3.	Credit Hours:	Contact Hours			Total (Credit Hours)
		Lecture	Practical	Seminar/Tutorial	
		2	-	2	3
4.	Study Level and Semester:	First Semester.			
5.	Pre-requisites (if any):	Heat and Mass Transfer and Renewable Energy Systems.			
6.	Co-requisites (if any):	-			
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:	Assoc. Prof. Dr. Abdul-Malik E. Momin.			
11.	Reviewed by:	Dr. ……			
12.	Date of Approval:				

• Course Description:

This course will provide students with concrete knowledge about energy conversion technologies' functioning and efficiency. After completion of the course, the students will have knowledge to perform simple calculations of power cycles and different systems. This course covers fundamentals of thermodynamics, and transport processes as applied to energy systems. The course will also incorporate fundamentals, process and system's analysis tools in the broad energy area, intended to educate future leaders in the field of energy technology.
The course also covers energy conversion, utilization and storage by introducing the common concepts and tools used in this field within a generic framework that allows students to analyze several alternative systems and determine according to fundamental principles which approach is compatible with the intended performance.

• Course Intended Learning Outcomes (CILOs):

Upon successful completion of Advanced Energy Conversion **Course**, the graduates will be able to:

a1- Identify the basic knowledge of engineering sciences subjects**.**
a2 - Describe the different trends and developments within the mechanical engineering contexts.
a3- Characterize concepts and techniques to design mechanical systems with sustainable and environmentally friendly approach.
b1 - Explore knowledge and skills to solve critical problems.
b2- Analyze different tools to solve complex engineering problems.
b3- Formulate mechanical components to meet the actual needs.
b4- Examine risks of the professional practice.
c1- Choose different manufacturing processes for the actual design of the mechanical components.
c2- Implement research to solve mechanical engineering problems within the constraints.
c3 - Perform different understanding to reach to modern operations and business management.
d1- Evaluate IT capabilities and other resources to develop a scientific research**.**
d2- Justify in both orally and writing forms for different audiences.
d3- Assess latest knowledge for life-long learning.

d4-	Cooperate effectively in teams 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 the Advance Energy Conversion **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.	Identify the basic knowledge of engineering sciences subjects.	**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 different trends and developments within the mechanical engineering contexts.	**A2.**	Identify and critically evaluate contemporary engineering technologies, current developments and emerging trends within the mechanical engineering contexts.
a3.	Characterize concepts and techniques to design mechanical systems with sustainable and environmentally friendly approach.	**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 Advance Energy Conversion **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.	Explore knowledge and skills to solve critical problems.	**B1.**	Identify and apply specialized knowledge and skills to solve problems that are critical to future growth of industry and business.
b2.	Analyze different tools to solve complex engineering 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.	Formulate mechanical components to meet the actual needs.	**B3.**	Design and optimize mechanical components, systems and process to meet desired needs within realistic constraints.
b4.	Examine risks of the professional practice.	**B4.**	Analyze and assess risks of the

			professional practice in the mechanical engineering contexts.
• **Professional and Practical Skills:** Upon successful completion of the Advance Energy Conversion **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.	Choose different manufacturing processes for the actual design of the mechanical components.	**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 mechanical engineering problems within the constraints.	**C2.**	Conduct research and studies to solve mechanical engineering problems professionally, ethically and responsibly within realistic constraints.
c3.	Perform different understanding to reach to modern operations and business management.	**C3.**	Demonstrate an in-depth understanding of the mechanical engineering business environment, including environmental aspects, and apply quality issues, modern operations and business management techniques and good practices in a range of contexts.
• **Transferable Skills:** Upon successful completion of the Advance Energy Conversion **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.	Evaluate IT capabilities and other resources to develop a scientific research.	**D1.**	Adopt effectively IT capabilities and other different resources of information to develop a scientific research in mechanical engineering fields.
d2.	Justify 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 latest knowledge for life-long learning.	**D3.**	Identify a need for the latest relevant knowledge and technologies and undertake life-long learning.
d4.	Cooperate effectively in teams to reach to a professional contexts.	**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.	Identify the basic knowledge of	▪ Lectures,	▪ Oral & Written Exams.

