

## **BIOCHEMICAL TECHNOLOGY PROGRAM**

The division of biochemical technology offers graduate program leading to a Master of Science in Biochemical Technology and a Doctor of Philosophy in Biochemical Technology. The students are required to take courses on fundamental biochemical technology and to select a group of electives to gain in depth specialization and/or to broaden the knowledge in specific field. Research thesis will allow students to obtain opportunity to carry out research under the guidance of advisor.

**Research interests in the division cover such areas as;**

- Enzyme Technology
  - Protein Engineering
  - Lipid Technology
  - Carbohydrate Technology
  - Flavor and Perfumery Technology
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## Master of Science Program in Biochemical Technology

### CURRICULUM

Total program credit **38 credits**  
Curriculum Component

#### **Plan A**

For applicants who have obtained a bachelor degree.

A. Core Courses 11 credits  
B. Elective Courses 15 credits  
C. Thesis 12 credits

#### **1. Core Courses 11 credits**

BCT	601	Enzyme Technology	3(3-0)
BCT	641	Functional Properties of Biochemicals	3(3-0)
BCT	661	Biochemical Techniques and Instrumentation	3(3-0)
BCT	691	Seminar I	1(0-2)
BCT	692	Seminar II	1(0-2)

#### **2. Elective Courses 15 credits**

BCT	602	Protein Engineering	3(3-0)
BCT	611	Carbohydrate Technology	3(3-0)
BCT	621	Lipid Technology	3(3-0)
BCT	631	Flavor Technology	3(3-0)
BCT	632	Perfumery Technology	3(3-0)
BCT	681	Selected Topics in Biochemical Technology	3(3-0)
BIT	551	Mathematics for Scientist	3(3-0)
BIT	611	Biodegradation and Biodeterioration	3(3-0)
BIT	631	Introduction to Gene Technology	3(3-0)
BIT	663	Marine Biotechnology	3(3-0)
BIT	672	Biochemical Reactor Design	3(3-0)
BIT	775	Separation and Purification for Bioprocesses	3(3-0)
BIT	741	Mechanism in Biocatalysis and Biomimetics	3(3-0)
CHE	512	Membrane Technology	3(3-0)
CHE	535	Unit Operations for Chemical Engineering	3(3-0)
CHE	661	Bioprocess Engineering I	3(3-0)
CHE	662	Bioprocess Engineering II	3(3-0)
FdE	624	Food Fabrication and Structure Synthesis	3(3-0)
CHM	541	Unit operation and control	3(3-0)
CHM	612	Fiber Technology	3(3-0)

#### **3. Thesis 12 credits**

BCT	693	Thesis	12(0-24)
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## CURRICULUM

Total program credit **38 credits**  
 Curriculum Component

### Plan B

For applicants who have considerable experience of working/doing research in the field related to biochemical technology are able to enroll in the special program. This program emphasizes more in the research work and less in taught courses.

A. Core Courses		2 credits
B. Elective Courses		12 credits
C. Thesis		24 credits

### 1. Core Courses **2 credits**

BCT	691	Seminar I	1(0-2)
BCT	692	Seminar II	1(0-2)

### 2. Elective Courses **12 credits**

BCT	601	Enzyme Technology	3(3-0)
BCT	602	Protein Engineering	3(3-0)
BCT	611	Carbohydrate Technology	3(3-0)
BCT	621	Lipid Technology	3(3-0)
BCT	631	Flavor Technology	3(3-0)
BCT	632	Perfumery Technology	3(3-0)
BCT	641	Functional Properties of Biochemicals	3(3-0)
BCT	661	Biochemical Techniques and Instrumentation	3(3-0)
BCT	681	Selected Topics in Biochemical Technology	3(3-0)

### 3. Thesis **24 credits**

BCT	693	Thesis	24(0-48)
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## STUDY PLAN

### Plan A

#### ◆ First Year

##### First Semester

BCT	601	Enzyme Technology	3(3-0)
BCT	641	Functional Properties of Biochemicals	3(3-0)
BCT	661	Biochemical Techniques and Instrumentation	3(3-0)
BCT	XXX	Elective	<u>3(3-0)</u>
<b>Total</b>			<b><u>12 (12-0)</u></b>

##### Second Semester

BCT	691	Seminar I	1(0-2)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	<u>3(3-0)</u>
<b>Total</b>			<b><u>13 (12-2)</u></b>

