1	**Course title**	Principles of Food Engineering
2	**Course number**	0643340
3	**Credit hours (theory, practical)**	2, 1
	Contact hours (theory, practical)	2, 3
4	**Prerequisites/corequisites**	
5	**Program title**	Food Science and Technology
6	**Program code**	042
7	**Awarding institution**	The University of Jordan
8	**School**	Agriculture
9	**Department**	Nutrition and Food Technology
10	**Level of course**	4
11	**Year of study and semester (s)**	Fall/Second semester
12	**Final Qualification**	BSc.
13	**Other department (s) involved in teaching the course**	None
14	**Language of Instruction**	English
15	**Date of production/revision**	9/12/2019

16. Course Coordinator: Prof. Mohammed Ismael Saleh

Office numbers, office hours, phone numbers, and email addresses should be listed.

Office hours					
Day/Time	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**
Day					
Time	**10:00 – 12:00**	**11:00-12:30**	**9:00 – 12:00**	**11:00-12:30**	

17. Other instructors:

Office numbers, office hours, phone numbers, and email addresses should be listed.

Office hours					
Day/Time	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**
Day					
Time	**10:00 – 12:00**	**11:00-12:30**	**9:00 – 12:00**	**11:00-12:30**	

18. Course Description:

Unit operation aspects such as material and energy balances, fluid flow theory, viscosity, heat transfer, evaporation, dehydration, freeze drying, mechanical separation, mixing, size reduction and extraction, cleaning, grading, handling and waste treatment

19. Course aims and outcomes:

A- Aims:
Learn basic principles of food engineering and apply these principles by solving food processing problems using mathematical calculations.

B- Intended Learning Outcomes (ILOs): Upon successful completion of this course students will be able to

A. Knowledge and Understanding: Student is expected to

A1- Understand the concept of basic units, it uses and conversions in food science applications.
A2- Understand the mass and energy balance, drying principles and calculations in relation to food applications.
A3- Understand the concept of heat transfer in food and thermal treatments.
A4- Understand the concept of fluid flow, energy calculations and refrigeration system.

B. Intellectual Analytical and Cognitive Skills: Student is expected to

B1- Develop a detailed application and use basic principles of food engineering and apply these principles by solving food processing problems.

C. Subject- Specific Skills: Students is expected to

C1- Apply, analyze and use mathematical calculations including steam tables, psychrometric chart, drying and heat transfer and fluid flow calculations that is related to food processing problems and able to find solutions
C2- Able to evaluate the needs/requirements for thermal processing, energy calculations and fluid flow for food applications

D. Transferable Key Skills: Students is expected to

D1- Convey basic food engineering information and use in concepts in manufacturing organizations.
D2- Critically review requirements of food applications that can be used in minimize losses and conserve energy.

20. Topic Outline and Schedule:

No. of lecture (s) /Week	Subject	Sources	ILOs
2 lectures/1 LAB (wk 1)	1. Syllabus; Introduction to dimensions, units 2. Mass/force relationships; Symbols and definitions; temperature system conversion. (LAB)	**Toledo Chapter 2, 3 Wilhelm Chapter 1**	**A-1, A-2, B-1**
2 lectures/1 LAB (wk 2)	3. Mass balances; Approach; Wet/dry basis MC, conversion. 4. Mass balance example problems. (LAB)	**Toledo Chapter 3 Wilhelm Chapter 1**	**A-2, B-1**
4 lectures/2 LAB (wk 3-4)	5. Steam tables; explanation and use. 6. Thermodynamic properties; combined mass and energy balances. (LAB) 7. Introduction to psychrometrics. Demonstration of psychrometric chart. (LAB)	**Toledo Chapter 5, 12 Wilhelm Chapter 9**	**A-1, A-2, B1**
2 lectures/1 LAB (wk 5)	8. Combined mass and energy balance example problems. 9. Psychrometric processes; wet bulb	**Wilhelm Chapter 10**	**A-2, B-1**

