

## **BRIEF OUTLINE OF COURSES**

### **THE PROGRAMME BIOENGINEERING 2017**

**EM1170      General law**

2(2-0-0-4)

Overview of origin of State and Law; nature, function and types of State and Law; the state apparatus of the Socialist Republic of Vietnam; the system of legal documents; law enforcement, legal violations and liability. Introduction of the most basic content of the major law branches in Vietnam.

**FL1100      English 1**

3(0-6-0-6)

The subject is for students who are beginning to learn English. The subject helps students to form and practice their Listening, Speaking, Reading and Writing skills in English at the beginning level. Students learn four skills through conversation or monologue, simple readings on different topics in life, developing skills in attractive, rich and practical situations. In addition, students can practice the pronunciation of individual words, intonation and accent in sentences.

**FL1101      English 2**

3(0-6-0-6)

English 2 provides students with basic English knowledge of elementary level of:

- Various topics such as sports, work, success, vacation, special days ... etc.
- Basic vocabulary related to the topics of each lesson.
- Grammatical phenomena such as single present tense, simple past, future, present completion, missing verbs, comparison.
- Regarding pronunciation, students are trained in accents and intonation
- Language skills in listening, speaking, reading and writing at the primary level.

**MI1112      Analytics I**

3(2-2-0-6)

Limit, continuous, differential and integral calculus of a function.

**MI1122      Analytics II**

3(2-2-0-6)

Multiple variables, Applying differential calculus to geometry, double integration (double multiple), second and second type integrals, field theory.

**MI1132      Analytics III**

3(2-2-0-6)

String of numbers, function strings, Fourier series, first-class differential equations, second-order linear differential equations, first-class differential equations, Laplace transforms, some models of technical problems.

**MI1142 Algebra**

3(2-2-0-6)

Basic contents of complex set, mapping, and numerical fields. Basic problems of linear algebra such as matrices, determinants, equations, vector spaces, linear mappings, specific vectors, specific values, global forms and Euclidean spaces, orthogonal crossover.

**MI3180 Probability Statistics and Experimental Planning**

3(3-1-0-6)

Basic concepts of probability, distribution law, numerical characteristics, limit theorem, parameter estimation and hypothesis testing of random variables (one-way as well as multidimensional); Minimum squared method, orthogonal planning (level I & II) as well as experimental planning to find extremes...

**PH1111 Physics I**

2(2-0-1-4)

Basic physical quantities and related laws such as momentum, theorems and laws of momentum; momentum, theorems and laws of angular momentum; kinetic energy, potential energy, conservation law of energy. Applying to consider the rotation of solid objects, vibrations and mechanical waves. Molecular dynamics uses statistical explanation and calculation of quantities: temperature, pressure, interior (ideal gas). Apply conservation laws and convert energy into thermal transition processes.

**PH1121 Physics II**

2(2-0-1-4)

Types of fields: Electric fields, magnetic fields; source of field; the properties of the field, the specific quantities for the field (intensity, voltage, magnetic flux ...) and the theorems, the law of relevance. The relationship between the magnetic field and the electric field. Electromagnetic field energy.

**PH1131 Physics III**

2(2-0-1-4)

Wave properties of light include interference, diffraction and polarization phenomena. Particle count of light consists of thermal radiation phenomena, Compton. Wave-particle duality of microscopic particles (such as electrons, atoms ...). Basic equation of quantum mechanics (Schrodinger equation). Survey: Tunnel effect, air conditioner. Two Einstein axioms. New concepts about space and time. Formula  $E = mc^2$  and application.

**IT1140 General Informatics**

4(3-1-1-8)

Information concept and information representation in computers. Computer system: hardware, operating system, internet, application software. Office computer software: drafting documents, spreadsheets, presentations. Algorithms and representations, Programming structures and basic data types in programming language C.

**CH1018 Chemistry I**

2 (2-1-0-4)

Composition of substances: Understand the basic assumptions about multiple electron atoms according to the approximate one electron and from there, based on the results of solving the hydrogen atom problem, knowing the electron cloud shape s, p, d, f and the dependence of energy levels s, p, d, f on the number of major quantum n and number of quantum l.