#### ◆ Second Year

##### First Semester

BCT	692	Seminar II	1(0-2)
BCT	693	Thesis	<u>3(-)</u>
<b>Total</b>			<b><u>4 (0-2)</u></b>

##### Second Semester

BCT	693	Thesis	<u>9(-)</u>
<b>Total</b>			<b><u>9 (-)</u></b>

### Plan B

#### ◆ First Year

##### First Semester

BCT	693	Thesis	1(-)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	<u>3(3-0)</u>
<b>Total</b>			<b><u>10 (9-0)</u></b>

##### Second Semester

BIF	XXX	Elective	3(3-0)
BCT	691	Seminar I	1(0-2)
BCT	693	Thesis	<u>8(-)</u>
<b>Total</b>			<b><u>12 (3-2)</u></b>

#### ◆ Second Year

##### First Semester

BCT	692	Seminar II	1(0-2)
BCT	693	Thesis	<u>8(-)</u>
<b>Total</b>			<b><u>9 (0-2)</u></b>

##### Second Semester

BCT	693	Thesis	<u>7(-)</u>
<b>Total</b>			<b><u>7 (-)</u></b>

## Doctor of Philosophy Program in Biochemical Technology CURRICULUM

### Type 1

Total program credit for <b>Master background in Biochemical Technology</b>	<b>48 credits</b>
Curriculum Component	
A. Fundamental Courses	non credits
B. Dissertation	48 credits
<b>1. Fundamental Courses</b>	<b>non credits</b>
BCT 791 Seminar I	1(0-2)
BCT 792 Seminar II	1(0-2)
<b>2. Dissertation</b>	<b>48 credits</b>
BCT 799 Dissertation	48 credits

### STUDY PLAN

◆	<b>First Year</b>		
	<b>First Semester</b>		
	BCT 791 Seminar I		1(0-2)
	BCT 799 Dissertation		<u>8 credits</u>
	<b>Total</b>		<u><b>9 (0-2)</b></u>
	 <b>Second Semester</b>		
	BCT 792 Seminar II		1(0-2)
	BCT 799 Dissertation		<u>8 credits</u>
	<b>Total</b>		<u><b>9 (0-2)</b></u>
◆	<b>Second Year</b>		
	<b>First Semester</b>		
	BCT 799 Dissertation		<u>8 credits</u>
	<b>Total</b>		<u><b>8 credits</b></u>
	 <b>Second Semester</b>		
	BCT 799 Dissertation		<u>8 credits</u>
	<b>Total</b>		<u><b>8 credits</b></u>
◆	<b>Third Year</b>		
	<b>First Semester</b>		
	BCT 799 Dissertation		<u>8 credits</u>
	<b>Total</b>		<u><b>8 credits</b></u>
	 <b>Second Semester</b>		
	BCT 799 Dissertation		<u>8 credits</u>
	<b>Total</b>		<u><b>8 credits</b></u>

## **Type 2**

Total program credit for **Master background in other fields** **50 credits**

Curriculum Component

A. Core Courses	3 credits
B. Electives Courses	9 credits
C. Dissertation	38 credits

### **1. Core Courses** **3 credits**

BCT	791	Seminar I	1(0-2)
BCT	792	Seminar II	1(0-2)
BCT	795	Special Problem	1(0-2)

### **2. Elective Courses** **9 credits**

BCT	601	Enzyme Technology	3(3-0)
BCT	602	Protein Engineering	3(3-0)
BCT	611	Carbohydrate Technology	3(3-0)
BCT	621	Lipid Technology	3(3-0)
BCT	631	Flavor Technology	3(3-0)
BCT	632	Perfumery Technology	3(3-0)
BCT	641	Functional Properties of Biochemicals	3(3-0)
BCT	661	Biochemical Techniques and Instrumentation	3(3-0)
BCT	662	Separation Technology	3(3-0)
BCT	681	Selected Topics in Biochemical Technology	3(3-0)
BIT	551	Mathematics for Scientist	3(3-0)
BIT	611	Biodegradation and Biodeterioration	3(3-0)
BIT	631	Introduction to Gene Technology	3(3-0)
BIT	663	Marine Biotechnology	3(3-0)
BIT	664	Electroanalytical Chemistry	3(3-0)
BIT	672	Biochemical Reactor Design	3(3-0)
BIT	775	Separation and Purification for Bioprocesses	3(3-0)
BIT	741	Mechanism of Biocatalysis and Biomimetics	3(3-0)
CHE	661	Bioprocess Engineering I	3(3-0)
CHE	662	Bioprocess Engineering II	3(3-0)
FdE	624	Food Fabrication and Structure Synthesis	3(3-0)
CHM	612	Fiber Technology	3(3-0)

