniques. Two species culture systems. Batch and continuous fermentation. Production, consumption, growth rate equations. Mass and heat transfers during_fermentation. Aeration and agitation. Media preparation, and sterilization. Heat exchangers. Cell-recycle, hollow-fibrous, dialysis, and biofilm reactors.

FE 463 Technology of Soft Wheat Products and Breakfast Cereals. (2-0)2
Ingredients of soft wheat products. Technology of biscuits, cookies, crackers and cakes. Production of breakfast cereals.

FE 464 Total Quality Management and ISO 9000 (2-0)2
Quality management and quality assurance standards. Quality and quality system elements. Total quality management. Revision of ISO 9000 to ISO 9000:2000. Statistical process and quality control.

FE 465 Physical Properties of Foods (2-0)2
Principles involved in physical properties of foods, density and specific gravity,surface properties including emulsion, foaming, gelation, adhesion, cohesion, solubility and wettability, optical and acustic properties.

FE 466 Frozen Food Technology (2-0)2
Introduction to freezing technology, frozen meat and meat products, frozen vegetables and fruits, frozen bakery products, nutritional aspects of frozen foods, packaging of frozen foods, safety of frozen foods.

FE467 Food Engineering Design II (2-1)3
Equipment design specific to assigned food factories. Examples of designed food factories. Special topics on food factory design. (Students will complete design of assigned food factories in groups by discussing and evaluating with their advisor weekly)

FE472 Sanitation in Food Processing (2-0)2
Principles of food safety; Food safety hazards; Preventing the food contaminants; Food sanitation; Personal hygiene; Cleaning in food processing; Food plant sanitation; Pest control; Treatment of waste from plant; Law and regulation in food sanitation.

FE 473 Preparation of Ready Can Foods (2-0)2
Preparationo of jam, marmalade, salad cream, ketchup, orange juice, apple juice, apricot juice, cherry juice, soup, baked-beans, red-beans and pickles with particular emphasis on processing, food quality and yield analyses.

FE 474 Food Packaging (2-0)2
Packaging materials: metal, glass, paper, plastic, and films. Types, requirements and functions of containers. Corrosion and enamel coating of can. Packaging of some foods.

FE 481 Storage of Fruits and Vegetables (2-0)2
Storage of fresh and processed fruits and vegetables. Principles of storage. Mechanical refrigeration, controlled and modified atmosphere storage, vacuum storage, storage in polymeric films. Transportation, distribution and marketing.

FE 482 Vegetable Oil Technology (2-0)2
The structure and chemistry of fats and oils. Modes of fat and deteriorations. Extraction of fats and oils from vegetables and fruit pulps (olive and palm). Olive oil technology. Refining technology of vegetables oils; degumming, neutralization, bleaching, deodorization. Hardening of oils and margarine production from vegetable oils. Side products from oil processing.

FE 483 Food Operations Laboratory (2-2)3
Experimental studies in major food processing equipment of pilot plant size. Evaluation of performance, capacity, efficiency and operating costs of individual units. Determination of optimum operating conditions.

FE 485 Food Industry Machineries, Automation and CE (2-0)2
Types and characteristics of materials used in the construction of food machinery, conveying, cleaning, grading, sorting, dehulling, size reduction and enlargement, mixing, energy supply, steam generation, vacuum systems, storing and handling equipments. Processing and packing machines. Machines used in heating, cooling, freezing and air conditioning. Automation systems, techniques and equipments in food industry. Principles and methods in CE system. Applications of CE in design.

FE 487 Food and Nutrition (2-0)2
Nutrition and introduction to nutrients. The energy nutrients; carbohydrates, lipids, proteins. Energy and weight control. Other nutrient; vitamins, minerals and water. Nutrition through the life cycle; feeding the infant, the preschool child, nutrition in the school years, nutrition, nutrition in practice. Nutrition around the world.

