13- Course Specification of Advanced Heat Transfer Course Code (ME523)

• General Information About the Course:

1.	**Course Title:**	Advanced Heat Transfer.				
2.	**Course Code and Number:**	ME523.				
3.	**Credit Hours:**	**Credit Hours**			**Total Credit Hours**	
		Lecture	Practical	Seminar/Tutorial		
		2	--	2	**3**	
4.	**Study Level and Semester:**	1st Level / 1st Semester.				
5.	**Pre-requisites (if any):**	Heat and Mass Transfer (ME353),				
6.	**Co-requisites (if any):**	None.				
7.	**Program (s) in which the course is offered:**	MSc. In Mechanical Engineering Program.				
8.	**Language of teaching the course:**	English Language.				
9.	**Study System:**	Courses & Thesis.				
10.	**Prepared By:**	Dr. Hamoud A. Al-Nahari.				
11.	**Reviewed by:**	Assoc. Prof. Dr. Abdul-Malik E. Momin.				
12.	**Date of Approval:**					

• Course Description:

The course will present detailed discussions and first-principles derivations of pertinent governing equations, analytical and computational problem-solving techniques, and the process of developing rational approximations to solve heat transfer problems. This course will emphasize more on the topics of conduction and radiation as compared to convection. Radiative heat transfer, which is often treated inadequately in typical undergraduate classes, will be specifically highlighted with applications to emerging energy conversion and storage technologies. In this comprehensive heat transfer introduction course, students will be asked to work on a final project using heat transfer analysis and design for a real-life engineering/research problem of their own choices.

Topics to be covered include but not limited to: conservation laws and the energy transport equation, conduction heat transfer – one-dimensional, two-dimensional, steady-state and transient systems, laminar convection, heat-exchanger design, fundamentals of radiative energy transport, radiative exchange between surfaces, radiative heat-transfer in absorbing-emitting-scattering media, introduction to Monte Carlo techniques, heat- and mass-transfer analogies, and advanced multimode heat-transfer problems.

• Course Intended Learning Outcomes (CILOs):

Upon successful completion of **Advanced Heat Transfer Course**, the graduates will be able to:

a1.	Explain the general heat conduction equation, fins heat transfer, solution of two-dimensional steady state equation.
a2.	Describe the solution of transient heat conduction equation and convection heat transfer.
a3.	Explain radiation properties and apply radiation networks to calculate radiation exchange between surfaces, and gas radiation.

b1.	Analyze the energy transport equations.
b2.	Explore different tools to solve the complex heat transfer problems.
b3.	Create multimode and realistic heat transfer problems.
c1.	Employ modern appropriate software packages to solve complex heat transfer problems.
c2.	Implement research to solve heat transfer problems within the constraints.
d1	Review IT capabilities and other resources to develop scientific research in heat transfer.
d2.	Examine effectively in both orally and writing forms for different audiences.
d3.	Assess lifelong learning of the developments in the field of advanced heat transfer.
d4.	Cooperate effectively in team work to reach to a professional context.

• Alignment of Course Intended Learning Outcomes (CILOs) to Program Intended Learning Outcomes (PILOs)