### **3. Dissertation** **38 credits**

BCT	798	Dissertation	38 credits
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## STUDY PLAN

◆ **First Year  
First Semester**

BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	<u>3(3-0)</u>
		<b>Total</b>	<b><u>9 (9-0)</u></b>

**Second Semester**

BCT	798	Dissertation	7 (-)
BCT	791	Seminar I	1(0-2)
BCT	795	Special Problem	<u>1(0-2)</u>
		<b>Total</b>	<b><u>9 (0-4)</u></b>

◆ **Second Year  
First Semester**

BCT	792	Seminar II	1(0-2)
BCT	798	Dissertation	<u>7 (-)</u>
		<b>Total</b>	<b><u>8 (0-2)</u></b>

**Second Semester**

BCT	798	Dissertation	<u>7 credits</u>
		<b>Total</b>	<b><u>7 credits</u></b>

◆ **Third Year  
First Semester**

BCT	798	Dissertation	<u>8 credits</u>
		<b>Total</b>	<b><u>8 credits</u></b>

**Second Semester**

BCT	798	Dissertation	<u>9 credits</u>
		<b>Total</b>	<b><u>9 credits</u></b>

**Type 3**

Total program credit for **Bachelor background** **72 credits**  
Curriculum Component

- A. Core Courses 12 credits
- B. Electives Courses 12 credits
- C. Dissertation 48 credits

**1. Core Courses** **12 credits**

- BCT 601 Enzyme Technology 3(3-0)
- BCT 641 Functional Properties of Biochemicals 3(3-0)
- BCT 661 Biochemical Techniques and Instrumentation 3(3-0)
- BCT 791 Seminar I 1(0-2)
- BCT 792 Seminar II 1(0-2)
- BCT 795 Special Problem 1(0-2)

**2. Elective Courses** **12 credits**

- BCT 602 Protein Engineering 3(3-0)
- BCT 611 Carbohydrate Technology 3(3-0)
- BCT 621 Lipid Technology 3(3-0)
- BCT 631 Flavor Technology 3(3-0)
- BCT 632 Perfumery Technology 3(3-0)
- BCT 662 Separation Technology 3(3-0)
- BCT 681 Selected Topics in Biochemical Technology 3(3-0)
- BIT 551 Mathematics for Scientist 3(3-0)
- BIT 611 Biodegradation and Biodeterioration 3(3-0)
- BIT 631 Introduction to Gene Technology 3(3-0)
- BIT 663 Marine Biotechnology 3(3-0)
- BIT 664 Electroanalytical Chemistry 3(3-0)
- BIT 672 Biochemical Reactor Design 3(3-0)
- BIT 775 Separation and Purification for Bioprocesses 3(3-0)
- BIT 741 Mechanism in Biocatalysis and Biomimetics 3(3-0)
- CHE 661 Bioprocess Engineering I 3(3-0)
- CHE 662 Bioprocess Engineering II 3(3-0)
- FdE 624 Food Fabrication and Structure Synthesis 3(3-0)
- CHM 612 Fiber Technology 3(3-0)

**3. Dissertation** **48 credits**

- BCT 799 Dissertation 48 credits

## STUDY PLAN

◆ **First Year**  
**First Semester**

BCT	XXX	Core Course	3(3-0)
BCT	XXX	Core Course	3(3-0)
BCT	XXX	Core Course	3(3-0)
BCT	791	Seminar I	1(0-2)
<b>Total</b>			<b><u>10 (9-2)</u></b>

**Second Semester**

BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	3(3-0)
BCT	XXX	Elective	3(3-0)
BCT	792	Seminar II	1(0-2)
<b>Total</b>			<b><u>10 (9-2)</u></b>

◆ **Second Year**  
**First Semester**

BCT	XXX	Elective	3(3-0)
BCT	795	Special Problem	1(0-2)
BCT	799	Dissertation	6 (-)
<b>Total</b>			<b><u>10 (3-2)</u></b>

