

《食品工程原理》课程教学大纲

课程基本信息 (Course Information)					
课程代码 (Course Code)	FS201	*学时 (Credit Hours)	64	*学分 (Credits)	4.0
*课程名称 (Course Name)	(中文) 食品工程原理 (英文) The Principles of Food Engineering				
课程性质 (Course Type)	专业基础类必修课				
授课对象 (Target Audience)	食品科学与工程专业大二学生或者食品科学研究生				
授课语言 (Language of Instruction)	双语教学 Bilingual				
*开课院系 (School)	农业与生物学院				
先修课程 (Prerequisite)	《高等数学》，《物理化学》，《机械制图》等				
授课教师 (Instructor)	赵大云	课程网址 (Course Webpage)			

<p>*课程简介 (Description)</p>	<p>课程性质:《食品工程原理》是阐述食品加工过程中的基本理论、有关单元操作及设备的基本原理,它是为专业工艺课的传授打基础的一门课程。这门课程讲授的内容可归纳为流体动力过程、质量传递过程、热量传递过程和热力过程等。</p> <p>教学目标:通过本课程的教学,使学生掌握其基本理论、各单元操作的基本规律;熟悉其设备的工作原理、性能和运转注意事项等,并能把这些知识用于食品加工的研究、设计和生产中,使生产能得到不断的改进。</p>
<p>*课程简介 (Description)</p>	<p>The stated content of this portion of the curriculum is “Engineering principles including mass and energy balances, thermodynamics, fluid flow, and heat and mass transfer”. The expectations include an application of these principles to several areas of food processing.</p> <p>Presenting these concepts to students with limited background in mathematics and engineering science presents a significant challenge. Our goal, in this course, is to provide students, planning to become food science professionals, with sufficient background in engineering concepts to be comfortable when communicating with engineering professionals.</p> <p>The course has been developed specifically for use in undergraduate food engineering courses taken by students pursuing a four-year degree program in food science. The topics presented have been selected to illustrate applications of engineering during the handling, processing, storage, packaging and distribution of food products. Most of the topics include some descriptive background about a process, fundamental engineering concepts and example problems. The approach is intended to assist the student in appreciating the applications of the concepts, while gaining an understanding of problem solving approaches as well as gaining confidence with the concepts.</p> <p>The scope of the course ranges from basic engineering principles, based on fundamental physics, to several applications in food processing. Within the first four chapters, the concepts of mass and energy balance, thermodynamics, fluid flow and heat transfer are introduced. A significant addition to this section of the fourth edition is an introduction to the concepts of process control. The next four chapters include applications of thermodynamics and heat transfer to preservation processes, refrigeration, freezing processes and evaporation processes used in concentration of liquid foods. Following the chapters devoted to the concepts of psychrometrics and mass transfer, several chapters are used to present applications of these concepts to membrane separation processes, dehydration processes, extrusion processes and packaging. Finally, a new chapter in this edition is devoted to supplemental processes, including filtration, centrifugation and mixing.</p>