CILOs		PILOs
• **Knowledge and Understanding:** Upon successful completion of **Advanced Solid Mechanics and Engineering Materials Course**, the graduates will be able to:		• **Knowledge and Understanding:** Upon successful completion of the **MSc. In Mechanical Engineering Program**, the graduates will be able to:
a1.	Explain the general heat conduction equation, fins heat transfer, solution of two-dimensional steady state equation.	**A1.** Acquire advanced concepts and knowledge of mathematics, scientific, mechanical engineering and associated technologies as well as across the boundaries of interdisciplinary disciplines.
a2.	Describe the solution of transient heat conduction equation and convection heat transfer.	**A2.** Identify and critically evaluate contemporary engineering technologies, current developments and emerging trends within the mechanical engineering contexts.
a3.	Explain radiation properties and apply radiation networks to calculate radiation exchange between surfaces, and gas radiation.	**A3.** Provide a holistic description of principles, concepts, approaches, techniques and analysis tools to design and development of existing and novel mechanical systems, while taking a sustainable and environmentally-friendly approach.
• **Cognitive/ Intellectual Skills:** Upon successful completion of the **Advanced Solid Mechanics and Engineering Materials Course,** the graduates will be able to:		• **Cognitive/ Intellectual Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:
b1.	Analyze the energy transport equations.	**B1.** Identify and apply specialized knowledge and skills to solve problems that are critical to future growth of industry and business.
b2.	Explore different tools to solve the complex heat transfer problems.	**B2.** Creatively thinking and apply analysis tools to formulate and solve complex engineering problems in the mechanical engineering context using modern techniques and tools.
b3.	Create multimode and realistic heat transfer	**B3.** Design and optimize mechanical

	problems.	components, systems and process to meet desired needs within realistic constraints.
• **Professional and Practical Skills:** Upon successful completion of the **Advanced Solid Mechanics and Engineering Materials Course,** the graduates will be able to:		• **Professional and Practical Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:
c1.	Employ modern appropriate software packages to solve complex heat transfer problems.	**C1.** Use modern manufacturing processes and materials, experimental tests, appropriate software packages and other modern tools for the design analysis and manufacture of mechanical components and systems.
c2.	Implement research to solve heat transfer problems within the constraints.	**C2.** Conduct research and studies to solve mechanical engineering problems professionally, ethically and responsibly within realistic constraints.
• **Transferable Skills:** Upon successful completion of the **Advanced Solid Mechanics and Engineering Materials Course,** the graduates will be able to:		• **Transferable Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:
d1	Review IT capabilities and other resources to develop scientific research in heat transfer.	**D1.** Adopt effectively IT capabilities and other different resources of information to develop scientific research in mechanical engineering fields.
d2.	Examine effectively in both orally and writing forms for different audiences.	**D2.** Communicate, present, challenge and defend research ideas, results and conclusions in both orally and writing forms to different audiences in contexts.
d3.	Assess lifelong learning of the developments in the field of advanced heat transfer.	**D3.** Identify a need for the latest relevant knowledge and technologies and undertake life-long learning.
d4.	Cooperate effectively in team work to reach to a professional context.	**D4.** Collaborate effectively within multidisciplinary teams and lead them in different professional contexts

• Alignment of CILOs to Teaching and Assessment Strategies

• Alignment of Knowledge and Understanding CILOs:

Knowledge and Understanding CILOs		Teaching Strategies	Assessment Strategies
a1.	Explain the general heat conduction equation, fins heat transfer, solution of two-dimensional steady state equation.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments.
a2.	Describe the solution of transient heat conduction equation and convection heat	▪ Lectures, ▪ Self-Learning	▪ Oral & Writing Exams ▪ Individual Projects and

	transfer.	Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	Studies Reports, ▪ Assignments.
a3.	Explain radiation properties and apply radiation networks to calculate radiation exchange between surfaces, and gas radiation.	▪ Lectures, ▪ Self-Learning Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments.

- **Alignment of Intellectual Skills CILOs:**

Intellectual Skills CILOs		Teaching Strategies	Assessment Strategies
b1.	Analyze the energy transport equations.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments.
b2.	Explore different tools to solve the complex heat transfer problems.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments.
b3.	Create multimode and realistic heat transfer problems.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments.

- **Alignment of Professional and Practical Skills CILOs:**

Professional and Practical Skills CILOs		Teaching Strategies	Assessment Strategies
c1.	Employ modern appropriate software	▪ Lectures, ▪ Self-Learning	▪ Oral & Writing Exams

	packages to solve complex heat transfer problems.	▪ Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Individual Projects and Studies Reports, ▪ Assignments.
c2.	Implement research to solve heat transfer problems within the constraints.	▪ Lectures, ▪ Self-Learning ▪ Problems/Studies, ▪ Case Study, ▪ Individual/Group Projects and Studies, ▪ Active Learning, ▪ Computer Hands-on Sessions.	▪ Oral & Writing Exams ▪ Individual Projects and Studies Reports, ▪ Assignments.