Constructing the electron configuration of the atoms of the elements, thereby understanding the cause of the periodic law and the principle of building the periodic table of chemical elements (cycles and groups). The relationship between the electron shell structure of atoms of elements and their position and properties in the periodic system table.

Understand two approximate methods of chemical bonding and molecular structure:

Linking electron pair method: It is necessary to understand how to set the problem and solution (qualitative) of Heitler-London H<sub>2</sub> molecular problem, thereby understanding the three propositions of Pauling (extending from the results of solving molecular problems H<sub>2</sub> to multiple atomic molecular problem). Hybrid method to consider the molecular structure of the molecule. Advantages and disadvantages of coupling electron method. Molecular orbital method - Atomic orbital linear method (MO method - LCAO): It is necessary to understand the assumptions and contents of the method. Principle of solving the problem according to MO-LCAO method and reaching the result: identify the MO, the energy of the MO, the distribution of electrons in the molecule and electron configuration of the molecule. Advantages of MO-LCAO method (compared to electron pair method) and disadvantages.

Distinguish polar molecules, non-polar molecules and dipole torque quantities that characterize the polarization of molecules. The force linking molecules, grasping the nature, its dependence on the nature of the bonds between atoms in the molecule and the spatial structure of the molecule; effects of these forces on the physical properties of substances (boiling temperature, melting temperature, vaporization temperature, solubility, ... of substances).

Chemical thermodynamic part: Understand the basic concepts and definitions of chemical thermodynamics. Knowing to apply Hess's law and its consequences, Kirchoff's law calculates the thermal effect of a reaction at any temperature. Applying Principle I, Principle II and Principle III of thermodynamics to validate the thermal response of a chemical reaction, building the basic equations of thermodynamics, expressions of thermodynamic functions. From there, it is possible to find the self-evolutions and limits of chemical processes. Understanding the concepts of chemical equilibrium, the equilibrium constant, Vanother Hoff's thermal equations on the relationship between equilibrium constants and the standard reciprocal variability of the reaction. Chemical equilibrium shift and factors affecting chemical equilibrium shift.

In the chemical dynamics, study the intermediate stages to convert the initial substances into final products, the velocities of the stages and the factors that affect velocity. Therefore, it is necessary to understand the factors affecting the speed of the reaction; the law of mass effects, Van's Hoff rule, equation of Arrhenius and experimental methods to determine the order of reaction and activation energy.

In the electrochemical section, studying the principle of turning energy into electricity. Electrode potential and direction of redox reaction. Dimension and equilibrium of redox reaction.

### **CH3224      Organic Chemistry**

2(2-1-0-6)

Basic concepts and basic modern methods for separation, purification, identification of organic compounds; Chemical bonds and types of effects in organic compounds; Acid-base properties of organic substances; Physical and chemical properties and methods for preparing major organic compounds: acyclic, normal and aromatic hydrocarbons; Halogen derivatives; Alcohol, Phenol; Aldehydes, ketones; Organic acids; Nitrogen derivatives such as Nitro, Amin, Dizo; Mixed compounds; Aromatic polymeric compounds; Heterocyclic compounds; Basic color and dye indicators.

### **CH3081      Physical Chemistry**

2(2-1-0-4)

This course aims to provide students with basic and modern knowledge of physical chemistry and surface chemistry related to technical processes, production technologies of food chemistry.

In addition, the course also provides students with the teamwork skills, presentations and attitudes needed to work in the company later.

### **CH3082      Experiments in Physical chemistry**

1(0-0-2-2)

The content of this course aims to provide students with the knowledge of physical chemistry and surface chemistry and practical laboratory skills. At the same time, provide students with methods to build experiments to identify chemical and physical chemistry and surface chemistry related to technical processes, production technologies of food chemistry.

