Master in Renewable Energy and the Environment – Curriculum Prerequisite & Progression

Program Level	Course Structure & Progression Path	Prerequisite / Requirement
Level 1 **Core Semesters**	1. **7161-ME-3:** Renewable Energy Systems 2. **7162-ME-3:** Environment and Sustainability 3. **7163-ME-3:** Advanced Heat Transfer	**None (NA)**
Level 2 **Specialization & Core**	1. **7164-ME-3:** Solar Energy *(Required)* 2. **71XX-ME-3:** Elective-1 *(From List 1)* 3. **71XX-ME-3:** Elective-2 *(From List 2)*	**None (NA)**
Progression Gateway	**Successful Completion of 18 Credit Hours**	**18 credit hours must be successfully completed from Levels 1 & 2**
Level 3 **Advanced Electives & Capstone**	1. **71XX-ME-3:** Elective-3 *(From List 3)* 2. **71XX-ME-3:** Elective-4 *(From List 4)* 3. **7185-ME-3:** Project *(Component 1)*	**Requires 18 credits completed from Levels 1 & 2**
Level 4 **Final Semester**	1. **71XX-ME-3:** Elective-5 *(From List 4)* 2. **7185-ME-3:** Project *(Component 2 / Defense)*	**Continuous enrollment in Project**

Program Completion & Graduation Requirements

Requirement	Condition
Master's Project	Successful defense of the Master's Project report and oral presentation
Minimum GPA	Minimum **3.5 overall Cumulative Grade Point Average (CGPA)**
Scientific Publication	Submission of at least **one scientific paper** to a specialized journal or conference, derived from the Master's Project

Total coursework before/through the gateway: 18 credit hours from Levels 1 and 2.
Progression to Level 3: Requires successful completion of those 18 credit hours.
Project: Component 1 begins at Level 3 and Component 2/Defense continues into Level 4.

Master in Renewable Energy and the Environment – List of Selected Elective Courses

List	Course Code	Course Title	Required/ Elective	Pre-Requisite Courses	Credit Hours
List: 1	7166-ME-3	Numerical Methods	Elective	NA	3
	7168-ME-3	Photovoltaic Energy Systems	Elective	NA	3
	7169-ME-3	Geothermal Energy	Elective	NA	3
	7170-ME-3	Advanced Fluid Mechanics	Elective	NA	3
List: 2	7171-ME-3	Wind Energy	Elective	NA	3
	7173-ME-3	Energy Conversion	Elective	NA	3
	7174-ME-3	Energy Storage Systems	Elective	NA	3
	7175-ME-3	Electrical Systems Related To Renewable Energy	Elective	NA	3
List: 3	7165-ME-3	Energy Efficiency	Elective	NA	3
	7172-ME-3	Finite Elements Method	Elective	NA	3
	7177-ME-3	Computational Fluid Dynamics	Elective	NA	3
	7179-ME-3	Advanced Mathematics	Elective	NA	3
List: 4	7180-ME-3	Economic Aspects Of Renewable Energy	Elective	NA	3
	7181-ME-3	Energy Comfort In Buildings	Elective	NA	3
	7182-ME-3	Environmental Pollution	Elective	NA	3
	7183-ME-3	Energy Management	Elective	NA	3
	7184-ME-3	Desalination	Elective	NA	3
	7176-ME-3	Energy Policy, Planning and Sustainable Development	Elective	NA	3

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COURSE DESCRIPTION

1. Course Number	7161-ME-3	**Course Name**	Renewable Energy systems
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	1/1		
3. Course Instructor	Dr. Sultan Alqahtani		
4. Textbook, title, author, and year	**Textbook:** 1. Wind and Solar power system By: Mukund R. Patel, Ph.D.,P.E. **a. Other supplemental materials:** 1. JeeJoe Michael , IniyanS , Ranko Goic,"Flat plate solar photovoltaic–thermal (PV/T) systems: A reference guide", Volume 51, November 2015, Renewable Energy Reviews. 2. HG Teo, PS Lee, MNA. Hawlader,"An active cooling system for photovoltaic modules",Appl. Energy, 90 (1) (2012).		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course, categorized under Engineering Science, provides a quantitative and applied introduction to renewable energy systems with emphasis on the Saudi Arabian context. Students examine solar, wind, hydro, bioenergy, geothermal, ocean (wave, tidal, OTEC), and fuel cell technologies through their underlying physical principles, mathematical models, performance characteristics, and environmental impacts. The course integrates resource assessment, simple system sizing, and efficiency calculations using fundamental mathematics, statistics, and simulation tools. Students apply critical thinking to compare technologies, evaluate feasibility under technical, economic, and environmental constraints.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Required	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Understand fundamentals and specialized knowledge in renewable energy systems CLO1.2 PLO 1.2. Describe environmental impact of renewable energy engineering professional practice techniques CLO2.1 PLO 2.1 Analyze and assess the renewable energy systems. CLO2.2 PLO 2.2 Develop a research study and /or write a scientific essay about renewable energy systems.		
7. Brief list of topics to be covered			