	engineering sciences subjects.	▪ Seminars, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Group/Individual Projects and Studies, ▪ Field Work ▪ Active learning, ▪ Computer hands-on sessions.	▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments
a2.	Describe the different trends and developments within the mechanical engineering contexts.	▪ Lectures, ▪ Seminars, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Group/Individual Projects and Studies, ▪ Field Work ▪ Active learning, ▪ Computer hands-on sessions.	▪ Oral & Written Exams ▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments.
a3.	Characterize concepts and techniques to design mechanical systems with sustainable and environmentally friendly approach.	▪ Lectures, ▪ Seminars, ▪ Self-Learning Problems/Studies, ▪ Case study, ▪ Group/Individual Projects and Studies, ▪ Field Work ▪ Active learning, ▪ Computer hands-on sessions.	▪ Oral & Written Exams. ▪ Reports, ▪ Survey, ▪ Written Exam, ▪ Assignments.

- **Alignment of Intellectual Skills CILOs:**

Intellectual Skills CILOs		Teaching Strategies	Assessment Strategies
b1.	Explore knowledge and skills to solve critical problems.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	▪ Oral & Written Exams, ▪ Reports, ▪ Report, ▪ Survey, ▪ Written Exam, ▪ Assignments.
b2.	Analyze different tools to solve complex engineering problems.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises,	▪ Oral & Written Exams, ▪ Reports, ▪ Report, ▪ Survey,

		▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	▪ Written Exam, ▪ Assignments.
b3.	Formulate mechanical components to meet the actual needs.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	▪ Oral & Written Exams, ▪ Reports, ▪ Report, ▪ Survey, ▪ Written Exam, ▪ Assignments.
b4.	Examine risks of the professional practice.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	▪ Oral & Written Exams, ▪ Reports, ▪ Report, ▪ Survey, ▪ Written Exam, ▪ Assignments.

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

Professional and Practical Skills CILOs		Teaching Strategies	Assessment Strategies
c1.	Choose different manufacturing processes for the actual design of the mechanical components.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	▪ Seminar Report, ▪ Written Research Proposal, ▪ Thesis and Publication.
c2.	Implement research to solve mechanical engineering problems within the constraints.	▪ Lectures, ▪ Project Supervision, ▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	▪ Seminar Report, ▪ Written Research Proposal, ▪ Thesis and Publication.
c3.	Perform different understanding to reach to modern operations and	▪ Lectures, ▪ Project Supervision,	▪ Seminar Report, ▪ Written Research

	business management.	▪ Self-Learning, ▪ Case Study, ▪ Simulation Exercises, ▪ Independent Study, ▪ Analysis and Problem Solving, ▪ Brainstorming, ▪ Presentations.	Proposal, ▪ Thesis and Publication.

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

Transferable (General) Skills CILOs		Teaching Strategies	Assessment Strategies
d1.	Evaluate IT capabilities and other resources to develop a scientific research.	▪ Dissertation Defenses and Presentation, ▪ Independent Study, ▪ Presentation, ▪ Brainstorming, ▪ Presenting Researches, ▪ Publish Research Papers.	▪ Written Research Proposal, Thesis and Publication, ▪ Written Exam, ▪ Assignments, ▪ Field Work, ▪ Survey, ▪ Presentation, ▪ Written Report.
d2.	Justify in both orally and writing forms for different audiences.	▪ Dissertation Defenses and Presentation, ▪ Independent Study, ▪ Presentation, ▪ Brainstorming, ▪ Presenting Researches, ▪ Publish Research Papers.	▪ Written Research Proposal, Thesis and Publication, ▪ Written Exam, ▪ Assignments, ▪ Field Work, ▪ Survey, ▪ Presentation, ▪ Written Report.
d3.	Assess latest knowledge for life-long learning.	▪ Dissertation Defenses and Presentation, ▪ Independent Study, ▪ Presentation, ▪ Brainstorming, ▪ Presenting Researches, ▪ Publish Research Papers.	▪ Written Research Proposal, Thesis and Publication, ▪ Written Exam, ▪ Assignments, ▪ Field Work, ▪ Survey, ▪ Presentation, ▪ Written Report.
d4.	Cooperate effectively in teams to reach to a professional contexts.	▪ Dissertation Defenses and Presentation, ▪ Independent Study, ▪ Presentation, ▪ Brainstorming, ▪ Presenting Researches, ▪ Publish Research Papers.	▪ Written Research Proposal, Thesis and Publication, ▪ Written Exam, ▪ Assignments, ▪ Field Work, ▪ Survey, ▪ Presentation, ▪ Written Report.