- Saturated vapor pressure: the relationship between a liquid saturated pressure and temperature, method of determining the vaporization temperature and boiling temperature of the liquid.
- Distribution law: the distribution of solvents in two solvents, the basis of the extraction process
- Conductivity: conductivity of strong, weak electrolytes; conductivity measurement method and apply to determine the separation and dissociation constant of weak electrolyte.
- Viscosity: The meaning of the types of viscosity, know the method of measuring the viscosity of a solution, applied to determine the approximate mass of the macromolecular compound
- Adsorption: Study on adsorption of solute from solution, using surface tension measurement method to determine the concentration of post-adsorption substance; know how to set up Langmuir equation.
- Colloidal chemistry: method of preparing colloid system, method of destroying the colloidal system with electrolyte and the relationship between the flocculation threshold and the charge of electrolyte.

In addition, the course also provides students with teamwork skills, method of processing experimental data, methods of writing experimental reports and attitudes needed to work in the company later.

Supplement basic science

### **CH3316      Analytical chemistry**

2(2-1-0-4)

Theoretical basis of chemical methods used in analysis (volume method and mass method). The basis of a commonly used separation method is the extraction method. Analytical chemistry experiments that students will practice in the laboratory.

### **CH3318 Experiments in Analytical chemistry**

1(0-0-2-2)

This course aims to provide students with a solid understanding of physical chemistry and surface chemistry and practical laboratory skills. At the same time, provide students with methods to build experiments to identify chemical and physical chemistry and surface chemistry related to technical processes, production technologies of food chemistry.

1. Saturated vapor pressure: the relationship between a fluid's saturated vapor pressure and temperature, the method of determining the vaporization and boiling temperature of a liquid.
2. Distribution law: the distribution of solvents in two solvents, the basis of the extraction process
3. Conductivity: conductivity of strong, weak electrolytes; conductivity measurement method and apply to determine the separation and dissociation constant of weak electrolyte.
4. Viscosity: The meaning of the types of viscosity, know the method of measuring the viscosity of a solution, applied to determine the approximate mass of the polymer compound
5. Adsorption: Study the phenomenon of adsorption of solute from solution, using surface tension measurement method to determine the concentration of post-adsorption substance; know how to set up Langmuir equation.
6. Glue chemistry: method of preparing colloid system, method of destroying the colloidal system with electrolyte and the relationship between the flocculation threshold and the charge of electrolyte.

In addition, the course also provides students with teamwork skills, methods of processing experimental data, methods of writing experimental reports and attitudes needed to work in the company later..

### **EE2012 Electrotechniques**

2(2-1-0-4)

Circuits: Basic concepts of electrical circuits. Sine current. Methods of circuit analysis. Three-phase circuit. Transient process in electrical circuit. Electric machine: General concept of electric machine. Transformers. Asynchronous motor. Synchronous electric machine. Direct current machine. Control the electric machine.

### **ME2015 Descriptive geometry**

3(3-1-0-6)

- Projection and visual representation (by the method of angular projection) of: points, lines, faces. The problem belongs to and is hidden.
- Technique of drawing and drawing objects.
- Standards in technical drawing.
- Figures shown in technical drawing: basic projection, secondary projection, sectional view, sectional view, measuring axial view, extracted image.
- Write geometric dimensions for objects.

- Analyzing, judging, deducing logic to read and understand flat drawings (with the support of software).
- Performing grafting details and smooth and threaded joints. Create simple assembly drawings.
- Using graphics software.

### **BF2701 Introduction to Bioengineering**

2(1-1-1-4)

The course introduces: Biotechnology and Bioengineering concept, Biotechnology and Bioengineering development history, Biotechnology sub-sectors: the applications of biotechnology in the fields of industry, agriculture, medicine/pharmaceuticals and the environment, the curriculum of Bioengineering program of Hanoi University of Science and Technology. Students are introduced to the ethical and biosafety rules applied in the field of biotechnology, learn the principles, how to operate and apply equipment and instruments in biotechnology at the laboratory and pilot scale. The course also introduces the trends of biotechnology and bioengineering development in the world, in Vietnam and career opportunities in the field,

In addition, the course also provides students with the teamwork skills, presentations and attitudes needed to work in the future.