**Second Semester**

BCT	799	Dissertation	<u>9 credits</u>
<b>Total</b>			<b><u>9 credits</u></b>

◆ **Third Year**  
**First Semester**

BCT	799	Dissertation	<u>9 credits</u>
<b>Total</b>			<b><u>9 credits</u></b>

**Second Semester**

BCT	799	Dissertation	<u>8 credits</u>
<b>Total</b>			<b><u>8 credits</u></b>

◆ **Fourth Year**  
**First Semester**

BCT	799	Dissertation	<u>8 credits</u>
<b>Total</b>			<b><u>8 credits</u></b>

**Second Semester**

BCT	799	Dissertation	<u>8 credits</u>
<b>Total</b>			<b><u>8 credits</u></b>

## COURSE DESCRIPTIONS

BCT	601	<b>Enzyme Technology</b> <b>Prerequisite : none</b> The chemistry and structure of enzymes. Enzyme kinetics and mechanism of enzyme action. Enzyme regulation and production. Extraction and purification of enzyme. Technique of immobilization. Characteristics of immobilized enzymes and enzyme reactors. Enzyme reaction in organic solvent; solid phase and supercritical fluid. Application of enzymes in industries. Modification of enzyme molecule. Principle of protein engineering. Modification of enzyme structure by protein engineering techniques. Example of engineered enzyme.	3 (3 - 0)
BCT	602	<b>Protein Engineering</b> <b>Prerequisite : biochemical</b> Structure, folding and function of proteins. Determination of protein structure by the method of X-ray crystallography and NMR. Principle for redesigning the structure of proteins by the technique of genetic engineering and chemistry. Creation of the new proteins by improvement the properties or functions of wild-type proteins by protein engineering and its applications.	3 (3 - 0)
BCT	611	<b>Carbohydrate Technology</b> <b>Prerequisite : biochemical</b> Classification, chemistry and biochemistry of carbohydrates. Structure and function of carbohydrates. Biosynthesis of carbohydrates. Hydrolysis and bioconversion of carbohydrates and applications of products. Modification of carbohydrates. Processing and application of native and modified carbohydrates in industries.	3 (3 - 0)
BCT	621	<b>Lipid Technology</b> <b>Prerequisite : biochemical</b> Chemistry, structures and occurrences of triglycerides and other lipids. Biosynthesis and degradation of fatty acid. Polyunsaturated fatty acids. Extraction of total lipid and purification. Industrial process of fat and oil extraction, degumming, physical and chemical refining, deodorization, crystallization and hydrogenation. Analysis and quality control of lipid and edible oil industries. Microbial and enzymatic modification of lipids. Fats and oils utilization and oleo chemical industries.	3 (3 - 0)
BCT	631	<b>Flavor Technology</b> <b>Prerequisite : biochemical</b> Chemistry and biochemistry of flavors. Theories of 3 dimensional chemistry. Sensory perception and analysis of flavors. Flavor production and its application in various food industries. Natural and synthetic flavors. Current development of flavor in industries.	3 (3 - 0)
BCT	632	<b>Perfumery Technology</b> <b>Prerequisite : biochemical</b> Systematic smelling classification of odours. The many faces of the fragrance business. The raw materials of perfumery and a summary of their chemistry. Methods of fragrance composition and creation. Application of fragrances and considerations in their formulation. Commercial aspects of fragrance and the effect on creativity. Basic production methods. Quality control and standardization methods. Marketing and meeting the demands of customers and consumers. Learning from the market. An overview of the worldwide business of perfumery and the opportunities.	3 (3 - 0)
BCT	641	<b>Functional Properties of Biochemical</b> <b>Prerequisite : none</b> Systematic approaches on the physical and chemical properties of sugars and polysaccharides, amino acids and polypeptides, fatty acids and other lipids, nucleic acids, phenols and polyphenols and other biomolecules. Relate these	3 (3 - 0)

physical and chemical properties to their functionality or functional properties in various and industrial products.