No	List of Topics	Contact Hours
1.	Introduction to Renewable Energy and Saudi Arabia's National Renewable Energy Program (NREP).	3
2.	**Solar energy:** solar thermal conversion devices, storage	6

		and applications, solar cell fundamentals, different solar cell technologies, photovoltaic systems, solar assisted heating, and cooling systems, scope in Saudi Arabia.	
	3.	**Fuel cell:** importance for fuel cell, classification of fuel cells, basic principle, design, materials used for developing fuel cells, applications and future prospects, scope in Saudi Arabia.	6
	4.	**Bioenergy:** biofuels and feedstocks for its production; Various biofuels: biodiesel, bioethanol, biobutanol, biohydrogen, biogas and biooil; concept of biorefinery, scope in Saudi Arabia.	6
	5.	**Hydro-electric energy:** Types of Hydroelectric Energy Plants; mini/micro-hydel systems, scope in Saudi Arabia.	6
	6.	**Ocean Wave energy:** Introduction to wave energy, resources and potential, examples from passed and current R&D facilities. Simplified wave theory; orbits, propagation velocities, stored & transported wave energy, scope in Saudi Arabia.	6
	7.	**Geothermal Energy:** Resources, types of wells, methods of harnessing the energy, scope in Saudi Arabia.	6
	8.	**Ocean Thermal Energy Conversion (OTEC):** Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants.	3
	9.	**Wind Energy**: Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator.	3
		Total	45
8. Any other information	**Course Assessment***		

	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7162-ME-3	**Course Name**	Environment and Sustainability
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	1/1		
3. Course Instructor	Dr. Mustafa		
4. Textbook, title, author, and year	**Textbook:** 1 Blewitt, J. (2014). Understanding Sustainable Development, Second Edition. Routledge, Abingdon. ISBN: 9780415707824. 2 Dresner, S. (2008). The Principles of Sustainability, Second Edition. Earthscan, London. ISBN: 9781840074969. 3 Sustainability - A Comprehensive Foundation by Heriberto Cabezas, (Open Access TextBook) , 2019		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course introduces the scientific and applied foundations of environment and sustainability, with emphasis on energy–environment linkages and the Saudi context. Students study global and local environmental challenges, climate change, resource use, and sustainable development, and apply quantitative metrics, simple models, and decision tools to assess environmental risk, sustainability performance, and policy options. Through case studies, problem-solving, and a structured mini-project, students evaluate sustainable infrastructure and policies in the Kingdom, integrating ethical, cultural, and public health dimensions.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Required	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Explain physical resources, modern environmental management and sustainable energy systems that leads to sustainability and safety with regard to mechanical engineering CLO1.2 PLO 1.2. Develop an environmental policy that includes realistic constraints by understanding sustainability which includes humanity and the environment CLO2.1 PLO 2.1 Study climate and global change and biosphere that demands broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context CLO2.2 PLO 2.2 Solve sustainability problems using suitable tools.		
7. Brief list of topics to be covered			

No	List of Topics	Contact Hours
1.	Introduction to Sustainability: Humanity and the	6

		Environment.	
	2.	Climate and Global Change	4
	3.	Biosphere	4
	4.	Physical Resources: Water, Pollution, and Minerals	4
	5.	Environmental and Resource Economics	5
	6	Modern Environmental Management	4
	7	Sustainable Energy Systems	6
	8	Problem-Solving, Metrics, and Tools for Sustainability	4
	9.	Sustainability: Ethics, Culture, and History	4
	10	Sustainable Infrastructure, The Evolution of Environmental Policy in the KSA	4
		Total	45
8. Any other information	**Course Assessment***		