FE 488 Plant Organization for Food Engineering (2-0)2
Location decisions of food processing plants. Organization structures. Forecasting methods; moving average, regression analysis, time-series analysis. Invertory management and control. Production planning and control. Production planning techniques; linear programming, CPM (Critical path method), PERT (Program evaluation and review technique). Quality control. Capacity planning.

FE 499 Graduation Project (1-2)2
An extensive literature and market survey on a topic approved by the department including experimental study in the laboratories, or participation in an already existing project. A final report is required at the end of the semester.

DESCRIPTION OF GRADUATE COURSES

FE 503 Industrial Microbiology (3-0)3
Sources of nutrient for Microorganisms. Microbial processes such as organic acids, vitamins, enzymes. Fundamental of genetic engineering. Bioengineered microorganisms and their products. Regulation of cellular activity.

FE 504 Alternative Food Preservation Techniques (3-0)3
Overview of food preservation. Pulsed electrical field. Pulsed light. High pressure processing. Microwave and radio frequency. Inductive and ohmic heating. High voltage arc discharge. Oscillating magnetic field. Ultrasound. Research needs on novel food processing technologies.

FE 505 Advanced Organic Chemistry (3-0)3
Generation and fate of reactive intermediates. Mechanisms and methods of determining them. Effects of structure on reactivity. Rearrangments. Oxidation and reductions. Phase transfer catalysis.

FE 506 Bioseparations (3-0)3
Role of biology. Removal of insolubles: filtration/microfiltration. centrifugation, cell disruption. Isolation; extraction adsorption. Prcoduct purification; elution chromatography, precipitation, ultrafiltration and electrophoresis. Polishing; crystallization, drying.

FE 507 Chemistry of Flavors (3-0)3
Theories of olfaciation; vibrational intermolecular, interaction and streochemical theories. Classification and description of odors. Analytical techniques in separation, detection and identification of flavor compounds. Flavor-compounds of food and synthetic preparations.

FE 508 Advanced Chemical Kinetics and Reactor Design (3-0)3
Catalytic reactions. Catalytic rate equations, heterogeneity and interactions. Diffusion in bores of catalyst pellet, and various diffusion models. Isothermal and nonisothermal effectiveness factors. Internal and external mass and heat transfers. Adiabatic, fixed-bed, fluidized-bed, and trickling-bed reactors.

FE 509 Enzyme Kinetics (3-0)3
Steady-state treatment of simple, reversible and multistep erıyzmatic reactions. Inhibition, analysis, activation, cooperative interactions. Multi-substrate systems. Environmental effects on enzyme activities. Transient state kinetics. Special emphasis will be given to food-related enzymes.

FE 510 Fundamentals of Analysis and Treatment of Waste Water (3-0)3
Overview of waste water characteristics. Sedimentation theory. Chemical oxygen demand (COD) and biochemical oxygen demand (BOD). Activated sludge processes and kinetic models. Natural treatment systems; lagoons. Applied microbiology, biosynthesis and growth. Aerobic and anaerobic treatment stems. Chemical treatment processes.

FE 511 Food Packaging (3-0)3
Requirements and functions of containers, types of containers, packaging materials; metals, glass, papers, plastic and films. Preparation and properties of packaging materials. Packaging of some foods.

FE 512 Plastics in Contact with Food (3-0)3
Plastic materials; thermoplastics, thermosets, natural polymers and their derivatives. Nonplastic components. Food hazards; spoilage in the absence of protection. Food hazards related to plastics. Toxic hazards. Migration. Manufacturing of some plastic packages.

FE 513 Advanced Food Microbiology (3-0)3
Behaviour of microorganisms in foods. Food spoilage and bioprocessing. Bacterial spores and characteristics. Psychrotrophs, thermodurics, radiation resistant microorganisms, and food safety.

FE 514 Food Lipids (3-0)3
Function of fats and oils as food ingredients. Sources of food fats. Structure and composition of fats and oils. Chemical reactions of fats and fatty acids. Methods of fats analysis. Physical properties of fats. Oil composition. Application of fats and oils in foods. Role of fats in nutrition and health. Interaction of emulsifiers and fats with starch and protein. Processing and engineering.