• Course Content

1.Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours	Course ILOs
1.	Engineering Fundamentals of the Thermodynamics.	▪ Introduction: Energy, Heat, Work, and Power. ▪ Energy Forms. ▪ Thermodynamics of Energy Conversion. ▪ Carnot Cycle and Energy Conservation Principle. ▪ Types of Cycles.	1	2	a1, b1, b2,d1, d3, d4
2.	Thermal Energy (Heat Exchangers).	▪ Introduction. ▪ Types of Heat Exchangers. ▪ Types of Flow Path Configurations through Heat Exchangers. ▪ Classifications According to Transfer Processes. ▪ Direct and Indirect Type Heat Exchangers. ▪ Heat Exchanger Analysis.	2	4	a1, a2, b1, b2, b3, d1, d3, d4
3.	Mechanical Energy (Pumps and Turbines)	▪ Introduction, Classifications and Selections of Pumps. ▪ Pumps Sealing and Pumps Bearings. ▪ Pump Drivers and Power Transmission. ▪ Installation, Operation and Maintenance. ▪ Pump Testing. ▪ Steam Power Plant. ▪ Economics of Power Plants. ▪ Gas Turbine Power Plants.	2	4	a1, a2, b1, b2, b3, d1, d3, d4
4.	Basic Principles of Energy Storage.	▪ Introduction. ▪ Performance Parameters of Energy Storage Systems. ▪ Energy Storage Technology. ▪ Mechanical Energy Storage. ▪ Pumped Hydro Electric Storage. ▪ Flywheel Energy Storage.	1	2	a1, a3, b1, b3,b4, c2, c3, d1, d2, d4
5.	Basic Background of Static and Electro-Mechanical Energy Conversion.	▪ Principles of Electro Mechanical Energy Conversion. ▪ Energy Balance Relationships. ▪ Conservation of Energy.	1	2	a3, b1, b3,b4, c2, c3, d1, d2, d4

6.	Mid-Term	▪ The First Five Chapters.	1	2	a1, a2, a3, b1, b2, b3, b4, d1, d2, d3
7.	Energy Conversion and Utilization.	▪ Introduction ▪ Hydraulic Turbines. ▪ Internal Combustion Engines. ▪ Advanced Fossil Fuels.	1	2	a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d4
8.	Renewable Energy Technology.	▪ Introduction (The Sun and the Earth). ▪ Solar Radiations. ▪ Solar Collectors. ▪ Parabolic Trough Solar Power Plants. ▪ Solar Cells. ▪ Principles of Photovoltaic Energy Conversion. ▪ Basic Wind Power Plants. ▪ Geothermal Energy Utilization.	2	4	a1, a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d3, d4
9.	Overall Energy Management Strategies.	▪ Introduction. ▪ Rules of the Energy Management Supervision Strategies. ▪ Principles of Energy Management Strategies.	1	2	a3, b1, b3 , c2, c3, d1, d3, d4
10.	Economic Considerations in Energy Production.	▪ Introduction. ▪ Environmental Concerns. ▪ The Economics of Renewable Energy.	1	2	a3, b1, b3 , c2, c3, d1, d3, d4
11.	Technical and Economic Criteria for the Design of Efficient Energy Conversion Systems.	▪ Introduction (Energy Technologies and their Role in our Life). ▪ Overall Free Energy Conversion Efficiency. ▪ Technical Limits for Energy Conversion Efficiency. ▪ Power Production with Direct Energy Conversion. ▪ Criteria and Method for Sustainable Design of Energy Conversion Systems.	1	2	a3, b1, b3 , c2, c3, d1, d3, d4
12.	The Global Energy Challenges and Environmental Research,	▪ Emissions from Fossil Fuel Power Plants. ▪ Air Pollutant Emission from Conventional Power Plants. ▪ Control of Particulate Matter Emissions. ▪ World Energy Resources. ▪ Global Energy Systems.	1	2	a3, b1, b3 , c2, c3, d1, d3, d4