BCT	661	<b>Biochemical Techniques and Instrumentation</b> <b>Prerequisite : none</b> General principle of chemical and physical quantification. Comparison of various methods for identification and quantification of biomolecules. Electrochemical principle in quantification and separation of biomolecules. Electrochemical instruments. Spectrophotometric methods and instruments in quantitative analysis. Chromatographic principles of separation, identification and quantitative analysis. Chromatographic instruments.	<b>3 (3 - 0)</b>
BCT	662	<b>Separation Technology</b> <b>Prerequisite : none</b> Principles and applications of separation processes relevant to concentration, fractionation and purification of biomolecules. The topics include techniques for cell disruption, centrifugation, conventional filtration, membrane filtration, solvent extraction, aqueous two phase extraction, adsorption, precipitation, distillation, crystallization, etc.	<b>3(3 - 0)</b>
BCT	681	<b>Selected Topics in Biochemical Technology</b> <b>Prerequisite : biochemical</b> Discussion and lectures on special aspects or advanced topics of current interest in biochemical technology. Check departmental announcement for topics offered any given semester or contact instructor for information.	<b>3 (3 - 0)</b>
BCT	691	<b>Seminar I</b> <b>Prerequisite : none</b> Preparation, presentation and discussion of the selected topics of interest literature, techniques and research pertaining to biochemical technology.	<b>1 (0 - 2)</b>
BCT	691	<b>Seminar II</b> <b>Prerequisite : none</b> Presentation and discussion of the research paper assigned by course organizer. Seminar II emphasizes reading, understanding of the content, catching the main point of the paper and rational paper discussion.	<b>1 (0 - 2)</b>
BCT	693	<b>Thesis</b> Intensive experimental research on biochemical technology which may extend throughout the year and furnish data under the supervision of the advisor.	<b>12 (0 - 24)</b>
BCT	791	<b>Seminar I</b> Preparation, presentation and discussion of the selected topics of interest literature, techniques and research pertaining to biochemical technology.	<b>1 (0 - 2)</b>
BCT	792	<b>Seminar II</b> Presentation and discussion of the research paper assigned by course organizer. Seminar 2 emphasizes reading, understanding of the content, catching the main point of the paper and rational paper discussion.	<b>1 (0 - 2)</b>
BCT	795	<b>Special Problem</b> <b>Prerequisite : none</b> Individual study and investigation on the topic (in different area from dissertation topic) assigned by course organizer. Students have to submit the proposal including the literature review, discussion and the idea to develop that research work.	<b>1 (0 - 2)</b>
BCT	798	<b>Dissertation</b> Intensive experimental research on biochemical technology which may extend throughout the year and furnish data under the supervision of the advisor.	<b>38 (0 - 76)</b>

BCT	799	<b>Dissertation</b> Intensive experimental research on biochemical technology which may extend throughout the year and furnish data under the supervision of the advisor.	<b>48 (0 - 96)</b>
BIT	551	<b>Mathematics for Scientist</b> <b>Prerequisite : none</b> Solution of Ordinary and Partial differential equation and its application. Numerical methods for solving systems of linear equations, and some important regression. Basic computer, emphasis on methods appropriate for use with computer, Data analysis by computerization. Introduction to statistic such as probability, Random sampling and analysis of variance.	<b>3 (3 - 0)</b>
BIT	611	<b>Biodegradation and Biodeterioration</b> <b>Prerequisite : biochemical and biology</b> Biodeterioration and materials, its causes, effects and prevention. The activity of different organisms in the decay of a wide range of organic and inorganic materials including metals. Organisms for biodeterioration testing. The techniques used in assessing the extent and cause of deterioration. Biodeterioration of timber in aquatic environments, petroleum products, synthetic polymers, tobacco and rubber in contact with water, sewage. Methods for testing, wrapping and coating for susceptibility to microbial attack. The microbial spoilage of pharmaceutical products, the detection of microorganism. The microbial degradation of preservatives and antimicrobial agents. Product resistance to microbial attack. The microbial breakdowns of pesticides, structural factors influencing biodegradability.	<b>3 (3 - 0)</b>
BIT	631	<b>Introduction to Gene Technology</b> <b>Prerequisite : biochemical and biology</b> Gene structure and function. Principles of gene cloning and recombinant DNA technology. Basic techniques. Applications in medicine and industries. The knowledge gained will enable students to follow the current literatures and future developments.	<b>3 (3 - 0)</b>
BIT	663	<b>Marine Biotechnology</b> <b>Prerequisite : biochemical and biology</b> Development of marine biotechnology at present. Potential use of marine animals, plants, algae and microbial for food, chemicals, bioactive metabolites and medicine e.g. anticancer, sterols, alkaloids, halogenated acetogenins, phenolic compounds and terpenoids. Marine algae as source of polysaccharides e.g. agar, caragenan and emulsifying agents. Potential use of freshwater and marine microalgae as sources of glycerol, pigments (carotenoids, $\beta$ -carotene), polyunsaturated fatty acids e.g. arachidonic acid, eicosatetraenoic acid and gamma-linolenic acid. Cultivation of algae, harvesting and extraction of chemicals. Development of photobioreactors. Immobilization of algae cell for commercial production of chemicals.	<b>3 (3 - 0)</b>
BIT	664	<b>Electroanalytical Chemistry</b> <b>Prerequisite : none</b> Fundamental concepts, electrochemical cells, principles of voltammetry, electrode-solution interface, types of electrode, electron transfer, mass transport, types of voltammetry, potentiometry, and modified electrodes and spectroelectrochemistry.	<b>3 (3 - 0)</b>
BIT	672	<b>Biochemical Reactor Design</b> The studies of the biological reaction kinetics for flow and batch measurement and control, modeling, scale up, dimensional analysis, and auxiliary equipment. Application to bioreactor design in stresses.	<b>3 (3 - 0)</b>
BIT	775	<b>Separation and Purification for Bioprocesses</b> <b>Prerequisite : none</b> Separations and purifications of metabolic products for specific uses e.g. food, pharmaceuticals and cosmetics.	<b>3 (3 - 0)</b>