FE 515 Solution Chemistry of Food Components (3-0)3
Properties of liquid water as a solvent. Experimental methods for study of solute-solvent interactions. Hydration of lipids, peptides, proteins and polysaccharides. Conformational analysis of biopolymers which have importance in food chemistry.

FE 516 Water Activity and Sorption Behavior of Foods (3-0)3
Introductory concepts about water activity. Measurement of water activity. Critical evaluation of various methods for measurement of moisture content of foods. General features of sorption

isotherms. Use of moisture sorption isotherms in relation to (i) crispness rind hardness, (ii) packaging predictions, (iii) storage conditions and (iv) dry ingredient mixing. Determination of moisture sorption isotherms. Experimental and theoretical considerations. Moisture sorption of various foods and food ingredients. Discussion on several related works in recent literature.

FE 517 Edible Films and Coatings (3-0)3
Edible films and coatings: Characteristics, formation, definitions, and testing methods. Edible coating applications for fresh, minimaly processed and processed foods. Application of edible films as carriers of food additives. Permeability properties of edible films based on polysaccharides, proteins, lipids and resins.

FE 518 Food Proteins (3-0)3
Structure-function relationships of food proteins, solubility of proteins; protein-salt-water interactions. Computer aided techniques for quantitative activity relationships. Study of food proteins, milk and egg proteins, plant proteins, animal proteins. Effect of processing on proteins.

FE 519 Physical Organic Chemistry (3-0)3
Some fundamentals of Physical Chemistry: Stereochemistry, linear free energy relationships, thermochemistry, solutions, kinetics and isotope effects. Acids and bases. Substitution addition and elimination reactions. Applications of basic principles to food systems.

FE 520 Principles and Practice of Genetic Engineering (3-0)3
Characterization and manipulation of DNA; Basic plasmids, restriction enzymes, DNA isolation and labeling, in vitro-mutagenesis. Cloning in bacteria; DNA and genomic libraries, screening of recombinant, expression vectors, expression in E.coli. Cloning in eukaryotes. Gene therapy.

FE 521 Cheese Technology (3-0)3
Nutritional aspects of cheese. Cheese varieties. Introduction to cheese making. Cheese operations. Cheese ripening. Cheese faults and grading. Whey processing. Mechanization of cheese making. Selected cheese recipes.

FE 522 Enzyme Biosensors (3-0)3
Principles of enzyme biosensors. History of biosensor development. Enzyme biosensors based on amperometric, conductimetric, potentiometric, colorimetric, fluorometric and calorimetric measurements. Transducers used in biosensor development.

FE 523 Microbiological Quality of Foods (3-0)3
Microbiological aspects of quality control. Indicators of pathogens and spoilage. Microbial toxins. Methods for microbiological analysis of foods.

FE524 Advanced Food Science: Selected Topics (3-0)3
Offered on a rotating basis among Food Science Lecturers throughout the term. Fats and Oils: The new and advanced techniques in fat and oil production and health. Food Flavors: Food flavors and their sources and the instrumental, chemical, and sensory methods used to identify and evaluate them. Food Colors: Food colors and their sources, color measurement methods and technological advances in food colors. Food Proteins: Functionality in colloidal foods. Food Microbiology: Significance of Microorganisms in Foods. Food Enzymes: Applications of Enzymes in Food Industry. Food Packaging: Active and intelligent food packaging. Food Waste: The new and advanced techniques in Food Waste Recovery and Processing Technologies. Food Carbohydrates: New techniques in carbohydrate analysis

FE 525 Stability of Food Products (3-0)3
Major modes of food degradation, basic food processing principles, open dating of foods, scientific evaluation of shelf-life of foods, discussion of the recent papers related to the shelf-lives of cereal grains, flour, poultry, meat, fish, dairy products, fruits, vegetables, coffee, tea, dehydrated and frozen foods, and others.