- **Alignment of Transferable (General) Skills CILOs:**

Transferable (General) Skills CILOs		Teaching Strategies	Assessment Strategies
d1.	Review IT capabilities and other resources to develop scientific research in heat transfer.	▪ Independent Study, ▪ Individual/Group Projects and Studies, ▪ Presentation,	▪ Presentation, ▪ Written Report.
d2.	Examine effectively in both orally and writing forms for different audiences.	▪ Independent Study, ▪ Individual/Group Projects and Studies,	▪ Presentation, ▪ Written Report.
d3.	Assess lifelong learning of the developments in the field of advanced heat transfer.	▪ Independent Study, ▪ Individual/Group Projects and Studies,	▪ Presentation, ▪ Written Report.
d4.	Cooperate effectively in team work to reach to a professional context.	▪ Independent Study, ▪ Individual/Group Projects and Studies,	▪ Presentation, ▪ Written Report.

• Course Content

• Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours	Course ILOs
26.	**Introduction**	- Conservation equations; - General heat conduction equation, - Dimensionless numbers, - 1-D steady-state equation.	1	2	a1
27.	**1-D conduction**	- 1-D steady-state heat conduction, - 1-D fins 2-D conduction, - Separation variables method.	1	2	a1

28.	**2-D conduction**	- Separation of variables, - Unsteady/transient conduction equation, - Analytical solution techniques, - Laplace transform solutions for lumped capacitance problems.	1	2	a1, a2, b1, b2
29.	**Transient conduction:**	Numerical and computational techniques (finite difference, finite volume) to solve conduction problems.	1	2	a1, a2, b1, b2, b3, c1, c2, d1, d3
30.	**Convection**	- Convection introduction, - Conservation equations derivation, - laminar boundary layer equations.	1	2	a1, a2, b1, b2, b3, c1, c2, d1, d3
31.	**External convective flow**	- Integral solutions, - Internal convective flows and correlations.	1	2	a1, a2, b1, b2, b3, c1, c2, d1, d3
32.	**Heat exchangers**	- Introduction, LMTD and e-NTU methods for heat exchanger design.	1	2	a1, a2, b1, b2, b3, c1, c2, d1, d3
33.	**Midterm Exam**	All previous topics	1	2	a1, a2, a3, b1, b2, b3, c1, c2
34.	**Radiation fundamentals**	- Surface optical properties, - View factors, - Radiative exchange between surfaces.	1	2	a1, a2, a3, b1, b2, b3, c1, c2, d1, d3
35.	**Gray-diffuse surface**	- Gray-diffuse surface radiation; - Semi-gray surfaces	1	2	a1, a2, a3, b1, b2, b3, c1, c2, d1, d3

		- Method of radiosity; - Monte Carlo method (Part I) for surface radiation exchange.			
36.	**Radiative Transport Equation (RTE)**	RTE approximations in participating media and solution techniques	1	2	a1, a2, a3, b1, b2, b3, c1, c2, d1, d3
37.	**Radiative Transport Equation (RTE)**	Monte Carlo method (Part II) for solving the RTE in participating media	1	2	a1, a2, a3, b1, b2, b3, c1, c2, d1, d3
38.	**Review and special topics discussion**	Review and special topics discussion	1	2	a1, a2, a3, b1, b2, b3, c1, c2, d1, d3
39.	**Final projects**	Follow up on final projects	1	2	a1, a2, b1, b2, b3, c1, c2, d1, d2, d3, d4
40.	**Final projects**	Presentation of final projects	1	2	a1, a2, b1, b2, b3, c1, c2, d1, d2, d3, d4
41.	**Final Theoretical Exam**	All previous topics	1	3	a1, a2, a3, b1, b2, b3, c1, c2
Number of Weeks /and Contact Hours Per Semester			**16**	**33**	