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

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COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7163-ME-3</td><td>Course Name</td><td colspan="2">Advanced Heat Transfer</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">1/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Prof.Dr.Irfan Anjum Magami</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
1. Johannes Wurm, Matthias Fitl, Michael Gumpesberger, EsaVäisänen, Christoph Hochenauer "Advanced heat transfer analysis of continuously variable transmissions (CVT)" Applied Thermal Engineering 114 (2017).
2. Heat and Mass Transfer: Fundamentals &Applications,5th Edition by Yunus A. Çengel, Afshin J. Ghajar (McGraw-Hill, 2015), ISBN: 978-0-07-339818-1
3. Heat Transfer - 10th Edition by J. P. Holman (McGraw-Hill,2010), ISBN -0073529362
4. Incropera, F. De Witt, D. , P., “Introduction to Heat Transfer”, John – Wileyand Sons, 2006.
Amir Faghri, Yuwen Zhang, John R. Howell, “Advanced heat and mass transfer”, Global Digital Press, 2010.</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This graduate course provides an advanced treatment of heat transfer, emphasizing rigorous mathematical formulation and solution of conduction, convection, and radiation problems relevant to modern energy and thermal systems. Starting from first principles, students derive and apply governing differential equations, boundary and initial conditions, and dimensionless groups to analyze steady and transient heat and mass transfer in 1D/2D/3D configurations. The course integrates analytical methods, numerical/computational techniques, and boundary-layer theory, and extends to phase-change phenomena and radiation exchange. Emphasis is placed on using advanced tools and modeling approaches to design and evaluate thermo-fluid components and systems in realistic engineering applications.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Required</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
</table>

6. Specific goals for the course

a. Specific outcomes of instruction

By the completion of the course the student should be able to:

CLO1.1 PLO 1.1 Explain the modes of heat transfer in steady and unsteady contexts.

CLO1.2 PLO 1.2. Describe various practical engineering situations where heat transfer occurs.

CLO2.1 PLO 2.1 Apply the fundamental/specialized theories of heat transfer with the relevant governing equations.

CLO2.2 PLO 2.2 Conduct advanced research or professional projects by analyzing heat transfer mechanisms in the field of mechanical engineering and associated fields.

7. Brief list of topics to be covered

No	List of Topics	Contact Hours
1.	Introduction And Basic Concepts, Application Areas of Heat Transfer, Specific Heats of Gases, Liquids, and Solids, Heat Transfer Mechanisms	3
2.	Steady state and transient conduction, convection, and radiation heat transfer.	6
3.	Advanced computational and analytical techniques for conduction, convection, and radiation.	6
4.	External and internal fluid flow.	3
5.	Free, forced, and mixed convection; Phase change heat transfer, including boiling and condensation	3
6.	Laminar and turbulent convection heat transfer; Boundary layer theory	6
7.	Radiation heat transfer.	6
8.	Mass transfer in laminar and turbulent flow	6
9.	Cooling of electronic equipment	3
10.	Design of engineering systems involving thermo-fluid phenomena.	3
Total		45

8. Any other information

Course Assessment*

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

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COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7164-ME-3</td><td>Course Name</td><td>Solar Energy</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td>3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="3">1/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="3">Dr. Talal</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="3">Textbook:
1. Solar Energy Engineering, Soteris A. Kalogirou, 2 Edition, Academic Press (2013), ISBN: 9780123972705
a. Other supplemental materials:
• Dunlop, James P. Photovoltaic systems. Amer Technical Pub, 2012. ISBN: 9781935941057.
• Duffie, J.A., and Beckman, W.A. Solar Energy Thermal Process, John Wiley and Sons, New York, Jui Sheng Hsieh, Solar Energy Engineering, Prentice-Hall, 2013. ISBN: 9780470873663
• Tiwari, Gopal Nath, et al. Handbook of solar energy: theory, analysis and applications. Springer Science Busines Media, 2016. ISBN: 978-981-10-0807-8.
• Smets, Arno H. M., et al. Solar energy: the physics and engineering of photovoltaic conversion, technologies and systems. UIT Cambridge Ltd., 2016. ISBN: 978-1906860325</td></tr>
<tr><td>5. Specific course information</td><td colspan="3">a. Brief description of the content of the course (catalog description)
This course provides a rigorous introduction to solar energy conversion with emphasis on photovoltaic (PV) electricity generation and thermal applications. Students develop the ability to quantify solar resource availability, understand solar radiation geometry, and calculate irradiance on arbitrarily oriented surfaces. The course covers PV cell physics, I–V characteristics, PV module and array design, thermal behavior of solar components, and performance modeling of flat-plate collectors and basic solar systems. Analytical methods and simple computational tools are used to design and evaluate solar systems for different applications under realistic operating conditions.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="3">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Required</td><td>Language of instruction</td><td>English</td></tr>
<tr><td>Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
</table>