13.	The Final Exam.	▪ All the Chapters.	1	3	a1, a2, a3, b1, b2, b3, b4, d1, d2, d3
Number of Weeks /and Contact Hours Per Semester			**16**	**33**	

2.Practical Aspect

Order	Practical / Tutorials topics (None)	Number of Weeks	Contact Hours	Course ILOs
1	▪			
2	▪ ▪			
3	▪ ▪			
4	•			
5	▪			
6	• ▪			
Number of Weeks /and Contact Hours Per Semester				

3.Tutorial Aspect:				
No.	**Tutorial**	**Number of Weeks**	**Contact Hours**	**Learning Outcomes (CILOs)**
1.	Thermal Energy (Heat Exchangers).	2	4	a1, a2, b1, b2, b3, d1, d3, d4
2.	Mechanical Energy (Pumps and Turbines).	2	4	a1, a2, b1, b2, b3, d1, d3, d4
3.	Energy Conversion and Utilization.	2	4	a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d4
4.	Renewable Energy Technology.	3	6	a1, a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d3, d4
5.	Technical and Economic Criteria for the Design of Efficient Energy Conversion Systems.	2	4	a3, b1, b3 , c2, c3, d1, d3, d4
6.	The Global Energy Challenges and Environmental Research,	2	4	a3, b1, b3 , c2, c3, d1, d3, d4
Number of Weeks /and Units Per Semester		13	26	

• Teaching Strategies:

- Lectures.
- Seminars.
- Group/ Individual Projects and Studies.
- Field Work.
- Computer Hands-on Session.
- Simulation Exercise.
- Analysis and Problem Solving.

- Dissertation Defenses and Presentation.
- Publish Research Papers.

• Assessment Methods of the Course:

- Oral and Written Exams.
- Reports.
- Assignments.
- Seminar Report.
- Written Research Proposal.
- Thesis and Publication.
- Field Work.
- Presentation.
- Written Report.

• Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due	CILOs (symbols)
1.	Homework and Assignments.	Individual	15	Every Week	a1, a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d3, d4
2.	Mini/Major Project (Thesis).	Group	40	At the End of the Semester	a1, a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d3, d4
3.	Case studies.	-	-	-	-
	Total Score		**55**	==	===

• Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment	CILOs
1.	Tasks and Assignments.	Every Week	55	55	a1, a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d3, d4
2.	Quizzes (4 quizzes).	Every 3 weeks	10	10	a1, a2, a3, b1, b2, b3, b4, c1, c2, c3, d1, d2, d3, d4
3.	Mid-Term Exam.	Sixth Week	10	10	a1, a2, a3, b1, b2, b3, b4, d1, d2, d3
4.	Final Exam (Practical).	-	-	-	-
5.	Final Exam (Theoretical).	Last Week (Week No. 16)	25	25	a1, a2, a3, b1, b2, b3, b4, d1, d2, d3
Total				**100%**	**===**

• Learning Resources :

1 Required Textbook(s) :

1. Nikolai V. Khartchenko and Vadym M. Kharchenko, "Advanced Energy Systems", Second Edition, Taylor & Francis Group, 2014.
2. D. Yogi Goswami and Frank Kreithi, "Energy Conversion", Second Edition, Taylor & Francis Group, 2017.

