Sana'a University
Faculty of Engineering
Department: Basic Engineering Sciences
Title of the Program: B.Sc. Of Architectural Engineering

1-Course Specification of Heating and cooling

I. Course Identification and General Information:						
1	**Course Title:**	Heating and cooling				
2	**Course Code & Number:**	ME259				
3	**Credit hours:**	C.H				TOTAL
		Th.	Seminar	Pr	Tr.	
		2	2	-	-	***3***
4	**Study level/ semester at which this course is offered:**	2^{nd} Level/2^{nd} Semester				
5	**Pre –requisite (if any):**					
6	**Co –requisite (if any):**					
8	**Program (s) in which the course is offered:**	Architectural Engineering				
9	**Language of teaching the course:**	English/Arabic				
10	**Location of teaching the course:**					
11	**Prepared By:**	Dr. Hamoud Al-Nahari				
12	**Date of Approval**					

II. Course Description:

This course will cover General topics in thermodynamics, heat transfer, refrigeration and air conditioning. These topics are: energy analysis and types, first law of thermodynamics, processes of heat transfer: conduction, convection and radiation, types of refrigeration, refrigeration cycle, load calculation, thermal behavior of buildings, HVAC systems/equipment, and design of space air-conditioning and its relationship to architectural design.

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III. Course Intended learning outcomes (CILOs) of the course		Referenced PILOs
a.1	Define the basic principles of energy.	**A3**
a.2	Describe the modes of Heat Transfer.	
a.3	Demonstrate fundamental principles of refrigeration and air conditioning systems.	**A5**
b.1	Design Air Conditioning system using cooling load calculations.	**B3**
b.2	Analyze problems; conclude software solutions associated with air conditioning.	**B5**
c.1	Make calculations of psychometric properties, processes, and heating and cooling load requirements.	**C2**
c.2	locate various important components of air conditioning systems.	
d.1	Cooperate in work successfully as a part of a team through training on simulation software and presentations.	**D1**
d.2	Discuss results and defend his ideas.	**D3**

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
a1. Define the basic principles of energy.	1- Lectures. 2- Tutorials. 3- Interactive class discussion.	1- Written tests and quizzes. 2- Homework and assignments.
a2. Describe the modes of Heat Transfer.		
a3. Demonstrate fundamental principles of refrigeration and air conditioning systems.		

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(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
b1. Design Air Conditioning system using cooling load calculations.	1- Lectures. 2- Tutorials. 3- Interactive class discussion.	1- Written tests and quizzes. 2- Homework and assignments.
b2. Analyze problems; conclude software solutions associated with air conditioning.		

© Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
c1. Make calculations of psychometric properties, processes, and heating and cooling load requirements.	1- Lectures. 2- Tutorials. 3- Simulations using computer software	1- Written tests and quizzes. 2- Homework and assignments.
c2. Locate various important components of air conditioning systems.		

(D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies:		
Course Intended Learning Outcomes	Teaching strategies	Assessment Strategies
d1. Cooperate in work successfully as a part of a team through training on simulation software and presentations.	1. Lectures. 2. Tutorials. 3. Simulations using computer software	1. Written tests and quizzes. 2. Homework and assignments.
d2. Discuss results and defend his ideas.		

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IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Learning Outcomes	Sub Topics List	Number of Weeks	contact hours
1.	Introduction:	a1	Brief history, need of refrigeration and air conditioning, methods of producing cooling, Energy Forms.	1	2
2.	First Law of the Thermodynamics.	a1	Different Applications of First Law, Energy Balance.	1	2
3.	Principles of heat transfer-	a2	Conduction-Convection-Radiation, Conduction through plane wall, Newton's law of cooling;	1	2
4.	Refrigeration Principles and Systems	a1, a2, a3 b1, b2, c1, c2, d1, d2	General introduction, Principles of Refrigeration-Capacity, Coefficient of performance (COP) -Carnot, refrigeration cycle vapor compression systems, Analysis using P-h and T-s diagrams-Standard refrigerants, Study of refrigeration system components-Compressors-Condensers, Expansion devices-evaporators, refrigerant control devices.	2	4
5.	Psychrometry	a1, a2, a3 b1, b2, c1, c2, d1, d2	• Properties of air. • Psychrometric chart. • Psychrometric processes.	1	2
6.	Human comfort	a1, a2, a3 b1, b2,	Selection of inside design conditions, thermal comfort, heat	1	

		c1, c2, d1, d2	balance equation for a human being, factors affecting thermal comfort, effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions		2
7.	Load analysis	a1, a2, a3 b1, b2, c1, c2, d1, d2	Site survey, outdoor and indoor design conditions, classification of loads, effect of building material, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL), heat transmission through sunlit and shaded glass, method of reduction of solar heat gain through glass, calculations of cooling load due to sunlit and shaded roof and walls using tables, ventilation and air infiltration, load due to outside air, heat gain from occupants components.	3	6
8.	Design Aspects of Air-conditioning systems	a1, a2, a3 b1, b2, c1, c2, d1, d2	Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems	4	8
Number of Weeks /and Units Per Semester				**14**	**28**

