FOOD ENGINEERING BSC

FIRST YEAR

Course: Differential and Integral Calculus I
Class hours: 160
Syllabus: Intervals, inequalities and absolute values. Single variable functions: definition, elementary functions and invertibility. Limit and continuity. Fundamental limits. Derivatives: definition; geometric and kinematic interpretation. Derivative as a rate of change. Differentiation rules, and implicit differentiation. Applications of derivatives. Theorems involving differentiable functions. Analysis of function variation. Optimization problems. L'Hôspital´s rule. Taylor series and approximation error. Antiderivatives. Riemann integrals. Area between curves. Fundamental Theorem of Calculus. Integration techniques. Volumes of solids of revolution. Improper integrals.

Course: Vectors, Curves and Surfaces
Class hours: 80
Syllabus: Vectors in bi and three-dimensional geometric space: definition, addition, scalar multiplication and properties. Dot product, vector projection, cross and triple product. Lines and planes in three-dimensional spaces: equations, relative positions and applications to geometric problems. Definition of curves in two and three-dimensional spaces. Cartesian equations and parameterization of curves in two-dimensional spaces, with an emphasis on lines, circles and conics. Quadric Surfaces. Parameterization of curves in three-dimensional spaces such as intersection of cylindrical, spherical, quadratic and planar surfaces. Vector function ideas. Functions of two real variables: definition, graphical representation and contour lines. Tangent planes and normal lines to surfaces. Partial derivatives: definition and geometric interpretation.

Course: Physics I
Class hours: 160
Syllabus: Theory: physical quantities and their measures. Motion in two or three dimensions. Applied forces. Newton's laws. Equilibrium of particle. Dynamics of particle. Work and kinetic energy. Potencial energy and energy conservation. Power. Momentum, impulse and collisions. Center of mass. Equilibrium of rigid bodies. Laboratory: Physical quantities and their Measures. Measuring instruments. Experiments involving the topics of the subject matter.

Course: Drawing
Class hours: 80 horas
Syllabus: Basic geometric constructions; Projection systems, systems of representation. Reading and interpreting drawings. Technical standards. Sketch orthographic views. Parallel isometric perspective. Auxiliary views and sections, 3D visualization, solid modeling and effects of realism in 3D computer visualization.

Course: Algorithms and Programming
Class hours: 80 horas
Syllabus: Logic. Logic for Engineers. Computer Programming. Algorithm. Flowchart. Data: variables and constants. Numerical, logical, strings and user-defined types of data. Programming structures: sequential, conditional and repetitive. Subroutines. Programming language as a tool for logic development.

Course: General Chemistry
Class hours: 160 horas
Syllabus: Scientific Method; Magnetic Properties; Electronic Distribution; Ionic Bond; Metallic Bond; Molecular Orbitals; Band Theory; Semiconductors; Insulators; Physical-Chemical Properties; Covalent Bond; Lewis Theory; Molecular Geometry (VSEPR); Polarity; Intermolecular Forces; Ideal Gas Model; Real Gas Model (van der Waals); Compressibility Factor; Thermodynamics; Enthalpy, Entropy; Free Energy; Spontaneity; The Study of Chemical Reactions; Equilibria; Chemical Kinetics; Redox Reactions; Electrolysis; Electrochemical Cells; Corrosion.

Course: Engineering Fundamentals

Class hours: 160 horas
Syllabus: Fundamental dimensions. Significant figures. Dimensional analysis. Homogeneity of equations. Systems of units and conversions. Physical measurements and treatment of experimental data. Electronic spreadsheets. Tables and graphs. Curve fittings, linear and non-linear models. Linearization. Trusses, machines and gantries. Optimization. Making prototypes. Oral, written and graphic communication.

Course: Projects and Special Activities I
Class hours: 160
Syllabus: Development of competencies, skills and attitudes relevant to the formation of future Engineer, through electives and student-centered practical activities. Training of interpretation and analysis skills. Problem solving methodologies. Development of engineering projects. Technical visits, lectures, workshops, seminars and technological competitions. Participation In undergraduate monitoring programs, scientific projects and technological research, as well as participation in social responsibility projects.