- **Practical Aspect**

Order	Practical / Tutorials topics	Number of Weeks	Contact Hours	Course ILOs
1	▪ None			
Number of Weeks /and Contact Hours Per Semester				

- **Tutorial Aspect:**

No.	Tutorial	Number of Weeks	Contact Hours	Learning Outcomes (CILOs)
1	• **All the above chapters.**	Weekly	28	
Number of Weeks /and Units Per Semester				

• Teaching Strategies:

- Lectures,
- Self-Learning Problems/Studies,
- Case Study,
- Individual Projects and Studies,
- Active Learning,
- Computer Hands-on Sessions.
- Independent Study, and
- Presentation.

• Assessment Methods of the Course:

- Oral & Written Exams,
- Individual/Group Projects and Studies Reports,
- Presentation,
- Assignments.

• Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due	CILOs (symbols)
1	Homework and Assignments.	Individual	10	3^{rd} , 6^{th} , 9^{th} , 12^{th}	a1, a2, a3, b1, b2, b3, c1, c2, d1, d2, d3, d4
2	Mini/Major Project	Group	10	7^{th} , 10^{th}	a1, a2, a3, b1, b2, b3, c1, c2, d1, d2, d3, d4
3	Mini/Major Project	Group	10	13^{th}	a1, a2, a3, b1, b2, b3, c1, c2, d1, d2, d3, d4
	Total Score		**30**	==	===

• Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment	CILOs
1	**Tasks and Assignments**	3^{rd} , 6^{th} , 9^{th} , 12^{th}	**30**	**20%**	a1, a2, a3, b1, b2, b3, c1, c2, d1, d2, d3, d4

2	**Quizzes**	**3rd , 8th , 13th**	**10**	**6.7%**	a1, a2, a3, b1, b2, b3, c1, c2
3	**Midterm Exam (Theoretical)**	**8th**	**30**	**20%**	a1, a2, a3, b1, b2, b3, c1, c2
4	**Final Exam (Theoretical)**	**16th**	**80**	**53.3%**	a1, a2, a3, b1, b2, b3, c1, c2
Total			**150**	**100%**	**===**

• Learning Resources :

1- Required Textbook(s) :

1. Greg F. Naterer, 2022, **Advanced Heat Transfer**, 3rd ed, CRC Press.
2. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt , 2018, **Fundamentals of Heat and Mass Transfer**, 8th Edition, Wiley.

2- Essential References:

1. Holman, J.P., Heat Transfer, 10th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
2. Lienhard IV and Lienhard V, A Heat Transfer Textbook (2012).
3. Nellis and Klein, Heat Transfer (2009).
4. Arpaci, V.S., *Conduction Heat Transfer*, Addison-Wesley (1966).
5. Ozisik, M.N., *Heat Conduction*, John Wiley (1984).
6. Carslaw, H.S. and J.C. Jaeger, *Conduction of Heat in Solids*, Oxford University Press (1959).
7. Kays, W.M. and M.E. Crawford, *Convective Heat and Mass Transfer*, McGraw-Hill (1993).
8. Bejan, A., *Convection Heat Transfer*, John Wiley (1984).
9. Modest, M. F., *Radiative Heat Transfer*, Mc-Graw Hill (1993).
10. Siegel, R. and J.R. Howell, *Thermal Radiation Heat Transfer*, Hemisphere (1992).
11. Bohren, C.F, and Hufman, D.R., 1984, *Absorption and Scattering of Light by Small Particles*, John Wiley & Sons.

3- Electronic Materials and Web Sites etc.