B: Tutorial Aspects				
Write up tutorial topics				
No.	**Tutorial topics**	**No. of Weeks**	**Contact Hours**	**CILOs**
1.	Energy Forms	1	2	a1, a2, a3 b1, b2, c1, c2, d1, d2
2.	First Law of the Thermodynamics	1	2	a1, a2, a3 b1, b2, c1, c2, d1, d2
3.	Principles of heat transfer	1	2	a1, a2, a3 b1, b2, c1, c2, d1, d2
4.	Refrigeration Principles and Systems	2	4	a1, a2, a3 b1, b2, c1, c2,d1, d2
5.	Psychrometry	1	2	a1, a2, a3 b1, b2, c1, c2, d1, d2
6.	Human comfort	1	2	a1, a2, a3 b1, b2, c1, c2, d1, d2
7.	Load analysis	3	6	a1, a2, a3 b1, b2, c1, c2, d1, d2
8.	Design Aspects of Air-conditioning systems	4	8	a1, a2, a3 b1, b2, c1, c2, d1, d2
Total number of weeks and hours		**14**	**28**	

V. Teaching strategies of the course:

Lectures, Tutorials, Exercises and homework, Interactive class discussion, Simulations using software

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VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Exercises	a1, a2, a3 b1, b2, c1, c2 d1, d2	Weekly	7.5 for all
2	Home works	a1, a2, a3 b1, b2, c1, c2, d1, d2	Weekly	7.5 for all

VII. Schedule of Assessment Tasks for Students During the Semester:

No.	Assessment Method	Week Due	Mark	Proportion of Final Assessment	Aligned Course Learning Outcomes
1	Exercises & Home works	Weekly	7.5	5 %	a1, a2, a3 b1, b2, c1, c2, d1, d2
2	Project (single\group)	13	7.5	5 %	a1, a2, a3 b1, b2, c1, c2, d1, d2
3	Quiz 1	8	7.5	5 %	a1, a2, a3 b1, b2, c1, c2, d1, d2
4	Quiz 2	12	7.5	5 %	a1, a2, a3 b1, b2, c1, c2, d1, d2
5	Mid-term Exam	8	30	20 %	a1, a2, a3 b1, b2, c1, c2, d1, d2
6	Final Exam (theoretical)	16	90	60 %	a1, a2, a3 b1, b2, c1, c2, d1, d2

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VIII. Learning Resources:

- *Written in the following order: (Author - Year of publication – Title – Edition – Place of publication – Publisher).*

1- Required Textbook(s) (maximum two).

1. "Heating, Ventilating and Air Conditioning: Analysis and Design, 6th Edition", Faye C. McQuiston, Jerald D. Parker and Jeffrey D. Spitler, John Wiley & Sons, 2004.
2. Refrigeration and Air Conditioning by W.F. Stocker and J. W. Jones, McGraw-Hill
3. Refrigeration and Air Conditioning by C P Arora, McGraw-Hill

2- Essential References.

1-Refrigeration and Air-conditioning by Ramesh Arora
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- http://www.springer.com/engineering/mechanical+engineering/journal/231
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IX. Course Policies:

1	**Class Attendance:** The students should have more than 75 % of attendance according to rules and regulations of the faculty.
2	**Tardy:** The students should respect the timing of attending the lectures. They should attend within 1 minutes from starting of the lecture.
3	**Exam Attendance/Punctuality:** The student should attend the exam on time. The punctuality should be implemented according to rules and regulations of the faculty for midterm exam and final exam.
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Reviewed By	**Vice Dean for Academic Affairs and Post Graduate Studies Dr. Tarek A. Barakat** **Quality Assurance Unit Dr. Mohammad Algorafi** **Name of Reviewer from the Department Dr. Mohammad Abdulla Algorafi** **Name of Reviewer from the Department: Dr. Riyad Muharram**
	Deputy Rector for Academic Affairs Prof. Dr. Ibrahim AlMutaa **Dr. Ahmed Mujahed** **Dr. Munaser Alsubri**

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Sana'a University
Faculty of Engineering
Department: Basic Engineering Sciences
Title of the Program: B.Sc. Of Architectural Engineering

Template for Course Plan (Syllabus) of Heating and cooling

I. Information about Faculty Member Responsible for the Course:							
Name of Faculty Member	Dr. Hamoud Al-Nahari	**Office Hours**					
Location& Telephone No.		**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	h_nahary@hotmail.com						