SECOND YEAR

Course: Differential and Integral Calculus II
Class hours: 80
Syllabus: Partial derivatives: Tangent plane, normal straight. Differentiability. Chain rule and implicit differentiation. Directional derivative and gradient vector. Maximum and minimum values and Lagrange multipliers. Double integrals: definition, properties, polar coordinates and applications. Triple integrals: definition, cylindrical and spherical coordinates and applications. Variable changes in multiple integrals. Vector calculation: vector fields, conservative fields, line integrals, Green's theorem, rotational and divergent operators, surface integrals, Stokes¿s theorem and Gauss¿s theorem.

Course: Computational Mathematics
Class hours: 80
Syllabus: Computer arithmetic / Errors: Type and Propagation / Taylor Series; Matrices and Matrix Operations / Introduction to Linear Systems / Direct Method (Gaussian Elimination) / Iterative methods (Jacobi and Gauss-Seidel) / Stopping and Convergence Criteria / Notions on Conditioning; Algebraic and Transcendent equations / Bisection Method / Newton Method; Approximation of functions / Interpolation / Linear and Polynomial Fit / Transformations / Determination Coefficient; Numerical Integration (Trapezoidal Rule, First and Second Simpson Rules); Solution of Ordinary Differential Equations / Numerical Solution (Euler and Runge-Kutta Methods) / Notions of Stability of the Solution / Errors / Solution of Higher Order Ordinary Differential Equations as a System of First Order Ordinary Differential Equations; Notions of Partial Differential Equations.

Course: Mechanics
Class hours: 80
Syllabus: Frenet frame (Moving Trihedron). Rigid Bodies Kinematics: velocity and acceleration fields, moving reference frames. Rigid Bodies Dynamics: mass distribution, center of mass theorem, angular momentum and angular momentum theorem, kinetic energy and kinetic energy theorem.

Course: Physics II
Class hours: 160
Syllabus: THEORY: Electromagnetic interaction. Electric Field. Gauss´s Law. Electric potential. Eletrostactic energy. Electric current. Magnetic induction. Biot-Savart´s Law. Ampere´s Law. Faraday´s Law. Periodic and oscillatory motions. Simple harmonic motion. Physical concepts of forced oscillations, resonance and damped oscillations. Mechanical waves. Energy propagation. Standing waves. Maxwell´s equations. LABORATORY: D.C. generator. Eletric Field.Filiform conductors. Capacitors. Oscillatory motion. Biot-Savart´s Law. Earth Magnetic Field. Faraday´s Law. Photoelectric effect. Diffraction.

Course: Statistics

Class hours: 80
Syllabus: Descriptive Statistics: tabular and graphical presentations, location, variability and distribution shape measures; Probability: basic concepts, unidimensional random variables and common discrete (binomial and Poisson models) and continuous distributions (exponential, Weibull and Gaussian distribution); Estimation: sampling and estimation concepts, sampling distribution, confidence interval (for a population mean, proportion and variance); Hypothesis Tests: basic concepts, testing a single population mean, proportion and variance; testing multiple population means (ANOVA).

Course: Elementary Principles of Process Engineering and Thermodynamics
Class hours: 160
Syllabus: Basic principles of Thermodynamics: system, surroundings, state, energy and its forms, extensive and intensive properties. PVT relations. Thermodynamic property tables. Mass and energy balances, problems with and without chemical reactions, transient and steady-state processes, open and closed systems. Balance calculations with the use of spreadsheets. Introduction to phase equilibrium: pure substances and multicomponent ideal systems. Water activity.

Course: Applied Chemistry I
Class hours: 240
Syllabus: Organic Chemistry: IUPAC nomenclature of organic compounds, chemical bonding, principles of stereochemistry, isomerism and chirality. Carbocations, carbanions and free radicals. Acids and bases. Effects of structure on reactivity. Main organic chemistry reactions (nucleophilic aliphatic substitution, eliminations, addition, radical reactions and redox). Physical Chemistry and Inorganic Chemistry: Chemical kinetics (rate law, reaction order, integrated equations, activated complex theory, reaction mechanisms, parallel and consecutive reactions). Analytical Chemistry: Laboratory safety; sampling; equilibrium: neutralization, precipitation, redox, complex formation; volumetric titration: neutralization, precipitation, redox, complex formation; indicators.