1. https://opencourses.emu.edu.tr/course/view.php?id=23
2. https://edu.epfl.ch/coursebook/en/advanced-heat-transfer-ME-465
3. https://umich.instructure.com/courses/279823
4. http://web.mit.edu/lienhard/www/ahtt.html
5. http://www.sciencedirect.com/science/book/9780123869449

• **الضوابط والسياسات المتبعة في المقرر Course Policies**	
بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:	
1	**سياسة حضور الفعاليات التعليمية Class Attendance:** **- يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك.** **- يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.**
2	**الحضور المتأخر Tardy:** **- يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.**
3	**ضوابط الامتحان Exam Attendance/Punctuality:** **- لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان** **- إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.**
4	**التعيينات والمشاريع Assignments & Projects:** **- يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها.** **- إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.**
5	**الغش Cheating:** **- في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب.** **- في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.**
6	**الانتحال Plagiarism:** **– في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك**
7	**سياسات أخرى Other policies:** **- أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ**

Academic Year: ……....

Course Plan (Syllabus) Advanced Heat Transfer

Course Code (ME523)

• Information about Faculty Member Responsible for the Course:

Name	**Dr. Hamoud A. Al-Nahari**	**Office Hours**					
Location &Telephone No.	772223240	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	H_nahary@hotmail.com						

• General information about the course:

	Course Title	Advanced Heat Transfer.			
2.	**Course Code and Number**	ME523.			
3.	**Credit Hours**	**Credit Hours**			**Total Credit Hours**
		Lecture	**Practical**	**Seminar/Tutorial**	
		2	--	2	**3**
4.	**Study Level and Semester**	1st Level / 1st Semester.			
5.	**Pre-requisites**	Heat and Mass Transfer (ME353).			
6.	**Co –requisite**	None.			
7.	**Program (s) in which the course is offered**	MSc. In Mechanical Engineering Program.			
8.	**Language of teaching the course**	English Language.			
9.	**Location of teaching the course**	Faculty Buildings.			

• Course Description:

The course will present detailed discussions and first-principles derivations of pertinent governing equations, analytical and computational problem-solving techniques, and the process of developing rational approximations to solve heat transfer problems. This course will emphasize more on the topics of conduction and radiation as compared to convection. Radiative heat transfer, which is often treated inadequately in typical undergraduate classes, will be specifically highlighted with applications to emerging energy conversion and storage technologies. In this comprehensive heat transfer introduction course, students will be asked to work on a final project using heat transfer analysis and design for a real-life engineering/research problem of their own choices.

Topics to be covered *include but not limited* to: conservation laws and the energy transport equation; conduction heat transfer – one-dimensional, two-dimensional, steady-state and transient systems; laminar convection; heat-exchanger design; fundamentals of radiative energy transport, radiative exchange between surfaces, radiative heat-transfer in absorbing-emitting-scattering media; introduction to Monte Carlo techniques; heat- and mass-transfer analogies; and advanced multimode heat-transfer problems.

• Course Intended Learning Outcomes (CILOs):

Upon successful completion of **Advanced Heat Transfer Course**, the graduates will be able to:

a1.	Explain the general heat conduction equation, fins heat transfer, solution of two-dimensional steady state equation.
a2.	Describe the solution of transient heat conduction equation and convection heat transfer.
a3.	Explain radiation properties and apply radiation networks to calculate radiation exchange between surfaces, and gas radiation.
b1.	Analyze the energy transport equations.
b2.	Explore different tools to solve the complex heat transfer problems.
b3.	Create multimode and realistic heat transfer problems.
c1.	Employ modern appropriate software packages to solve complex heat transfer problems.
c2.	Implement research to solve heat transfer problems within the constraints.
d1	Review IT capabilities and other resources to develop scientific research in heat transfer.
d2.	Examine effectively in both orally and writing forms for different audiences.
d3.	Assess lifelong learning of the developments in the field of advanced heat transfer.
d4.	Cooperate effectively in team work to reach to a professional context.