2 Essential References:

1. John A. Duffie and William A. Beckman, "Solar Engineering of Thermal Processes", Fourth Edition, John Wiley & Sons Inc.

3 Electronic Materials and Web Sites etc.

1.
2.
3.
4.

• **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:2021/2022

Course Plan: Advanced Energy Conversion

Course Code (ME524)

• Information about Faculty Member Responsible for the Course:								
Name	Assoc. Prof. Dr. Abdul-Malik E. Momin	**Office Hours**						
Location &Telephone No.	Sana'a, Faculty of Engineering 777943334	**SAT**	**SUN**	**MON**	**TUE**	**WED**	**THU**
E-mail	dramalikmomin@yahoo.com						

• General information about the course:					
	Course Title	Advanced Energy Conversion.			
2.	Course Code and Number	ME524.			
3.	Credit Hours	Contact Hours			Total (Credit Hours)
		Lecture	Practical	Seminar/Tutorial	
		2	-	2	3
4.	Study Level and Semester	First Semester.			
5.	Pre-requisites	Heat and Mass Transfer and Renewable Energy Systems.			
6.	Co –requisite	-			
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 of Engineering, Mechanical Engineering Department.			

• Course Description:

This course will provide students with concrete knowledge about energy conversion technologies' functioning and efficiency. After completion of the course, the students will have knowledge to perform simple calculations of power cycles and different systems. This course covers fundamentals of thermodynamics, and transport processes as applied to energy systems. The course will also incorporate fundamentals, process and system's analysis tools in the broad energy area, intended to educate future leaders in the field of energy technology.
The course also covers energy conversion, utilization and storage by introducing the common concepts and tools used in this field within a generic framework that allows students to analyze several alternative systems and determine according to fundamental principles which approach is compatible with the intended performance.

• Course Intended Learning Outcomes (CILOs):

Upon successful completion of the **Advanced Energy Conversion** course, graduate students will be able to:

Upon successful completion of Advanced Energy Conversion **Course**, the graduates will be able to:

a1- Identify the basic knowledge of engineering sciences subjects**.**
a2 - Describe the different trends and developments within the mechanical engineering contexts.
a3- Characterize concepts and techniques to design mechanical systems with sustainable and environmentally friendly approach.
b1 - Explore knowledge and skills to solve critical problems.
b2- Analyze different tools to solve complex engineering problems.
b3- Formulate mechanical components to meet the actual needs.
b4- Examine risks of the professional practice.
c1- Choose different manufacturing processes for the actual design of the mechanical components.
c2- Implement research to solve mechanical engineering problems within the constraints.
c3 - Perform different understanding to reach to modern operations and business management.
d1- Evaluate IT capabilities and other resources to develop a scientific research**.**
d2- Justify in both orally and writing forms for different audiences.
d3- Assess latest knowledge for life-long learning.
d4- Cooperate effectively in teams to reach to a professional context.

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

CILOs		PILOs
a.Knowledge and Understanding: Upon successful completion of the Advance Energy Conversion **Course**, the graduates will be able to:		**A.Knowledge and Understanding:** Upon successful completion of the **MSc. In Mechanical Engineering Program**, the graduates will be able to:
a1.	Identify the basic knowledge of engineering sciences subjects.	**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 different trends and developments within the mechanical engineering contexts.	**A2.**	Identify and critically evaluate contemporary engineering technologies, current developments and emerging trends within the mechanical engineering contexts.
a3.	Characterize concepts and techniques to design mechanical systems with sustainable and environmentally friendly approach.	**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.
b.Cognitive/ Intellectual Skills: Upon successful completion of the Advance Energy Conversion **Course,** the graduates will be able to:		**B.Cognitive/ Intellectual Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:	
b1.	Explore knowledge and skills to solve critical problems.	**B1.**	Identify and apply specialized knowledge and skills to solve problems that are critical to future growth of industry and business.
b2.	Analyze different tools to solve complex engineering 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.	Formulate mechanical components to meet the actual needs.	**B3.**	Design and optimize mechanical components, systems and process to meet desired needs within realistic constraints.
b4.	Examine risks of the professional practice.	**B4.**	Analyze and assess risks of the professional practice in the mechanical engineering contexts.
c.Professional and Practical Skills: Upon successful completion of the Advance Energy Conversion **Course,** the graduates will be able to:		**C.Professional and Practical Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:	
c1.	Choose different manufacturing processes for the actual design of the mechanical components.	**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 mechanical engineering problems within the constraints.	**C2.**	Conduct research and studies to solve mechanical engineering problems professionally, ethically and