FE 527 Physical Properties of Foods I (3-0)3
Physical properties (momentum and mass) important to handling, processing, and storage of foods and agricultural products. Definitions of properties; principles and techniques of measurement.

FE 528 Physical Properties of Foods II (3-0)3
Physical properties (momentum, heat and mass) important to handling, processing, and storage of foods and agricultural products. Definitions of properties; principles and techniques of measurement. Textural electrical,optical and thermal properties of food materials.

FE 529 Refrigeration and Freezing of Foods (3-0)3
Thermal properties of foods. Refrigeration load of cold storage rooms. Refrigeration of fruits and vegetables. Refrigeration of meats, poultry and fish. Freezing and refrigeration of eggs, milk and bakery products. Transportation of refrigerated foods.

FE 530 Transport Phenomena (3-0)3
A summary of vector and tensor notation. Equations of change for isothermal systems. Macroscopic balances for isothermal systems. Analytic and approximate solutions to equations of mass, momentum and energy transport. Interphase momentum, heat, and mass transfer.

FE 531 Advances in Baking Technology (3-0)3
Processing, equipment in baking technology. Frozen-dough production. Emulsifiers in baking. Enzymes as dough improvers. Microwave-techrıology in baking. Extrusion of baked prodıcts.

FE 532 Advanced Cereal Science and Technology (3-0)3
Structure of cereals. Cereal starch and proteins. Storage and dry milling of cereals. Wet milling: Production of starch, oil protein. Rice, oat and barley processing, malting and brewing. Yeast leavened products. Soft wheat products. Pasta and noodles. Breakfast cereals and snack foods.

FE 533 Extrusion Cooking (3-0)3
Food extruders and their applications, engineering aspects of food extrusion processes, extrusion cooking modeling, control and optimization, extrusion cooking of starch and starchy products, protein reactions during extrusion cooking, nutritional properties of extruded foods.

FE 534 Process Modeling and Simulation in Engineering (3-0)3
Mathematical models of food engineering systems. Computer simulation examples. Numerical methods. Time domain dynamics and control. Responses of simple linear systems. Steady-state techniques.

FE 535 Food Rheology (3-0)3
Principles and methods for measuring. Rheological properties. Definition, analysis and measurement of rheological properties to describe the steady shear, dynamic, viscoeleastic, extensional, and solid behavior of food materials and relationships to food texture and commodity damage during harvest, handling and processing. Influence of time, composition and processing. Focus on the application of fundamental methods to solve industrial problems with emphasis on fluid and semi-solid foods.

FE 536 Food Products and Heat Transfer (3-0)3
Classification and characterization of food stuffs. Heat transfer phenomena. Heat transfer and solid foods. Heat transfer and liquid foods. Thermal process equipment. Examples on control and optimization of thermal processes.

FE 537 Computer Applications in Food Technology (3-0)3
Chemical kinetics in food processing. Microbial destruction in thermal processing of foods. Mechanical transport of liquid foods. Refrigeration, freezing and evaporation.

FE 538 Drying and Storage of Grains and Oil Seeds (3-0)3
Drying of grains in particular cereals, maize, rice, and wheat, and the oilseeds, soybeans and canola. Design of the optimum operating conditions for dryers. Grain equilibrium moisture content. Grain quality. Introductory analysis of fixed bed drying systems. Theory and simulation of grain drying. High capacity grain drying systems. Dryer control systems.

FE 539 Solid Mechanics and Handling (3-0) 3
Basic principles of solid mechanics. Stress and strain. Applications of solid mechanics in Food Engineering. Solid handling, conveying and flow of solids. Properties of particular solids. Bulk properties of solids. Hopper and cyclone designs. Size reduction and enlargement. Sieving and mixing. Fluid-particle systems.