Course: Projects and Special Activities II – AL
Class hours: 160
Syllabus: Development of competencies, skills and attitudes relevant to the formation of future Food Engineer, through electives and student-centered practical activities. Training of interpretation and analysis skills. Problem solving methodologies. Development of engineering projects. Technical visits, lectures, workshops, seminars and technological competitions. Participation in undergraduate monitoring programs, scientific projects and technological research, as well as participation in social responsibility projects.

THIRD YEAR

Course: Food Microbiology
Class hours: 160
Syllabus: Important bacteria and fungi in food. Factors affecting the growth of microorganisms in food. Sources of food contamination. Control of microbial growth in food by high temperatures, low temperature, drying, radiation and chemical preservatives. Spoilage of foods by microorganisms. Microbial foodborne diseases. Practice: Methods for detection microorganisms in food.

Course: Transport Phenomena
Class hours: 160
Syllabus: Transport phenomena: mechanisms, driving force and resistance. Fluid mechanics: behavior of fluids, laminar and turbulent flows, Newton's law for viscosity, overall momentum balance, pressure loss in the systems. Introduction to heat transfer: mechanisms and basic equations; law of conservation of energy. Conduction: Driving rate equation and the equation of heat diffusion. One-dimensional conduction in steady state. Convection: boundary layer; individual coefficients of heat transfer; analogies between the transfer of momentum and heat transfer. Natural convection. Radiation: processes and properties. Radiation exchange between surfaces. Mass transfer: mass transfer coefficients and diffusion mechanisms. Concentrations,

velocities and flows. Differential balance for one component. Steady state diffusion. Transient diffusion. Diffusion with and without chemical reaction. Mass convection. Mass transfer between phases: global coefficients of mass transport.

Course: Electricity
Class hours: 40
Syllabus: Standards and safety in electrical installations; alternating voltage electrical circuits; AC power; three-phase circuits (applications and examples with motors); three-phase power; power factor correction; consumption measurement and electricity billing systems; electricity bill simulation.

Course: Laboratory of Food Engineering I
Class hours: 160
Syllabus: Programming, implementation and analysis of experiments related to the topics: Transport Phenomena, Thermodynamics for Food Engineering and Unit Operations in the Food Industry. Use of computational tools that enable the treatment of experimental results, as well as a greater understanding and optimization of the processes.

Course: Elementary Principles of Food Engineering
Class hours: 80
Syllabus: Measurable thermodynamic properties and basic principles. First Law of Thermodynamics. Irreversibility, Entropy and the Second Law of Thermodynamics. Heat engines and Thermodynamic Cycles. Equations of state and calculations of thermodynamic properties of pure fluids and mixtures. Phase equilibrium for multicomponent systems. Thermal Properties of Foods.

Course: Food Chemistry and Biochemistry
Class hours: 240
Syllabus: Water: definition, structure, physical properties, water in food, water activity, glass transition temperature, water activity and stability of food. Carbohydrates: definition, structure, classification, chemical reactions and functional properties. Proteins: definition, structure, classification, chemical reactions, stability and functional properties. Enzymes: classification, properties, activity, kinetic. Enzyme regulators. Industrial application of enzymes. Lipids: definition, structure, classification, chemical reactions, stability and functional properties. Postharvest physiology. Rigor Mortis. Food analysis: water activity, moisture, ashes, total proteins, sugars and fat content. Nucleic acids, vitamins, coenzymes, biochemical energy. Metabolic pathways: glycolysis, cellular respiration. Fatty acid oxidation. Degradation of amino acids. Lactic fermentation. Heterolactic Fermentation. Alcoholic Fermentation.

Course: Strength of Materials
Class hours: 40
Syllabus: Statics applied to the equilibrium of structures: external and internal forces. Geometrical properties of an area. Axial load. Thermal stress. Shear stress. Torsion. Bending Stresses. Bending deformation. Pressure Vessels. Buckling of columns.

Course: Projects and Special Activities III - AL
Class hours: 160
Syllabus: Development of competencies, skills and attitudes relevant to the formation of future Food Engineer, through electives and student-centered practical activities. Training of interpretation and analysis skills. Problem solving methodologies. Development of engineering projects. Technical visits, lectures, workshops, seminars and technological competitions. Participation in undergraduate monitoring programs, scientific projects and technological research, as well as participation in social responsibility projects.