			responsibly within realistic constraints.
c3.	Perform different understanding to reach to modern operations and business management.	**C3.**	Demonstrate an in-depth understanding of the mechanical engineering business environment, including environmental aspects, and apply quality issues, modern operations and business management techniques and good practices in a range of contexts.
d.Transferable Skills: Upon successful completion of the Advance Energy Conversion **Course,** the graduates will be able to:		**D.Transferable Skills:** Upon successful completion of the **MSc. In Mechanical Engineering Program,** the graduates will be able to:	
d1.	Evaluate IT capabilities and other resources to develop a scientific research.	**D1.**	Adopt effectively IT capabilities and other different resources of information to develop a scientific research in mechanical engineering fields.
d2.	Justify 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 latest knowledge for life-long learning.	**D3.**	Identify a need for the latest relevant knowledge and technologies and undertake life-long learning.
d4.	Cooperate effectively in teams to reach to a professional contexts.	**D4.**	Collaborate effectively within multidisciplinary teams and lead them in different professional contexts

VI.Course Content

1.Theoretical Aspect

Order	Topic List / Units	Sub -Topics List	Number of Weeks	Contact Hours
1.	Engineering Fundamentals of the Thermodynamics.	▪ Introduction: Energy, Heat, Work, and Power. ▪ Energy Forms. ▪ Thermodynamics of Energy Conversion. ▪ Carnot Cycle and Energy Conservation Principle. ▪ Types of Cycles.	1	2
2.	Thermal Energy (Heat Exchangers).	▪ Introduction. ▪ Types of Heat Exchangers. ▪ Types of Flow Path Configurations through Heat Exchangers. ▪ Classifications According to Transfer Processes. ▪ Direct and Indirect Type Heat Exchangers.	2	4

		▪ Heat Exchanger Analysis.		
3.	Mechanical Energy (Pumps and Turbines)	▪ Introduction, Classifications and Selections of Pumps. ▪ Pumps Sealing and Pumps Bearings. ▪ Pump Drivers and Power Transmission. ▪ Installation, Operation and Maintenance. ▪ Pump Testing. ▪ Steam Power Plant. ▪ Economics of Power Plants. ▪ Gas Turbine Power Plants.	2	4
4.	Basic Principles of Energy Storage.	▪ Introduction. ▪ Performance Parameters of Energy Storage Systems. ▪ Energy Storage Technology. ▪ Mechanical Energy Storage. ▪ Pumped Hydro Electric Storage. ▪ Flywheel Energy Storage.	1	2
5.	Basic Background of Static and Electro-Mechanical Energy Conversion.	▪ Principles of Electro Mechanical Energy Conversion. ▪ Energy Balance Relationships. ▪ Conservation of Energy.	1	2
6.	Mid-Term	▪ The First Five Chapters.	1	2
7.	Energy Conversion and Utilization.	▪ Introduction ▪ Hydraulic Turbines. ▪ Internal Combustion Engines. ▪ Advanced Fossil Fuels.	1	2
8.	Renewable Energy Technology.	▪ Introduction (The Sun and the Earth). ▪ Solar Radiations. ▪ Solar Collectors. ▪ Parabolic Trough Solar Power Plants. ▪ Solar Cells. ▪ Principles of Photovoltaic Energy Conversion. ▪ Basic Wind Power Plants. ▪ Geothermal Energy Utilization.	2	4