FE 540 Active Food Packaging (3-0)3
Functions of food packaging, requirement of effective food packaging, types of containers, food packaging materials (metal can, glass, paper, paperboard, plastics, laminates, retortable pouches, and edible films), packaging testing, aseptic packaging, safety of food packaging, environmental considerations, and new trends in food packaging.

FE 541 Advanced Food Additives (3-0)3
Food Additives-Preservatives, Antimicrobials, Antioxidants, Colorings, Flavorings, Emulsifiers, Gelling Agents, Stabilizers, Thickeners and Indirect Food Additives

FE 542 Chromatographic Analysis of Foods (3-0)3
Theory of Chromatography, Paper Chromatography, Thin Layer Chromatography, Ion Exchange Chromatography, Partition Chromatography, Adsorption Chromatography, HPLC, LC-MS, GC, GC-MS, Sample Preparation for Chromatography, Application of Paper Chromatography in Food Analysis, Application of Adsorption Chromatography in Food Analysis, Application of HPLC Chromatography in Food Analysis and Application of GC Chromatography in Food Analysis.

FE 543 Experimental Enzymology (3-0)3
Biochemical and molecular aspects of enzymes. Preparation of food enzymes and their use.

FE 544 Immobilized Enzymes for Industrial Reactors (3-0)3
Immobilization techniques. Carrier morphology and configuration. Characteristics of free versus immobilized enzymes. Reactor types. Performance of immobilized enzyme reactors in terms of mass transfer limitations, electrostatic effects, backmixing, temperature and activity loss. Various applications of immobilized enzymes.

FE 545 Food Waste Management, Valorization, and Sustainability in the Food Industry (3-0)3
Definitions of "Food Waste" and "Food Loss", Origin of Food Waste and Food Loss, Management and Valorization Strategies, Treatment of Food Waste, Classification and Target Compounds: Cereals, Root and Tubers, Oilcrops and Pulses, Fruit and Vegetables, Meat Products, Fisheries By-Products, Dairy Products, Sustainability of Food Systems by Food Waste Recovery.

FE 546 Thermal Process Engineering (3-0)3
General principles of heat transfer. Conductive. Thermal conductivity. Methods for thermal process evaluation. Experimental methods for food sterilization. Analytical and numerical solution of steady and unsteady state conduction problems. Thermal methods in food processing.

FE547 Functional and Nutraceutical Lipids (3-0)3
Introduction to Functional and Nutraceutical Lipids, Chemistry of Dietary Lipids (Oilseed and Animal Fat Composition and Modification for Health and Nutrition), Functional and Nutraceutical Properties of Speciality Oils, Roles of Lipids in Human Nutrition and Health, Functional and Nutraceutical Lipids in Global Market, Consumer and Regulatory Issues (Contaminants in Food Lipids, Traceability and Authenticity of Dietary Lipids, Regulatory Issues)

FE548 Minimizing Postharvest Losses (3-0)3
Postharvest losses in Fresh Fruit and Vegetable Sector; The role of harvesting methods to reduce losses; The importance of transportation and storage in reduction of postharvest losses; The effects of packaging on postharvest behaviour of fruits and vegetables; Appropriate valorization technologies of the wastes from fresh fruits and vegetables; Sales conditions in retail and wholesale market; Marketing of fresh fruits and vegetables; Discussion on reduction of losses for targeted fruits (cherry, grape, fig, tomato)

FE 550 Interactions and Functionality of Proteins (3-0)3
Interactions of proteins with lipids, proteins, polysaccharides and protein interactions in foams. Chemical and enzymatic modification of proteins for improved functionality. Functionality of soy proteins, whey proteins. Protein gel ultrastructure and functionality. Edible films and coatings form proteins.

FE 551 Advanced Milling Engineering (3-0)3
Basic principles of milling operations. Properties of raw materials. Grains. Cereals, Legumes. Quality control for raw materials and products. Milling equipment and design. Control of milling operations. Dry milling. Wet milling. Cleaning operations. Tempering. Size reduction. Screening. Storage systems. Conveying. Milling technologies for cereals and legumes/pulses such as hard and soft wheat, rice, corn, lentils, barley. Special products milling; coffee, cacao. Design of milling plant. Diagrams.