FOURTH YEAR

Course: Physical Chemistry of Foods
Class hours: 80

Syllabus: Pigments. Vitamins. Dispersions: study of surface and interfacial phenomena, rheology, emulsions, foams and food gels. Physical Chemistry of Foods describes the physiochemical principles of the reactions and conversions that occur during the manufacture, handling, and storage of plant and animal foods - milk, meat, eggs, soybeans and wheat.

Course: Laboratory of Food Engineering II
Class hours: 160
Syllabus: Programming, implementation and analysis of experiments related to the themes Transport Phenomena, Unit Operations of Food Industry, Modeling and Process Control.

Course: Unit Operations in the Food Industry
Class hours: 240
Syllabus: Flow in porous beds. Particle size reduction techniques. Flow of food fluids in ducts. Food fluids pumping, agitation and mixing. Membrane separation process. Filtration process. Sedimentation process. Extraction process. Crystallization process. Distillation process.

Course: Food Technology
Class hours: 240
Syllabus: Processing of food of plant and animal origin: raw materials, ingredients, production processes, unit operations, mass and energy balances, controls, recovery and treatment of waste. Beverages. Fruit and vegetables products. Cereals and cereal products. Milk and dairy products. Meat and meat products.

Course: Instrumentation, Control and Automation
Class hours: 40
Syllabus: Study of modeling, simulation and control of food processes. Mathematical modeling and numerical techniques applied to food processes. Fundamentals of instrumentation and applications in the food industry.

Course: Sensory Analysis and Shelf Life
Class hours: 40
Syllabus: Introduction to Sensory Analysis. Human Senses. Organization of Sensory Tests. Factors that Influence the Sensory Evaluation. Sensory Methods: Difference Tests, Affective Tests and Descriptive Tests. Mathematical modeling and numerical techniques applied to food processes. Study and modeling of the shelf-life of foods.

Course: Entrepreneurship and Management
Class hours: 80
Syllabus: Brief history of the evolution of the Business Administration in the modern World. Systemic vision of a company, through the General Theory of Organizations Conceptualization and practical application of: Strategic Planning, Marketing Planning, Operations Planning and Financial Planning, through the design of a Business Plan of a new company, thus encouraging the entrepreneurial spirit of the students.

Course: Projects and Special Activities IV – AL
Class hours: 160
Syllabus: Development of competencies, skills and attitudes relevant to the formation of future Food Engineer, through electives and student-centered practical activities. Training of interpretation and analysis skills. Problem solving methodologies. Development of engineering projects. Technical visits, lectures, workshops, seminars and technological competitions. Participation in undergraduate monitoring programs, scientific projects and technological research, as well as participation in social responsibility projects.

FIFITH YEAR

Course: Industrial Projects
Class hours: 160
Syllabus: Concepts related to the elaboration, implementation and management of industrial projects:) Flowcharts of the process (PD)under study (process flowchart and engineering

flowchart). Engineering flowchart (P&ID) indicating all instrumentation and control strategies.) Preparation of the descriptive memorial of the process.) Development of the mass and energy balance of an industrial project.) Estimation of utility consumption. Sizing of lines, calculations of pipe diameter for the transport of fluids.) Preliminary design of equipment and preparation of the respective data sheets. Preparation of Project Risk Analysis. Preliminary assessment of project costs.

Course: Economics
Class hours: 80
Syllabus: Concepts and economic relations: definition of economics. Object of the economy and basic economic problems. Theory and economic analysis: a new microeconomics. Notions of macroeconomics: concept, measures of economic activity and economic policy instruments. International Economics: Balance of Payments and current economic analysis. Brazilian Economy and Contemporary World.

Course: Food Materials
Class hours: 40
Syllabus: Types of materials, competition among materials, recent advances in materials technology and their future trends. Intelligent materials, nanomaterials and major applications in the food industry. Ferrous metal engineering materials: carbon steel, alloy steels, stainless steels and cast iron. Non-ferrous metal engineering materials: copper, aluminum, zinc, nickel, lead, titanium, magnesium and their respective alloys. Thermal, mechanical, thermochemical treatments, mechanisms of resistance increase, influence on the properties of metallic materials and analysis of the correlation between properties. Corrosion: types and control. Polymeric materials: thermoplastics, thermosets and elastomers. Ceramic materials: traditional and engineering ceramics. Composite materials: materials, processes, properties and applications.