9.	Overall Energy Management Strategies.	▪ Introduction. ▪ Rules of the Energy Management Supervision Strategies. ▪ Principles of Energy Management Strategies.	1	2
10.	Economic Considerations in Energy Production.	▪ Introduction. ▪ Environmental Concerns. ▪ The Economics of Renewable Energy.	1	2
11.	Technical and Economic Criteria for the Design of Efficient Energy Conversion Systems.	▪ Introduction (Energy Technologies and their Role in our Life). ▪ Overall Free Energy Conversion Efficiency. ▪ Technical Limits for Energy Conversion Efficiency. ▪ Power Production with Direct Energy Conversion. ▪ Criteria and Method for Sustainable Design of Energy Conversion Systems.	1	2
12.	The Global Energy Challenges and Environmental Research,	▪ Emissions from Fossil Fuel Power Plants. ▪ Air Pollutant Emission from Conventional Power Plants. ▪ Control of Particulate Matter Emissions. ▪ World Energy Resources. ▪ Global Energy Systems.	1	2
13.	The Final Exam.	▪ All the Chapters.	1	3
Number of Weeks /and Contact Hours Per Semester			**16**	**33**

2.Practical Aspect				
Order	**Practical / Tutorials topics (None)**	**Number of Weeks**	**Contact Hours**	**Course ILOs**
1	▪			
2	▪ ▪			
3	▪ ▪			
4	•			
5	▪			
6	• ▪			
Number of Weeks /and Contact Hours Per Semester				

No.	**Tutorial**	**Number of Weeks**	**Contact Hours**
1.	Thermal Energy (Heat Exchangers).	2	4
2.	Mechanical Energy (Pumps and Turbines).	2	4
3.	Energy Conversion and Utilization.	2	4
4.	Renewable Energy Technology.	3	6
5.	Technical and Economic Criteria for the Design of Efficient Energy Conversion Systems.	2	4
6.	The Global Energy Challenges and Environmental Research,	2	4
Number of Weeks /and Units Per Semester		13	26

VII.Teaching Strategies:

- Lectures.
- Seminars.
- Group/ Individual Projects and Studies.
- Field Work.
- Computer Hands-on Session.
- Simulation Exercise.
- Analysis and Problem Solving.
- Dissertation Defenses and Presentation.
- Publish Research Papers.

VIII.Assessment Methods of the Course:

- Oral and Written Exams.
- Reports.
- Assignments.
- Seminar Report.
- Written Research Proposal.
- Thesis and Publication.
- Field Work.
- Presentation.
- Written Report.

IX.Tasks and Assignments:

No	Assignments/ Tasks	Individual/ Group	Mark	Week Due
1.	Homework and Assignments.	Individual	15	Every Week
2.	Mini/Major Project (Thesis).	Group	40	At the End of the Semester
3.	Case studies.	-	-	-
4.				
	Total Score		**55**	==

X.Learning Assessment:

No.	Assessment Tasks	Week due	Mark	Proportion of Final Assessment
1.	Tasks and Assignments.	Every Week	55	55
2.	Quizzes (4 quizzes).	Every 3 weeks	10	10
3.	Mid-Term Exam.	Sixth Week	10	10
4.	Final Exam (Practical).	-	-	-
5.	Final Exam (Theoretical).	Last Week (Week No. 16)	25	25
Total				**100%**

XI.Learning Resources :

1.Required Textbook(s) :

1.Nikolai V. Khartchenko and Vadym M. Kharchenko, "Advanced Energy Systems", Second Edition, Taylor & Francis Group, 2014.
2.D. Yogi Goswami and Frank Kreithi, "Energy Conversion", Second Edition, Taylor & Francis Group, 2017.

2.Essential References:

1.John A. Duffie and William A. Beckman, "Solar Engineering of Thermal Processes", Fourth Edition, John Wiley & Sons Inc.

3.Electronic Materials and Web Sites *etc.*

• 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