	<p>The approaches used to present the concepts and applications are based on our own combined teaching experiences. Instructors will select chapters and associated materials to meet the specific objectives of the course being taught. The descriptive information, concepts and problems have been organized to provide maximum flexibility in teaching. The organization of the information in the course does serve as a study guide for students. Some students may be able to solve the problems at the end of chapters after independent study of the concepts presented within a given chapter.</p>
<p>课程教学大纲 (Course Syllabus)</p>	
<p>*学习目标(Learning Outcomes)</p>	<p>1. 知识体系: 要求掌握食品加工过程中重要的单元操作, 熟练各种工艺之间的关系, 掌握各单元操作的基本原理, 学会运用理论知识解决食品加工中一些工程实际问题。</p> <p>2. 能力培养: (1) 了解食品工程原理的基础知识, 以及在食品加工工程中的应用, 清晰思考和用语言文字准确表达的能力(A1); (2) 发现、分析和解决问题的能力(A3); (3) 批判性思考和创造性工作的能力(C3); (4) 与不同类型的人合作共事的能力(D3); (5) 至少一种外语的应用能力; (6) 终生学习的能力, 组织管理能力, 获取整理信息的能力(C5)。</p> <p>3. 素质培养: 刻苦务实、视野开阔、精勤进取。</p> <p>1. Knowledge system: After learning the course, students can deal with the issue of how to calculate the key parameters from some important unit operations in the food processing based on mass balance and energy balance. Also, to grasp the analogies among momentum conservation, heat transfer and mass transport.</p> <p>2. Capacity Cultivation: (1) To learn the basic principle of unit operations in food engineering, as well as its application in food processing; to grasp the ability to summarize and express correctly using terminology(A1); (2) the ability to discover, analyze and solve engineering problems in food processing(A3); (3) the ability to think critically and creatively(C3); (4) the ability to communicate with colleagues and/or partners during work(D3); (5) using English in food engineering; (6) lifelong learning. Strong organization and management skills, and demonstrated ability to organize & Lead team and be a team player as well(C5).</p> <p>3. Quality training: painstaking, pragmatic, open minded, diligent and enterprising.</p>

*教学内容 进度安排及要求 (Class Schedule & Requirements)	教学内容	学时	教学方式	作业及要求	基本 要求	考查方 式
	CHAPTER 1 Introduction	2	以课堂教学为主，结合自学； 授课方式为双语教学，即英 文教材和 PPT，中文讲授。 在教学方法和手段上采用现 代教育技术，理论与实践相 结合，促进学生掌握相关的 教学内容。 课堂教学主要讲解基本原 理，并将食品加工过程中遇 到现象和产生的问题等融入 基本原理的讲解，使同学们 更好地理解食品工程原理、 提高对食品学科的兴趣。课 堂教学中还引入讨论，使同 学们能更好地融入课堂教 学。 讨论和作业能培养同学们的 综合能力：熟练运用所学知 识的能力、收集和提炼信息 的能力、表达能力等。	Problem 1.5,1.6		
	CHAPTER 2 Fluid Flow in Food Processing, Energy and Controls in Food Processes	8		Problems 2.1,2.6,2.9,2.10		
	CHAPTER 3 Heat Transfer in Food Processing, Preservation Processes	10		Problems 3.2,3.3,3.13,3.23,3.26,3.31,3.39,3.45,3.54		
	CHAPTER 4 Refrigeration and Food Freezing	6		Problems 4.1,4.2,4.3,4.6,4.7,4.8		
	CHAPTER 5 Evaporation	6		Problems 5.1,5.2,5.4,5.5,5.7,5.8		
	CHAPTER 6 Psychrometrics and Dehydration	8		Problems 6.1,6.4,6.6,6.7,6.10,6.11,6.14		
	CHAPTER 7 Mass Transfer and Distillation	12		Problems 7.1,7.2,7.3,7.4,7.5,7.6		
	CHAPTER 8 Membrane Separation	6		Problems 8.1,8.2,8.3,8.4,8.5		
	CHAPTER 9 Supplemental Processes	6		Problems 9.1,9.4,9.6,9.7,9.10,9.11,9.14		