II. Course Identification and General Information:						
1-	**Course Title:**	Heating and cooling				
2-	**Course Number & Code:**	ME259				
3-	**Credit hours:**	**C.H**				**Total**
		Th.	**Seminar**	**Pr.**	**F. Tr.**	
		2	2	-	-	***3***
4-	**Study level/year at which this course is offered:**	2nd Level/2nd Semester				
5-	**Pre –requisite (if any):**					
6-	**Co –requisite (if any):**					
7-	**Program (s) in which the course is offered**	Architectural Engineering				
8-	**Language of teaching the course:**	English/Arabic				
9-	**System of Study:**					
10-	**Mode of delivery:**	Dr. Hamoud Al-Nahari				
11-	**Location of teaching the course:**					

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IV. Intended learning outcomes (ILOs) of the course:

- Brief summary of the knowledge or skill the course is intended to develop**:**

a.1	Define the basic principles of energy.
a.2	Describe the principles of Heat Transfer.
a.3	Demonstrate fundamental principles of refrigeration and air conditioning systems.
b.1	Design Air Conditioning system using cooling load calculations.
b.2	Analyze problems; conclude software solutions associated with air conditioning.
c.1	Make calculations of psychometric properties, processes, and heating and cooling l irements.
c.2	locate various important components of air conditioning systems.
d.1	Cooperate in work successfully as a part of a team through training on simulation vare and presentations.
d.2	Discuss results and defend his ideas.

IV. Course Content:

A – Theoretical Aspect:

Order	Units/Topics List	Sub Topics List	Number of Weeks	contact hours
1.	Introduction:	Brief history, need of refrigeration and air conditioning, methods of producing cooling, Energy Forms.	1	2
2.	First Law of the Thermodynamics.	Different Applications of First Law, Energy Balance.	2	2
3.	Principles of heat transfer-	Conduction-Convection-Radiation, Conduction through plane wall, Newton's law of cooling;	3	2
4.	Refrigeration Principles and Systems	General introduction, Principles of Refrigeration-Capacity, Coefficient of performance(COP)-Carnot, refrigeration cycle vapor compression systems, Analysis using P-h and T-s diagrams-Standard refrigerants, Study of refrigeration system components-Compressors-Condensers, Expansion devices-evaporators, refrigerant control devices.	4+5	4
5.	Psychrometry	• Properties of air. • Psychrometric chart. • Psychrometric processes.	6	2
6.	Human comfort	Selection of inside design conditions, thermal comfort, heat balance equation for a human being, factors affecting thermal comfort, effective temperature, comfort chart and factors governing effective temperature, selection of outside design conditions	7	2
7.	Midterm Exam		8	2
8.	Load analysis	Site survey, outdoor and indoor design conditions, classification of loads, effect of	9+10+11	6

		building material, effect of wall construction on cooling load, instantaneous heat gain (IHG) and instantaneous cooling load (ICL), heat transmission through sunlit and shaded glass, method of reduction of solar heat gain through glass, calculations of cooling load due to sunlit and shaded roof and walls using tables, ventilation and air infiltration, load due to outside air, heat gain from occupants components.		
9.	Design Aspects of Air-conditioning systems	Classification, system components, all air; all water; and air-water systems, room air conditioners, packaged air conditioning plant, central air conditioning systems, split air conditioning systems	12+13+14+15	8
10.	Final exam		16	2
Number of Weeks /and Units Per Semester			**16**	**32**

B: Tutorial Aspects

Write up tutorial topics

No.	Tutorial topics	No. of Weeks	Contact Hours
1.	Energy Forms	1	2
2.	First Law of the Thermodynamics	1	2
3.	Principles of heat transfer	1	2
4.	Refrigeration Principles and Systems	2	4
5.	Psychrometry	1	2
6.	Human comfort	1	2
7.	Load analysis	3	6
8.	Design Aspects of Air-conditioning systems	4	8

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Total number of weeks and hours	14	28

V. Teaching strategies of the course:

Lectures, Tutorials, Exercises and homework, Interactive class discussion, Simulations using software

VI. Assignments:

No	Assignments	Aligned CILOs(symbols)	Week Due	Mark
1	Exercises	a1, a2, a3 b1, b2, c1, c2, d1, d2	Weekly	7.5 for all
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VII. Schedule of Assessment Tasks for Students During the Semester:

Assessment	Type of Assessment Tasks	Week Due	Mark	Proportion of Final Assessment
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2	Project (single\group)	13	7.5	5 %
3	Quiz 1	8	7.5	5 %
4	Quiz 2	12	7.5	5 %
5	Mid-term Exam	8	30	20 %
6	Final Exam (theoretical)	16	70	60 %

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