Course: Food Packaging
Class hours: 40
Syllabus: Packaging System: basic concepts. The packaging Brazilian economy context. The main questions of the packaging project: what do consumers want? How is the product damaged and how to protect it during the expected shelf-life? Principles of closing packages. Packaging materials: metallic, glass, polymer, cellulose and for goods transportation. Filling lines: typical equipment, balancing and determination of operational efficiency (OEE). Performance indicators.

Course: Food Safety
Class hours: 80
Syllabus: Good Manufacturing Practices (GMP) in the food industry. Standard Operating Procedures (SOP). Hazard Analysis and Critical Control Points (HACCP). Food safety standards. Sanitizers used in the food industry. Methods of cleaning and sanitization of equipment and surfaces. Chemical contaminants of food. Food allergens.

Course: Industrial Process Management
Class hours: 80
Syllabus: Concept of processes and process indicators (KPIs). Quality Management in organizations. Quality tools for quality improvement. Method for problems analysis (MASP). Concept of 5S. Sustainable operations management. Decisions to make investments. Six sigma strategy and introduction to the concept of lean manufacturing. Statistical control of processes. Process capability. Fundamentals of people management in organizations.

Course: Business Law
Class hours: 40
Syllabus: Fundamentals of Law. Civil Law. Business Law. Trademarks and patent. Labor Law. Tax Law. Environmental Law. Consumer Law. System CONFEA/CREA.

Course: Hygiene and Work Safety
Class hours: 40
Syllabus: Prevention; Accidents at work; Diseases of work; Notions of occupational hygiene; Specific themes; FOODS: biological agents: assessment and control measures; biosafety;

security in cold rooms; AUTOMATION AND CONTROL: ionizing and non-ionizing radiation; dangerousness; ELECTRICAL: low, medium and high voltage, electrical and fire safety. MECHANICS: occupational vibration: evaluation and measures control; safety in machinery and equipment; safety in boilers and pressure vessels; safety in welding; PRODUCTION: transportation safety and handling; warehousing and material handling; safety in layout; risk management; accident investigation. CHEMISTRY: chemical agents: assessment and control measures; safety in laboratories and transportation of hazardous materials; safety signage and labeling; Hazard and Operability Study - HAZOP.

Course: Undergraduate Thesis
Class hours: 160
Syllabus: The generation and dissemination of scientific and technological knowledge in society. Information sources. Academic work: its purpose and structure. Elements of Standard NBR 14724 and its construction in electronic media. Oral and graphic presentations: techniques and methodology.

Course: Supervised Internship
Class Hours: 160

ELECTIVE COURSES

Course: Chemical Analysis
Class hours: 80
Syllabus: Objectives and fundamentals of physical, chemical and instrumental analysis to control raw materials, processes and chemical products. Choice of methods; Sampling; preparation of samples. Validation of analytical methods.

Course: Food Design
Class hours: 80
Syllabus: Introduction to Design. Food Design Thinking. Design Thinking - Introduction. Design Thinking - Immersion - Exploratory research. Design Thinking - Analysis - Interviews / User journey. Design Thinking - Synthesis - Empathy / Persona map. Design Thinking - Mind map, SCAMPER, Brainstorming, Evaluation matrix, Definition of the final proposal. Naming (creation of the company and product name). Brand definition: purpose, values and promise. Creation of visual identity: primary elements - logo and symbol, secondary elements - institutional colors and alphabet, accessories. Brand Application Manual. Visual identity manual.

Course: Food Nutrition Labeling
Class hours: 80
Syllabus: Updates on nutrition facts label; Nutrition facts label; Food labeling legislation; Food claims.

Course: Fermented Food and Beverages Technology
Class hours: 80
Syllabus: Microorganisms of industrial interest used in the production of beverages and fermented foods. Cider production technology. Distilled Beverage Production Technology: Brandy. Technology of production of fermented vegetables: pickles and sauerkraut. Vinegar and Kombucha production technology. Fermented milk production technology. Salami production technology.

Note: The student may apply for enrollment in any course offered by the CEUN-IMT, as an elective to complement the required workload, provided it has the approval of the Course Coordinator.