- **Course Content**
  - **Theoretical Aspect**

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours
1	**Introduction**	- Conservation equations; - General heat conduction equation, - Dimensionless numbers, - 1-D steady-state equation.	1	2
2	**1-D conduction**	- 1-D steady-state heat conduction, - 1-D fins 2-D conduction, Separation variables method.	1	2
3	**2-D conduction**	- Separation of variables, - Unsteady/transient conduction equation, - Analytical solution techniques, - Laplace transform solutions for lumped capacitance problems.	1	2
4	**Transient conduction:**	Numerical and computational techniques (finite difference, finite volume) to solve conduction problems.	1	2
5	**Convection**	- Convection introduction, - Conservation equations derivation, - laminar boundary layer equations.	1	2
6	**External convective flow**	- Integral solutions, - Internal convective flows and correlations.	1	2
7	**Heat exchangers**	- Introduction, LMTD and e-NTU methods for heat exchanger design.	1	2

8	**Midterm Exam**	All previous topics	1	2
9	**Radiation fundamentals**	- Surface optical properties, - View Factors, - Radiative exchange between surfaces.	1	2
10	**Gray-diffuse surface**	- Gray-diffuse surface radiation; - Semi-gray surfaces - Method of radiosity; Monte Carlo method (Part I) for surface radiation exchange.	1	2
11	**Radiative Transport Equation (RTE)**	RTE approximations in participating media and solution techniques	1	2
12	**Radiative Transport Equation (RTE)**	Monte Carlo method (Part II) for solving the RTE in participating media	1	2
13	**Review and special topics discussion**	Review and special topics discussion	1	2
14	**Final projects**	Follow up on final projects	1	2
15	**Final projects**	Presentation of final projects	1	2
16	**Final Theoretical Exam**	All previous topics	1	3
Number of Weeks /and Contact Hours Per Semester			**16**	**33**

- **Practical Aspect**

Order	Practical / Tutorials topics	Number of Weeks	Contact Hours	Course ILOs
1	▪ None			
Number of Weeks /and Contact Hours Per Semester				

• Training/ Tutorials/ Exercises Aspects:

Order	Tutorials/ Exercises	Week Due	Contact Hours
1	▪ **All the above chapters.**	Weekly	28
Number of Weeks /and Contact Hours Per Semester			

• Teaching Strategies:

- Lectures,
- Self-Learning Problems/Studies,
- Case Study,
- Individual Projects and Studies,
- Active Learning,
- Computer Hands-on Sessions.
- Independent Study, and
- Presentation.

• Assessment Methods of the Course:

- Oral & Written Exams
- Individual/Group Projects and Studies Reports,
- Presentation,
- Assignments.

• Tasks and Assignments:

No	Assignments	Individual /Groups	Mark	Week Due
1	Homework and Assignments.	Individual	10	3^{rd} , 6^{th} , 9^{th} , 12^{th}
2	Mini/Major Project	Group	10	7^{th} , 10^{th}
3	Mini/Major Project	Group	10	13^{th}
	Total Score		**30**	

• Learning Assessment:

No	Assessment Method	Week Due	Mark	Proportion of Final Assessment %
1	Tasks and Assignments	3^{rd} , 6^{th} , 9^{th} , 12^{th}	30	20%
2	Quizzes	3^{rd} , 8^{th} , 13^{th}	10	6.7%
3	Midterm Exam (Theoretical)	8^{th}	30	20%
4	Final Exam (Theoretical)	16^{th}	80	53.3%
	Total		**150**	**100%**

• Learning Resources :

1. Required Textbook(s) :

1. Greg F. Naterer, 2022, **Advanced Heat Transfer**, 3rd ed, CRC Press.
2. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt , 2018, **Fundamentals of Heat and Mass Transfer**, 8th Edition, Wiley.