FE552 Food Policy and Economics (3-0)3
Principles of food policy and economy. Legislation and regulations. Food data mining. Food production, distribution, importation, exportation, international and domestic rules and conservation. Food trading and tariffs. Food production, price stabilization, traceability, supply and demand. World food surveys. Food politics. Horizon scanning and foresight techniques. Planning and programing techniques. Methodologies for economics and policies. Policies for producers and consumers. Macro, micro and infrastructure policies and economics.

FE 555 Food Texture (3-0)3
Principles and practise of objective texture measurements. Textural classification of foods and instrumental techniques for their study. Measurement of mechanical properties of food materials in relation to texture. Relation between instrumental and sensory measures of food texture.

FE 556 Advanced Fermentation Technol. 3-0)3
Microbial growth kinetics. The isolation, preservation and improvement of industrial micro-organisms. Media for industrial fermentations. Transport phenomena in microbial systems. Mass and energy balances for microbial growth and product formation kinetics. Design and analysis of biological reactors. The recovery and purification of fermentation products. Specific applications of fermentation technology (i.e. ethanol and single-cell-protein productions).

FE 561 Intermediary Metabolism and Its Regulation (3-0)3
Intensive study of the metabolic pathways of carbohydrates, lipids, and nitrogenous compounds and their interrelationships, including control

mechanisms. The effects of hormonal and nutritional status on the activity of these major pathways.

FE 562 Advanced Food Biochemistry (3-0)3
Review of analytical and preparative methods used in protein research with emphasis on proteins and enzymes of particular importance to foods. Protein interactions and their effect on the physical and chemical characteristics of a product. The use of food related enzymes in industry.

FE 563 Advanced Food Dehydration (3-0)3
Types and classification of industrial dryers. Removal of moisture in the constant rate and falling rate periods. Estimation of drying time when two falling rate periods coexist. Modeling of tunnel and tray dryers.

FE 564 Simulation-Techniques in Food Dehydration (3-0)3
Review of mathematical principles and applications in food processing by using computational methods. Drying phenomena. Internal mass transfer mechanisms and drying forces. Prediction of moisture diffusivity in foods with its computer applications.

FE 565 Spray Drying (3-0)3
Properties of water, water vapor and air. Types and classifications of industrial dryers: Theoretical modeling of the drying behavior of droplets in spray dryers; drying rates and estimation of spray drier capacity; selection of industrial dryers.

FE566 Food Emulsions (3-0)3
Understanding emulsion science and technology in the food industry, general characteristics of food emulsions and molecular characteristics, colloidal interactions, interfacial properties, emulsion formation mechanisms, emulsion stability and food emulsions in practice.

FE 569 Design of Experiments for Food Engineers (3-0)3
Design of experiments. Common parametric and non-parametric tests. Two and three way ANOVA and interaction analysis. Applications on data analysis in Food Engineering.

FE 570 Response Surfaces Design and Analyses (3-0)3
Principles of experimental design, first-order models and designs, second-order models and designs, determining optimum conditions, mixture design and analyses, application of response surface methodology in food research.

FE 572 Regression Analysis (3-0)3
Simple and multiple linear regression analysis,. Non-linear regression analysis. Applications on data analysis in Food Engineering.

FE 575 Applied Sensory Analysis of Foods (3-0)3
Selection and training of panelists, Test room design, Discrimination testing, Acceptance and preference testing, Descriptive analysis, Measuring responses, Sensory thresholds, Time Intensity Evaluations, Quality Evaluations, Affective Tests, Descriptive analysis, Relating instrumental to sensory data, Statistical analysis of data, Statistical Designs

FE 581 Processing and Nutritional Quality of Fruits and Vegetables I (3-0)3
Quality of fresh produce for processing. Minimal processing, canning, freezing, dehydration, fermentation. Nutritional losses during processing. Discussion of related subjects appearing in recent issues of technical journals.

