UNIVERSITI TEKNOLOGI MARA

FST209: PRINCIPLES OF FOOD ENGINEERING

Course Name (English)	PRINCIPLES OF FOOD ENGINEERING APPROVED
Course Code	FST209
MQF Credit	3
Course Description	This course covers the study of the principle of food engineering. Topics covered include conversion of units, mass balance, energy balance, heat transfer, thermodynamics, use of steam tables, and psychrometric chart, fluid flow, pumps and material of construction in food industry.
Transferable Skills	1) Reflective Learner
Teaching Methodologies	Lectures, Project-based Learning
CLO	CLO1 Describe the principles applied in food engineering CLO2 Determine the solutions to the food engineering related problems CLO3 Explain an overview of pumps used in food industry
Pre-Requisite Courses	No course recommendations

Topics
1. Engineering Dimensions and Units 1.1) 1.1 Conversion of units from British unit to S.I. unit and from S.I. to British unit
2. Mass Balance 2.1) 2.1 Introduction and theory
3. Energy Balance 3.1) 3.1 Introduction and theory 3.2) 3.3) 3.2 Steady Flow Energy Equation
4. Steam Table and Psychrometric chart 4.1) 4.1 Saturated steam, superheated steam, and enthalpy 4.2) 4.3) 4.2 Use of steam table – interpolation, two property rule,saturated steam, superheated steam, wetness fraction 4.4) 4.5) 4.3 Use of Psychrometric chart
5. Thermodynamics 5.1) 5.1 Internal energy, entropy, enthalpy, sensible and latent heats
6. Heat transfer 6.1) 6.1 Nature of heat flow, conduction, convection (natural and forced) and radiation 6.2) 6.3) 6.2 Heat transfer by conduction: Fourier's equation, thermal conductivity, its unit, steady state heat condition 6.4) 6.5) 6.2.1 Heat equation and application 6.6) 6.7) 6.2.2 Heat transfer by conduction through cylinder and composite wall 6.8) 6.9) 6.2.3 Definition and summation of thermal resistance 6.10) 6.11) 6.2.4 Problems on heat transfer by conduction 6.12) 6.13) 6.3 Heat transfer by convection, film heat transfer coefficient and overall heat transfer coefficient 6.14)

6.15) 6.3.1 Heat equation and application
6.16)
6.17) 6.3.1.1 Natural convection equations
6.18)
6.19) 6.3.1.2 Forced convection equations
6.20)
6.21) 6.3.1.3 Problems on heat transfer by convection
6.22)
6.23) 6.3.2 Logarithmic mean for temperature difference for co-current and counter-current flow
6.24)
6.25) 6.3.3 Relationship between overall heat transfer coefficient, film heat transfer coefficient and fouling factor
6.26)
6.27) 6.3.4 Correlation equation for heat transfer by convection: Nusselt's number, Reynolds' number, Prandtl's number, heat transfer in tube, jacketed kettle, coil in vessel
6.28)
6.29) 6.4 Radiation heat-transfer
6.30)
6.31) 6.4.1 Black body radiation
6.32)
6.33) 6.4.2 Emissivity

7. Fluid Mechanics
7.1) 7.1 Definition, fluid static, relationship between pressure and height, absolute pressure and gauge pressure
7.2)
7.3) 7.2 Newton’s Law of Viscosity
7.4)
7.5) 7.3 Relationship between laminar and turbulent flow with Reynold’s number
7.6)
7.7) 7.4 Continuity Equation
7.8)
7.9) 7.5 Bernoulli’s equation: pressure, velocity and elevation heads
7.10)
7.11) 7.6 Friction losses through pipes

8. Pumps
8.1) 8.1 Importance of pumps
8.2)
8.3) 8.2 Types of pumps: Principle and operation for centrifugal pump, piston pump, gear pump diaphragm, mono pump and flow inducer
8.4)
8.5) 8.3 Factors affecting pump selection

9. Construction materials for processing equipment
9.1) 9.1 Choice of materials
9.2)
9.3) 9.2 Properties of stainless steel and its application
9.4)
9.5) 9.3 Properties and uses of other construction materials

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment

Assessment Type	Assessment Description	% of Total Mark	CLO
Group Project	1 Group Assignment, Report in PowerPoint Form, Chapter 8.	20%	CLO3
Quiz	1 Online Quiz (MCQ) Chapter 1 & 2.	10%	CLO1
Test	1 Online Test (MCQ), Chapter 3, 4 & 5.	30%	CLO1

Reading List

Reference Book Resources

- **Zeki Berk 2018, *Food Process Engineering and Technology*, 3rd Ed., Academic Press San Diego [ISBN: 9780128120187]**
- **Albert Ibarz,Gustavo V. Barbosa-Canovas 2014, *Introduction to Food Process Engineering*, 1st Ed., CRC Press [ISBN: 9781439809181]**
- **Igor J. Karassik,Paul Cooper,Joseph P. Messina,Charles C. Heald 2007, *Pump Handbook*, 4th Ed., McGraw-Hill Education New York [ISBN: 0071460446]**
- **Theunis Christoffel Robberts 2013, *Food Plant Engineering Systems, Second Edition*, CRC Press United States [ISBN: 1439848092]**
- **R. Paul Singh,Dennis R. Heldman 2013, *Introduction to Food Engineering*, 5th Ed., Academic Press San Diego [ISBN: 0123985307]**
- **Romeo T. Toledo,Rakesh K. Singh,Fanbin Kong 2019, *Fundamentals of Food Process Engineering*, 4th Ed., Springer Cham, Switzerland [ISBN: 3030079333]**

Article/Paper List: This Course does not have any article/paper resources

Other References: This Course does not have any other resources