<p>*考核方式 (Grading)</p>	<p>最终成绩由平时作业、课堂表现、结业考试成绩组合而成。各部分所占比例如下： 平时作业和上课参与程度：10%。主要考核对知识点的掌握程度、口头及文字表达能力。 作业及报告讨论：20%。主要考核分析解决问题、创造性工作、处理信息、口头及文字表达等方面的能力。 考试：70%。主要考核对食品工程的基本原理和食品工作者的思维方式的掌握程度。 10% attendance, 20% homework and 70% final examination.</p>
<p>*教材或参考资料(Textbooks & Other Materials)</p>	<p>教材： R. Paul Singh; Dennis R. Heldman. Introduction to Food Engineering-Fifth Edition. Academic Press; 2014. 参考书目： 《食品工程原理》(第三版)，李云飞、葛克山主编，中国农业大学出版社，2014年8月。</p>
<p>其它 (More)</p>	
<p>备注 (Notes)</p>	<p>CHAPTER 2 Fluid Flow in Food Processing, Energy and Controls in Food Processes 要求：掌握实际流体与理想流体的区别，掌握流体流动中能量平衡方程的区别并能熟练运用这些方程解决问题，掌握流体参数的测量原理和方法，掌握流体流动阻力计算方法和泵性能的计算方法，了解非牛顿流体种类和简单计算。</p> <p>CHAPTER 3 Heat Transfer in Food Processing, Preservation Processes 要求：掌握导热、对流传热和辐射传热的基本计算和应用，能够在使用条件和范围内选用对流传热系数关联式计算对流传热系数，掌握非稳定传热的一般解决方法和简化计算方法及适用条件，重点掌握稳定传热过程的计算与应用。</p> <p>CHAPTER 4 Refrigeration and Food Freezing 要求：掌握食品工业中的制冷技术原理和食品冷冻冷藏相关知识，可完成食品冷冻冷藏工艺设计和管理工作的，掌握必要的热力学基础知识和制冷热力循环理论，熟悉食品冷冻加工中的各种技术原理和相关计算方法，熟悉食品冷藏链的构成和冷库冷量的计算方法。</p> <p>CHAPTER 5 Evaporation</p>

	<p>要求：了解溶液浓缩的几种基本方法；掌握了解各种蒸发设备的结构、特点及其适用范围；熟悉掌握单效蒸发时溶液沸点升高和温度差损失的概念及计算，能正确进行单效蒸发的物料衡算和热量衡算；了解多效蒸发的操作流程，掌握多效蒸发和单效蒸发的比较、多效蒸发中效数的限制及最佳效数；了解其它提高蒸汽利用经济性程度的措施；掌握这些方法在食品工程上的应用。</p> <p>CHAPTER 6 Psychrometrics and Dehydration</p> <p>要求：掌握湿空气的主要性质，它们的定义和计算公式；掌握湿空气的“h-d”图的应用及由状态点确定空气有关参量的方法；熟练掌握干燥过程的物料衡算和热量衡算；掌握等焓干燥过程干燥器出口空气状态确定方法；正确理解干燥器的热效率和干燥效率。掌握物料平衡水分与自由水分、结合水分与非结合水分的概念；掌握干燥速率的定义及干燥速率曲线；掌握临界水含量的概念；了解影响恒速干燥和降速干燥的因素。掌握恒速和降速段干燥时间的计算方法。</p> <p>CHAPTER 7 Mass Transfer and Distillation</p> <p>要求：了解传质的基本概念、分子扩散和涡流扩散；了解扩散系数的影响因素；掌握分子扩散的基本计算与应用；了解吸收与解吸的基本概念和吸收过程机理；掌握吸收与解吸的一般计算方法；重点掌握等温条件下的低浓度逆流吸收塔的计算与应用；了解精（蒸）馏的基本概念；理解精（蒸）馏原理；了解精馏的装置的基本组成及各部分所起的作用；掌握逐板计算方法及图解法求取理论板数的方法；重点掌握两组分连续精馏塔的计算。</p> <p>CHAPTER Membrane Separation</p> <p>要求：了解膜分离的基本原理、各种膜分离的分离机理和各种分离膜的构造和特性，了解膜分离典型流程，掌握膜分离过程中浓差极化与膜污染的产生原因与消除方法，重点掌握膜分离装置的选用。</p> <p>CHAPTER 9 Supplemental Processes</p> <p>要求：掌握流体绕过颗粒以及颗粒在流体中沉浮的速度和阻力计算方法，能够分析并处理流化加工、气力输送、沉降和过滤中的工程实际问题；掌握评价物料混合度的各种方法，熟悉影响液体搅拌功率的因素，并且能够计算搅拌功率和混合速率等参数，掌握乳化操作原理，了解气液混合方法。</p>
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备注说明：

1. 带*内容为必填项。
2. 课程简介字数为 300-500 字；课程大纲以表述清楚教学安排为宜，字数不限。