### **BF3711 Processes and equipment in Biotechnology I**

2 (1-1-1-4)

- The principles of processes and hydraulic equipment,
- Hydraulic principles, processes and equipment
- Mixing principles and equipment

### **BF3712 Processes and equipment in Biotechnology II**

3(2-1-1-6)

Part 1: Theoretical basis of heat transfer, heat transfer methods (thermal conductivity, convection, radiation), processes and equipment for heating, cooling, condensing, condensing, freezing.

Part 2: Theoretical foundations of the mass transfer process. The process of distillation, absorption, adsorption, extraction, crystallization, drying. Basis of structure, working principle, application and calculation method, design of various types of mass transfer devices.

### **BF3713 Processes and equipment in Biotechnology III**

2(2-1-0-4)

Kinetics of growth, consumption of substrates, products formation of microorganisms in continuous, batch or fed batch fermentation; balance of material in the biological system, stoichiometry of growth; construction, instrumentation and control devices of bioreactor; classification of bioreactor; supplying and consuming oxygen in bioreactor; kinetics of sterilization; scale up bioreactor.

The subject also provides students with the skills of analysis, synthesis, teamwork.

**BF4725      Techniques for Measuring and Automatic control in Biotechnology**

**2(2-0-1-4)**

Part 1: Theoretical basis for automatic control of linearization system. In which, the method of analyzing and synthesizing automatic control system includes the Laplace differential equation and transform method. Survey the characteristics of the basic stages. Regulatory law. Evaluate the stability of the automatic system and the quality of the adjustment process.  
Part 2: Techniques for measuring basic technological parameters. Introducing the basic concepts of measurement science, in which the accuracy of measuring instruments, measurement errors. Presenting the principle of measurement, structure of sensors, measuring diagrams and methods of installing sensors to the technology objects to measure and control basic technological parameters (temperature, pressure, flow, level), humidity, pH).  
Part 3: Setting up the diagram of measurement and control functions of technological processes. Introducing international standards for setting up diagrams to control and control technological processes. Practice setting up diagrams to measure and control biotechnology processes.

**BF4726      Quality Product Management in Biotechnology**

**2 (2-0-0-4)**

Quality assurance activities and quality management. Sampling and inspection techniques with sample planning according to ISO standards. Some management and quality assurance systems. Biological safety.

**BF3714      Project of Processing and Equipments in Bioengineering**

**1 (0-2-0-4)**

Instruct students how to synthesize knowledge learned from related subjects to calculate material and energy balance for specific mechanical, thermal, and mass transfer processes.  
How to analyze and select design plans  
How to calculate material and energy balance for a specific process.  
How to select extra equipment  
How to present a blueprint of the project.  
How to show an assembly drawing

**BF2702      Biochemistry**

**4 (4-0-0-8)**

The course provides knowledge on the following:

- Basic biological macromolecules including structure, function, properties of the proteins, glucids, lipids and vitamins
- Introduction of enzymes and enzyme classification, involving structure, characteristics, factors influencing on the enzyme reaction
- Concept of water activity and its influences on the behavior of biological macromolecules
- Metabolic pathways in the living body

**BF2703      Experiments in biochemistry**

**2(0-0-4-4)**

Introduction to the principles and operation of instrumentation, preparation of glass wares and chemical solutions in biochemical analysis. Determining total nitrogen, proteins, reducing sugars, polysaccharides, lipids, vitamins and enzyme assay according to Vietnamese or international standards. Isolations and components analysis of oligosaccharides, proteins by physic-chemical methods (chromatography, electrophoresis).

**BF3701      Microbiology I**

3 (3-0-0-6)

The module is divided into 6 chapters: Morphological characteristics and classification of microorganisms (bacteria, fungi, viruses, algae, animal protozoa); Metabolism in microorganisms (cell composition, nutrition, respiration); Growth and development in microorganisms (population growth and development characteristics, kinetics of microbiological growth processes, monitoring directions for application of microbiological growth and microbiological development); some genetic and microbiological immunological characteristics; and ability to exploit microbiological applications in industrial production.