<b>BIT</b>	<b>741</b>	<b>Mechanism in Biocatalysis and Biomimetics</b> <b>Prerequisite : none</b> Mechanisms in biochemical reactions. Catalysis by enzyme and coenzymes. Bioorganic designed catalysts to mimic biological system and lead to better understanding of biochemical reaction.	<b>3 (3 - 0)</b>
<b>CHE</b>	<b>512</b>	<b>Membrane Technology</b> <b>Prerequisite : chemical</b> Principles and theories of synthetic membrane separation and concentration processes such as reverse osmosis, ultra filtration, dialysis and pervaporation. Types and preparation of synthetic membranes. Membrane separation equipments. Application of membrane separation processes.	<b>3 (3 - 0)</b>
<b>CHE</b>	<b>535</b>	<b>Unit Operations for Chemical Engineering</b> <b>Prerequisite : none</b> Principles and theories of momentum, heat and mass transfer. Applications or process involving momentum transfer; fluid transportation and metering. Heat transfer process; evaporation, heat exchanger and condensation. Mass transfer processes; gas absorption, extraction and drying.	<b>3 (3 - 0)</b>
<b>CHE</b>	<b>661</b>	<b>Bioprocess Engineering I</b> <b>Prerequisite : chemical</b> Design and analysis of various types of biological reactors. Reactor dynamics. Engineering principles for bioprocess: consideration of operation of bioreactor for suspension and immobilized cultures, selection, scale up and operation control of bioreactors. Applications to non-conventional biological system.	<b>3 (3 - 0)</b>
<b>CHE</b>	<b>662</b>	<b>Bioprocess Engineering II</b> <b>Prerequisite : CHE 661</b> Recovery and purifications such as, filtration, centrifugation and extraction etc. Monitoring and control of bioprocess measurement of biological variables, process and optimization. Methodology for process control in research and development in industries. Concept of bioprocess design.	<b>3 (3 - 0)</b>
<b>FdE</b>	<b>624</b>	<b>Food Fabrication and Structure Synthesis</b> <b>Prerequisite : FdE 511, FdE 512</b> Structure of ingredients needed to enhance or diminish the properties of products. Roles of proteins, water, starch and other biopolymers. Microencapsulation. Texturization by extrusion. Theory and application of film formation, foaming, thickening, gelatinization, globular formation hydrolysis process.	<b>3 (3 - 0)</b>
<b>CHM</b>	<b>541</b>	<b>Unit operation and control</b> <b>Prerequisite : none</b> Unit operation and control of industrial equipment for heat exchange, water cooling, evaporation, drying, crystallization, humidification, adsorption, extraction, leaching and membrane technology.	<b>3 (3 - 0)</b>
<b>CHM</b>	<b>612</b>	<b>Fiber Technology</b> <b>Prerequisite : none</b> Natural and synthetic fibers. Fiber production technology. Surface structure. Fiber properties, mechanical, electrical friction optical and chemical properties. Modification and treatment of fibers. Dyeing of fibers. Chemistry and technology.	<b>3 (3 - 0)</b>