2. Essential References:

1. Holman, J.P., Heat Transfer, 10th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.
2. Lienhard IV and Lienhard V, *A Heat Transfer Textbook (2012)*.
3. Nellis and Klein, Heat Transfer (2009).
4. Arpaci, V.S., *Conduction Heat Transfer*, Addison-Wesley (1966).
5. Ozisik, M.N., *Heat Conduction*, John Wiley (1984).
6. Carslaw, H.S. and J.C. Jaeger, *Conduction of Heat in Solids*, Oxford University Press (1959).
7. Kays, W.M. and M.E. Crawford, *Convective Heat and Mass Transfer*, McGraw-Hill (1993).
8. Bejan, A., *Convection Heat Transfer*, John Wiley (1984).
9. Modest, M. F., *Radiative Heat Transfer*, Mc-Graw Hill (1993).
10. Siegel, R. and J.R. Howell, *Thermal Radiation Heat Transfer*, Hemisphere (1992).
11. Bohren, C.F, and Hufman, D.R., 1984, *Absorption and Scattering of Light by Small Particles*, John Wiley & Sons.

3.Electronic Materials and Web Sites *etc.*

1. https://opencourses.emu.edu.tr/course/view.php?id=23
2. https://edu.epfl.ch/coursebook/en/advanced-heat-transfer-ME-465
3. https://umich.instructure.com/courses/279823
4. http://web.mit.edu/lienhard/www/ahtt.html
5. http://www.sciencedirect.com/science/book/9780123869449

• **الضوابط والسياسات المتبعة في المقرر Course Policies**	
بعد الرجوع للوائح الجامعة يتم كتابة السياسة العامة للمقرر فيما يتعلق بالآتي:	
1	**سياسة حضور الفعاليات التعليمية Class Attendance:** **- يلتزم الطالب بحضور 75% من المحاضرات ويحرم في حال عدم الوفاء بذلك.** **- يقدم أستاذ المقرر تقريرا بحضور وغياب الطلاب للقسم ويحرم الطالب من دخول الامتحان في حال تجاوز الغياب 25% ويتم اقرار الحرمان من مجلس القسم.**
2	**الحضور المتأخر Tardy:** **- يسمح للطالب حضور المحاضرة إذا تأخر لمدة ربع ساعة لثلاث مرات في الفصل الدراسي، وإذا تأخر زيادة عن ثلاث مرات يحذر شفويا من أستاذ المقرر، وعند عدم الالتزام يمنع من دخول المحاضرة.**
3	**ضوابط الامتحان Exam Attendance/Punctuality:** **- لا يسمح للطالب دخول الامتحان النهائي إذا تأخر مقدار (20) دقيقة من بدء الامتحان** **- إذا تغيب الطالب عن الامتحان النهائي تطبق اللوائح الخاصة بنظام الامتحان في الكلية.**
4	**التعيينات والمشاريع Assignments & Projects:** **- يحدد أستاذ المقرر نوع التعيينات في بداية الفصل ويحدد مواعيد تسليمها وضوابط تنفيذ التكليفات وتسليمها.** **- إذا تأخر الطالب في تسليم التكليفات عن الموعد المحدد يحرم من درجة التكليف الذي تأخر في تسليمه.**
5	**الغش Cheating:** **- في حال ثبوت قيام الطالب بالغش في الامتحان النصفي أو النهائي تطبق عليه لائحة شؤون الطلاب.** **- في حال ثبوت قيام الطالب بالغش او النقل في التكليفات والمشاريع يحرم من الدرجة المخصصة للتكليف.**
6	**الانتحال Plagiarism:** **– في حالة وجود شخص ينتحل شخصية طالب لأداء الامتحان نيابة عنه تطبق اللائحة الخاصة بذلك**
7	**سياسات أخرى Other policies:** **- أي سياسات أخرى مثل استخدام الموبايل أو مواعيد تسليم التكليفات ..... الخ**