**BF3702      Experiments in microbiology**

2 (0-0-2-4)

The tests include: Preparation of laboratory equipment; Manufacturing nutritional environment using microscopes; techniques for microorganism cultivation; microbial isolation techniques; Quantitative techniques of microbial cells, aerobic and anaerobic microbial breeding techniques, evaluation of microbial fermentation ability

**BF3703      Cell biology**

2 (2-0-1-4)

Cell structure and function; Chromosome and cell cycle; Cell membrane and process of material and information transport; Metabolic pathways and energy metabolism in living organisms; Cell information receiving and processing mechanism; Differentiation of cells.

**BF3704      Immunology**

2(2-0-0-4)

The contents include humoral immune response, cell-mediated immunity, antigen, antibody, immune-competent cells, complement system and immunomodulatory, phagocytic substances, Antigen reaction - antibody, molecular antibody structure, monoclonal antibody, polyclonal antibody, organized antigen. Applications of immunology in developing immunological analysis methods, vaccine design, immunotherapy

**BF3705      Genetics and molecular biology**

3 (2-2-0-6)

Part 1. Genetics: Genetic material, Genetic structure and genome; Genetic microorganisms; Genetic rules; Variations

Part 2. Molecular biology: Reproducing and stabilizing genes; Gene expression and activity; Applications and prospects of molecular biology.



**BF3706 Genetic engineering**

2(2-0-1-4)

Genetic engineering facility; Basic techniques in genetic engineering, gene flow separation; Gene expression; Application of genetic engineering in practice.

Experiment:

Lesson 1: Extract and purify DNA

Lesson 2: PCR method

Lesson 3: Transforming recombinant DNA into cells

**BF3707 Bioinformatics**

2(1-0-2-4)

General information on biology (general concept, online databases on biotechnology); Principles of exploitation and development of bio-information (Basis for building a database of biodatabases, characteristics of data sources and exploitation and application of information-biological databases); Practicing the application of some bio-data processing tools in scientific activities (Online data exploitation; Using the movement rules analysis program of the chain group with similar characteristics of ClustalW , Bait design program, ePCA simulated DNA synthesis program, homologous characterization program on first order structure of BLAST sequence and program to display Cn3D spatial structure;);

**BF3708 Analytical methods in biotechnology**

2(2-0-1-4)

Operational Principles, equipment system diagrams of analytical methods commonly used in the field of biotechnology such as: Chromatographic methods (liquid chromatography, gas chromatography, ion exchange chromatography, thin layer chromatography, gel chromatography, mass spectrometry); Spectroscopy methods (molecular absorption and emission spectroscopy, atomic absorption and emission spectroscopy, fluorescence spectroscopy, infrared spectroscopy), Electrochemical methods (potential and amperometric method) , labeling methods and capillary electrophoresis. Experimental works: ion exchange chromatography, molecular absorption spectroscopy, potential method, protein electrophoresis

**BF4701 Biological engineering for waste treatment**

3(2-2-0-6)

Waste and Environment. Characteristics of waste. Role of biological agents in waste treatment. Biological engineering for solid waste treatment. Biological engineering for wastewater treatment. The problem issues in waste treatment.

**BF4702 Environmental Toxicology**

2(2-0-0-4)

History of research on toxins, applications and the role of toxicology research. Basic concepts of toxins, toxic effects, relationships between doses and toxic effects. The pathways of exposure, absorption, metabolism and elimination of toxins. Basic concepts of organ toxicity (absorption, metabolism and toxic effects of environmental toxins on individual organs in the body). Some practical issues about toxins formed in the environment.

**BF4703      Microbiology II - Environmental Microbiology**

2(2-0-0-4)

The distribution of microorganisms in the environment. The conversion of natural compounds by microorganisms. Organic microorganisms and pollutants.

**EV4241      Environmental Management**

2 (2-0-0-4)

To provide students the fundamental knowledge of environment and environmental management such as definitions, functions and basic components of the environment, when the environment is polluted, problems related to environmental management and sustainable development; Basic principles and tools for environmental management; Current regulations on environmental quality management (air, water, land, solid waste and hazardous waste); Approaches and methods of environmental management at production facilities (towards environmental management systems). The course also provides students with teamwork skills, presentation skills and the ability to judge and solve environmental problems related to the applications in engineering.

