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**Course Book**

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| **1. Course name** | **Food Plant Engineering** |
| **2. Lecturer in charge** | **Abdulla Fathi Younis & Yazdin Huseein Ali**  |
| **3. Department/ College** | **Food technology- Salahaddin University** |
| **4. Contact** | **e-mail:** **abdfathi2000@gmail.com****Tel: (optional)** |
| **5. Time (in hours) per week**  | **Practice : 2**  |
| **6. Office hours** | **2** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | **I have over six years experience in the food processing** **I have been organized more than four summer courses for introducing students to a practical field in real life by standing cooperation with public and private sectors by visiting factories in Erbil .** |
| **9. Keywords** | **Engineering unit , mass balance, thermodynamic, energy, energy balance, extensive and intensive properties, fluid flow in food processing, continuity equation, Reynolds number, Entrance Region and Fully Developed Flow, Forces Due to Friction, Bernulli equation, Frictional Energy Loss, power of pump.** |
| **10. Course overview:**The stated content of this course 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. 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. |
| **11. Course objective:*** Applications of engineering during the handling, processing, storage, packaging and distribution of food products.
* An introduction to the concepts of process control
* Engineering unit; in solving numerical problems, it is also useful to write the units of each dimensional quantity within the equations. This practice is helpful to avoid mistakes in calculations.
* Material balances; are useful in evaluating individual pieces of equipment, such as a pump or a homogenizer, as well as overall plant operations consisting of several processing units.
* The science of thermodynamics; gives us the foundation to study commonly occurring phenomena during processing of foods.
* Energy, energy balance; energy that is important in the analysis of food engineering problems and discuss each based on the type of a system at hand—closed or open and account for all forms of energy that are important for the given system.
* Fluid flow in food processing; the movement of liquid foods from one location to another becomes an essential operation. We will examine the factors and their role in the design of equipment for transporting different types of liquid foods and ingredients to different locations within a processing plant.
* The principle of conservation of matter is frequently used to solve problems related to fluid flow. To understand this important principle, consider a fluid flowing in a pipeline.
* Describing the flow characteristics of a fluid flowing either in a pipe or on the surfaces of objects of different shapes.
* Force due to friction; the forces that must be overcome in order to pump a liquid through a pipe derive from several sources.
* Force balance on a fluid element flowing in a pipe derivation of Bernoulli equation.
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| **12. Student's obligation**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."As well as being a product in its own right, food in its many forms is now a core raw material in a vast industry that encompasses many forms of processing and preservation techniques. This course will benefit those who wish to gain a better understanding of food engineering" |
| **13. Forms of teaching****USING WITE BORD AND DATA SHOW** |
| **14. Assessment scheme**20 MARK FOR EXSAM +5 MARK STUDENT ACTIVITY AND COUISE TEST REPORT =25 MARK  |
| **15. Student learning outcome:**It will appeal to those involved in new product development, quality control and technical management as well as auditors and production staff. |
| **16. Course Reading List and References‌:**▪ Key references: Singh, R. P. and Heldman, Dennis R., (2009).Introduction to food engineering. 4th ed. Elsevier Inc. USA.▪Useful references: 1- Toledo, R. T. (2007). Fundamentals of Food Process Engineering. 3rd ed. Springer Inc. USA2- Valentas, K. J. ; Rotstein, E. and Singh, R. P. (1997). Handbook of food engineering practice. CRC Press LLC Boca Raton New York USA.3- Berk, Zeki (2009). Food Process Engineering and Technology. 1st ed. Elsevier Inc. USA.4- Fellows, P. (2000). Food Processing Technology principle and practice.2nd ed. CRC Press LLC Boca Raton New York USA.▪Magazines and review (internet): Food engineeringjournals  |
| **17. The Topics:** | **Lecturer's name** |
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| **No.** | **Title of the Subject** |
| **Week 1** | **Introduction to food engineering and engineering units.** |
| **Week 2** | **Material Balance and blending of food ingredients**  |
| **Week 3** | **Material balance problems involved in dilution, concentration and dehydration**  |
| **Week 4-5** | **Thermodynamic, energy, energy balance and solve problems**  |
| **Week 6** | **Power transmission**  |
| **Week 7** | **Exam**  |
| **Week 8** | **Extensive and intensive properties in food processing**  |
| **Week 9-11** | **Fluid flow in food processing, continuity equation and solve problem, Reynolds Number and solve problem, Entrance Region and Fully Developed Flow.** |
| **Week 12-13** | **Forces Due to Friction and Force Balance on a Fluid Element flowing in a Pipe- Derivation of Bernoulli Equation**  |
| **Week 14** | **Energy Equation for Steady Flow of Fluids, Frictional Energy Loss** |
| **Week 15** | **Power Requirements of a Pump** |
| **Week 16** | **Exam**  |

 | ex:( 2 hrs per week ) |
| **18. Practical Topics**  |  |
| Viscosity Pressure Principle Base units Power transmission methods Material balances Energy balances Bernoulli’s equation Power plant Reynolds number**Pumps**  The pump is a mechanism that can transfer and raising the fluid.  **Types of pumps****Centrifugal pump** |  (3 hrs) |
| **19. Examinations:** **Q1:A.** Match the words in list A with appropriates words in list B, by briefly information:  **(15 M)**

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| No. | A | B |
| 1 | Cooling | Steady state |
| 2 | Heat content | Thermodynamic |
| 3 | Created energy | Plane angle |
| 4 | Radian | Luminous intensity |
| 5 | Accumulation | Crystallizer |
| 6 | Candela | Enthalpy |

**B.** Enumerate kind of movement with an example of each of them. **(10 M)****Q2 : (25 M)** An evaporator has a rated evaporation capacity of 500 kg water/h. Calculate the rate of production of juice concentrate containing 45% total solids from raw juice containing 12% solids. **Q3:** properly convert each of below units: **(25 M)**1. 1646 in3 yd3
2. 4.1 \* 10-3 cm2 nm2
3. 5.7 light year mi
4. 0.053 mi m
5. 24 year min

**Q4:** Skim milk at 20°C is being pumped through a 25 mm internal diameter smooth pipe, at a volumetric flow rate of 0.001 m3 s-1. The pipeline is 26 m long and horizontal. Calculate the pressure drop due to friction.Data: For skim milk at 20°C, density (ρ) =1035 kg/m3 , viscosity (μ)= 0.002 Pa.s **(25 M)** |
| **20. Extra notes:**5 MARK STUDENT ACTIVITY LIKE COUISE TEST REPORT. |
| **21. Peer reviewپێداچوونه‌وه‌ی هاوه‌ڵ** This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*ئه‌م کۆرسبووکه‌ ده‌بێت له‌لایه‌ن هاوه‌ڵێکی ئه‌کادیمیه‌وه‌ سه‌یر بکرێت و ناوه‌ڕۆکی بابه‌ته‌کانی کۆرسه‌که‌ په‌سه‌ند بکات و جه‌ند ووشه‌یه‌ک بنووسێت له‌سه‌ر شیاوی ناوه‌ڕۆکی کۆرسه‌که و واژووی له‌سه‌ر بکات.هاوه‌ڵ ئه‌و که‌سه‌یه‌ که‌ زانیاری هه‌بێت له‌سه‌ر کۆرسه‌که‌ و ده‌بیت پله‌ی زانستی له‌ مامۆستا که‌متر نه‌بێت.‌‌  |