	temperature definition, heating, cooling, adiabatic saturation. (LAB)		
2 lectures/1 LAB (wk 6)	10. Equilibrium MC; definition and relationships; Water activity. 11. Grain drying calculations using the psychrometric chart. (LAB) 12. Drying; constant rate and falling rate regions, thin layer drying equation.	**Wilhelm Chapter 10**	**C-1, B-1, D-1**
Exam I			
2 lectures/1 LAB (wk 7)	13. Basic overview of heat transfer modes. 14. Concept of resistance for calculating steady state heat flow and temperature distribution in plane walls. 15. Steady state radial heat transfer, example problem. (LAB)	**Toledo Chapter 7 Wilhelm Chapter 5**	**A-1, A-3, B-1**
2 lectures/1 LAB (wk 8)	16. Radiation heat transfer. 17. Transient heat transfer; lumped capacitance. (LAB)	**Toledo Chapter 7 Wilhelm Chapter 5, 6**	**A-3, B-1**
4 lectures/2 LAB (wk 9-10)	18. Thermal properties of foods. 19. Transient heat transfer; graphical solutions. (LAB) 20. Transient heat transfer; comparison of measured and calculated transient geometric center temperatures in an apple. (LAB) 21. Transient heat transfer; superposition principle.	**Toledo Chapter 7 Wilhelm Chapter 6**	**A-3, B-1**
2 lectures/1 LAB (wk 11)	22. Heat exchanger overview and analysis. 23. Thermal sterilization of foods—development of D_T, z and F_o. (LAB) 24. Calculation of F_o values.	**Toledo Chapter 7, 9 Wilhelm Chapter 5, 7**	**A-3, B-1, C-1, C-2, D-1, D-2**
2 lectures/1 LAB (wk 12)	25. Classification of fluids and flows; Reynolds No. 26. Energy components of fluid flow. Mechanical energy balance of fluid flow; Bernoulli's Equation. (LAB)	**Toledo Chapter 6 Wilhelm Chapter 4**	**A-4, C-1, C-2**
2 lectures/1 LAB (wk 13)	27. Explanation of pump and system characteristic curves. Pumping system analysis; energy requirement calculations. 28. Pump sizing example problem. (LAB) 29. Pipe friction.	**Toledo Chapter 6 Wilhelm Chapter 4**	**A-4, C-1, C-2, D-2**
2 lectures/1 LAB (wk 14)	30. Development of viscosity; Newton's viscosity law. 31. Non-Newtonian fluids; accounting for in pumping calculations. Layout of example problem using non-Newtonian fluid. (LAB)	**Toledo Chapter 6 Wilhelm Chapter 8**	**A-4, C-1, C-2**
2 lectures/1 LAB (wk 15)	32. Work the non-Newonian fluid example problem presented in lab. 33. Introduction to vapor compression refrigeration systems. 34. Application of the Mollier diagram to vapor compression systems. (LAB)	**Toledo Chapter 6, 10 Wilhelm Chapter 8**	**A-1, A-4**

2 lectures/1 LAB (wk 16)	35. Refrigeration system calculations using the Mollier diagram. 36. Latent heat of fusion; calculation of cooling loads. 37. Respiration; calculation of cooling loads. (LAB)	**Toledo Chapter 10 Wilhelm Chapter 8**	**A-4, D-1, D-2**

21. Teaching Methods and Assignments:

Class Procedures:

- Homework assignments are due at the beginning of the class period of the day in which they are due.
- Late homework or laboratory assignments will be penalized by deducting 50% of the point value of the assignment per late day.

Laboratories:

Unit exams will normally be given during laboratory times. Additionally, many laboratory sessions will be used to illustrate problem-solving demonstrations. Finally, some laboratory sessions may be used for field trips to local food industry facilities.

22. Evaluation Methods and Course Requirements:

Problem sets will be assigned approximately once per week, graded, returned with marks, and counted toward the final grade tabulation. Exams will be administered after completion of the course technical units; these unit exams will comprise both essay and problem-oriented questions. The final exam is comprehensive.

23. Course Policies:

Students and instructors each have an important role in maintaining a classroom environment optimal for learning, and are expected to treat each other with respect during class, using thoughtful dialogue, and keeping disruptive behaviors to a minimum. Class discussions are interactive and diverse opinions will be shared; please be thoughtful in sharing your perspectives and responses with one another. Other behaviors that can be disruptive are chatting and whispering during class, the use of electronic equipment, preparing to leave before class is over, and consistently arriving late to class. Please keep these disruptions to a minimum. Inappropriate behavior in the classroom may result in a request to leave the class and/or subject to penalty.

24. Required equipment: (Facilities, Tools, Labs, Training….)

Classroom facilities

25. References:

Main Reference/s:

Toledo, R.T. 2007. Fundamentals of Food Process Engineering, 3rd Ed., 233 Spring Street, New York, NY 10013-1522.

Additional reference:

1. Heldman, D.R. and R.W. Hartel. 1997. Principles of Food Processing. Chapman and Hall. 115 Fifth Av., New York, NY 10003-1004.
2. Singh, R.P and Heldman, D.R. 2003. Introduction to Food Engineering. 3rd edition. Academic Press, San Diego California.
3. Wilhelm, L.R., D.A. Suter, and G.H. Brusewitz. 2004. Food & Process Engineering Technology. American Society of Ag. Engineers, 2950 Niles Rd., St. Joseph, MI 47085-9659.

26. Additional information:

Name of Course Coordinator: **Prof. Mohammed Ismael Saleh** Signature: ---------- Date: ---------

Head of curriculum committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature: ----------

Head of curriculum committee/Faculty: ---------- Signature: ----------

Dean: ---------- -Signature: ----------