**BF4704      Practical work in Biological Engineering for Waste treatment**

2(0-0-4-4)

Solid waste treatment: sampling; analysis of some characteristics of solid waste; making microbial preparations; applications microbial preparation handling solid waste into composting.

Wastewater treatment: sampling; analysis of some characteristics of wastewater; activated sludge process; operate one of the laboratory scale wastewater treatment systems.

**BF4705      Fermentation Engineering**

3 (2-2-0-6)

Basic knowledge of fermentation equipment, fermentation techniques (surface, submerged fermentation), fermentation method (batch, semi-continuous, continuous). Control the fermentation process to obtain the desired product. Upgrade the scale of fermentation.

**BF4706      Molecular and Immunological Methods in Food Industry**

2(2-0-1-4)

General introduction to rapid methods in food industry. Immunological techniques. Nucleic acid-based techniques. Bioluminescence technique. Biosensors.

**BF4707      Microbiology II - Food Microbiology**

2(2-0-0-4)

The module is divided into 5 chapters: Microbiological system in food (VSV meat, VSV fish, VSV milk, VAV vegetables, cereals, fermented food VSV); Exploiting microbial metabolism capacity in food production (beer industry, alcoholic industry, wine industry); Exploiting VSV activity in food processing (CN yogurt, cheese industry, vegetable and salt pickling industry); Functional foods and the role of microorganisms; Harmful microorganisms during processing and microorganisms cause disease to humans through food pathways.

**BF4511 Enzymes in Food Technology**

2(2-0-0-4)

Upon completion of this module, students are able to understand the nature of technological transformations under the action of enzymes, select commercial enzyme preparations or facilitate proper operation with intrinsic enzymes to meet the item. technology target set.

**BF4708 Practical work in Fermentation Engineering**

2 (0-0-4-4)

- Perform batch fermentation process: prepare the environment, prepare fermentation equipment, install equipment into the system, operate equipment, monitor and control process parameters. Calculation and analysis of pH, pO<sub>2</sub>, biomass indicator....
- Implementing fed-batch fermentation to increase the product yield compared to batch fermentation: calculating the amount of substrate, determining the timing of substrate and substrate mode Prepare and operate the fermentation device according to the specified parameters. Tracking fermentation process. Calculation, analysis and comparison with batch fermentation

**BF4709 Downstream processing**

2(2-0-0-4)

The methods used and sequencing to recover and purify the product with high purity from the cells obtained after fermentation. Methods include cell-breaking methods; methods for the separation of insoluble solids such as centrifugation and filtration; methods of concentration products such as membrane filtration, solvent extraction, adsorption and precipitation; purification method: chromatography; finishing method: crystallization, drying and freeze drying.

**BF4711 Microbiology II - Industrial Microbiology**

2(2-0-0-4)

The role of microorganisms in industrial biotechnology; Selection of industrial microbiological strains; Preserving industrial strains; Breeding and seed supply for industrial fermentation; Basis of microbiological application in industrial biotechnology (Technology of microbial biomass products; Technology of microbial biosynthesis products; Technology of collecting micro-metabolized products creature).

**BF4712 Enzymology**

3(3-0-0-6)

Technology for collecting enzyme preparations from microbial, animal and plant sources; Fixed enzymes (Concepts, fixed enzyme modulation methods, properties); Biological electrodes (enzyme electrodes and other biological electrodes); Equipment for enzyme reaction.

**BF4713 Animal cell technology**

2(2-0-0-4)

Animal cell biology development; Methods for animal cell culture; Stem cells and applications; Animal cell technology; Animal cloning technology, Some applications of animal cell culture

**BF4714      Molecular diagnostics**

2(2-0-1-4)

General introduction to diagnostic techniques. Nucleic acid extraction techniques used in diagnostics. Nucleic acid amplification techniques. Nucleic acid hybridization techniques. Next-Generation Sequencing technologies. DNA biosensors.