FE 582 Processing and Nutritional Quality of Fruits and Vegetables II (3-0)3
Jams, jellies and preserves. Juices, concentrates, bases and nutrification. Nutritional stability. Fruits and vegetables processing waste utilization. Discussion of related subjects appearing in recent issues of technical journals.

FE 583 Fats and Oils Technology (3-0)3
The structure and chemistry of fats and oils. Glycerides and fatty acids; essential fatty acids, w-group fatty acids. Modes of lipid deteriorations. Antioxidants. The extraction of fats and oils from animals and vegetables. Refining technology of vegetable oils; degumming, neutralization, bleaching, deodorization. Hardening of oils and margarine production. Innovations in fats and oils technology.

FE 584 Advances in Fresh-Cut Fruits and Vegetables Processing (3-0)3
Fresh-cut produce: tracks and trends. Quality parameters, safety aspects, physiology and microbiology of fresh-cut fruits and vegetables. Enzymatic effects on flavor and texture of fresh-cut produce. Preservative treatments. Application of packaging and modified atmosphere to fresh-cut fruits and vegetables. Use of edible coatings. Biotechnology and fresh-cut produce industry. Process design, facility, and equipment requirements. Future economic and marketing considerations.

FE 599 MSc Thesis (0-1) non-credit
FE 699 PhD Thesis (0-1) non-credit
FE 800 PhD Seminar I (0-2) non-credit

FE 850 PhD Seminar II (0-2) non-credit

FE 700 MSc Seminar (0-2) non-credit
Directed study and research for Masters level graduate students on a subject of mutual interest to student and faculty member. Course content will depend on intrests of the student and faculty member. A paper is to be prepared and presented by the enrolled graduate student at the end of the semester.

FE 750 Non- Thesis MSc Semester Project (0-2) non-credit
A one-semester experimental and/or theoretical research project supervised by a faculty member. The project topic is determined by the advisor and the student. A written final report is required at the end of the semester.

FE 899 Special Studies (4-0) non-credit
This special studies course is designed to introduce students to topics of contemporary importance or special interest that fall outside the scope of the curriculum Supervisor discusses problems related to individuals MS level work and guides MS level students to generate new ideas in their particular research areas. The course is aimed to enhance research and to interchange state of the art information in technological and scientific fields.

FE 999 Special Topics (4-0) non-credit
This special topics course is designed to introduce Ph.D. level students to topics of contemporary importance or special interest that fall outside the scope of the curriculum. Supervisor discusses problems related to individuals Ph.D. level work and guides Ph.D. level students to generate new ideas in their particular research areas. The course is aimed to enhance research and to interchange state of the art information in technological and scientific fields.

FBE501 Araştırma Yöntemleri ve Bilimsel Etik (3-0)3 AKTS:6
Bilgi okur-yazarlığı, Bilimsel yöntemler, Araştırma metot ve teknikleri, Bilimsel araştırma, Bilimsel Projelerin hazırlanması ve sunumu, Etik ve tarihçesi, Etik ile ilgili kavramlar ve terimler, Bilimsel etiğe giriş, Bilimsel araştırma ve yaynlarda etik, Mesleki etik (Mühendislik ve doğa bilimlerinde etik), Bilim dünyasında etik ihlalleri ve sonuçları, Yüksek öğretimde etik kuralları ve uygulamaları.

NAS501 Research Methods and Scientific Ethics (3-0)3 ECTS: 6
Information literacy, Scientific methods, Research methods and techniques, Scientific research, Preparation and presentation of Scientific Projects, Ethics and its history, Ethical concepts and terms, Introduction to scientific ethics, Ethics in scientific research and publications, Professional ethics (ethics in engineering and natural sciences), Violations of rules of ethics and its consequences in the scientific world, Ethical rules and practices in higher education.