**BF4715      Virus culture technology**

2(2-0-0-4)

Present basic knowledge about viruses such as classification, structure, properties. Analyzing the role of virus in research as well as practical application. Presentation of virus culture technologies for diagnosis, research and development of drugs, vaccines and other bio-products.

**BF4716      Recombinant DNA technology**

2(2-0-0-4)

General introduction to recombinant DNA technology. Technologies for extraction and purification of nucleic acids. Technologies for gene isolation and cloning. Technologies for construction of expression vector. Transfection techniques. Expression systems. Genome-Editing technologies.

**BF4717      Methodology in Recombinant DNA Technology**

2(0-0-4-4)

Design of expression vector, extraction and purification of DNA and RNA, amplification of target coding sequence by PCR and RT-PCR, restriction and ligation of DNA, transformation of expression vector into Escherichia coli host strain, screening of transformants, analysis of expression of recombinant protein in host strain.

**BF4718      Techniques for Obtaining Bioactive Compounds from Plant**

2(2-1-0-4)

Introduction of chemical structure and properties; the biological and pharmaceutical activities of bioactive compounds; the extraction, separation and purification techniques and also the qualification and quantification techniques for above bioactive compounds; their application in the prevention of diseases, in the production of pesticide and insecticide.

**BF4719      Practical work in Techniques for Obtaining Bioactive Compounds from Plant**

2(0-0-4-4)

The module provides practical techniques for extracting and purifying some active substances from plants. After obtaining the activity, students will practice some qualitative and quantitative analysis techniques of these active groups. In addition to this module, for

biological activity, students will be able to practice methods to test antiviral activity and antioxidant activity.

**BF4721 Genetically Modified Organism and Application**

2(2-0-0-4)

Genetically modified organisms (GMO) and genetically modified food (GMF). Steps to create GMO / GMF. Major groups of genetically modified organisms and applications in food. Control, identify GMO / GMF by molecular techniques. GMO / GMF management. Some processes in the management of genetically modified organisms in Vietnam.

**BF4722 Plant Cell and Tissue Culture Technology**

2(2-0-0-4)

Introduction to Plant Biotechnology. Micropropagation. Basic laboratory layout and equipment. Components of plant tissue culture media. Somaclonal variation. Plant transformation.

**BF4723 Practical work in Animal Cell Technology**

2(2-0-0-4)

Provide theoretical knowledge of animal cell culture, cell culture laboratory conditions, culture media, culture procedure, culture and storage product evaluation and analysis. Provides practical skills on environmental preparation, culture and analysis of animal cell culture products.

**BF4724 Practical work in Enzyme Technology**

2(0-0-4-4)

Methods for collecting enzyme preparations from microorganisms, plants, purification and determination of basic enzymes, including: Enzymatic culture of microorganisms; Collect technical enzyme preparations; Collect pure products by column chromatography method (gel filter or affinity, ion exchange); Testing enzyme purification by polyacrylamide gel electrophoresis method SDS-PAGE; Immobilizing enzymes; Enzyme application

**BF727 Project work in bioengineering**

2(0-4-0-4)

Find and review documents related to the selected topic. Diagram of the process and corresponded equipment's for obtaining a biological product / preparation / tool. Calculate mass balance for products.

**BF4781 Technical practice in Bioengineering**

2(0-4-6-4)

During the internship in the industrial environment or in the research institute from a technical point of view is to familiarize and gain knowledge from the university that is applied in the industrial environment. Internship is also a career orientation (specialized...).

- Internship in Industrial company: administrative structure, organization of production, production planning, production process technology, methods of quality control and

quality assurance of products, semi-finished products, composition, operation and maintenance of equipment.

- Internship in research institute: methods of organization, implementation and evaluation, analytical techniques and equipment used for product research / development.

**BF4791 Bachelor thesis in Bioengineering**

6(0-0-12-12)

Apply in groups of 1-4 students in the form of research, design or practical problem solving. Students can work in laboratories, plant (guided by instructors) or at industrial facilities (taught by lecturers and field staff). Write report and defense before the Council.