6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Describe solar solar radiation, thermodynamics and heat transfer, power station technologies, types of solar energy systems, including solar systems focused using parabolic surfaces, concentrated solar energy technology CLO1.2 PLO 1.2. Outline actual power output from a solar PV module, accounting for incident irradiance, angle of incidence, and cell temperature. CLO2.1 PLO 2.1 Analyze the concept to design solar systems for various applications. The socio-economic and environmental merits of solar systems for a variety of applications. The prospects of solar technology for sustainable power generation. CLO3.1 PLO 3.1 Assess PV module performance ,I-V characteristics of a PV module.
7. Brief list of topics to be covered	

No	List of Topics	Contact Hours
1.	Source of radiation, solar constant, solar charts, measurement of diffuse, global and direct solar radiation	3
2.	Pyrheliometer, pyranometer, pyregeometer, net pyradiometer-sunshine recorder	6
3.	Solar Non-Concentrating Collectors- Design considerations – Classification air, liquid heating collectors.	6
4.	Derivation of efficiency and testing of flat plate collectors – Analysis of concentric tube collector - Solar green house.	3
5.	Design – Classification– Concentrator mounting –Focusing solar concentrators Heliostats.	6
6.	Solar powered absorption A/C system, water pump, chimney, drier, dehumidifier, still, cooker.	6
7.	Photo-voltaic cell – characteristics-cell arrays-power electric circuits for output of solar panels.	6
8.	Choppers-inverters-batteries-charge regulators, Construction concepts, Solar ponds.	6
9.	Energy Storage -Sensible, latent heat and thermo-chemical storage-pebble bed etc. materials for phase change-Glauber's salt-organic compounds.	3
Total		45

8. Any other information

Course Assessment*

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7165-ME-3	**Course Name**	Energy Efficiency
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	3/2		
3. Course Instructor	Dr. Ali Anqi		
4. Textbook, title, author, and year	**Textbook:** 1. Energy Management Principles (Second Edition) , Applications, Benefits, Savings, Craig B. Smith and Kelly E. Parmenter ,ISBN: 978-0-12-802506-2 **a. Other supplemental materials:** Guide to Energy Management, Seventh Edition 7th Edition by Barney L. Capehart Ph.D. CEM , Wayne C. Turner Ph.D. PE CEM , William J. Kennedy Ph.D. PE		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course introduces the concepts, methods, and quantitative tools needed to analyze and improve energy efficiency in buildings, industry, and energy systems. Students review different forms of energy and energy conversion processes, then learn how to model energy flows, identify losses, and evaluate conservation options. Emphasis is placed on energy management, energy auditing, cost–effectiveness analysis, and environmental impacts of energy use, including pollutants and greenhouse gas emissions. The course also addresses materials and technologies for energy conservation and storage, equipping students to propose and assess efficiency measures within technical, economic, and sustainability constraints.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Discuss the importance of managing energy CLO2.1 PLO 2.1 Use low energy principles for domestic buildings and design CLO2.2 PLO 2.2 Apply environmental methods, energy efficiency and requirements for zero carbon homes and buildings.		
7. Brief list of topics to be covered			

No	List of Topics	Contact Hours
1.	Introduction to Energy and Energy Efficiency	3
2.	System analysis	6
3.	Systems thinking and Energy Systems	6
4.	Methods for evaluation of large and complex energy systems and Energy system modeling.	6
5.	Understanding about Energy and user behavior	6

	6.	Energy Economics	6
	7.	Energy portfolio sustainability management	6
	8.	Business logics in modern energy systems	6
		Total	45
8. Any other information	**Course Assessment***		

	Activity	Assessment% (Marks)
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7166-ME-3</td><td>Course Name</td><td colspan="2">Numerical Methods</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">2/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Prof. Dr. Irfan Anjum Magami</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
Steven Chapra and Raymond Canale , Numerical Methods for Engineers, 8th Edition, 2021, McGraw Hill
ISBN10:1260232077 ISBN13:9781260232073
a. Other supplemental materials:
1. Amos Gilat, Vish Subramaniam Numerical Methods for Engineers and Scientists, 3rd Edition, Wily, 2013, ISBN: 978-1-118-55493-7</td></tr>
<tr><td>1 Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course develops the mathematical and computational foundations of numerical methods for solving engineering and scientific problems. Students learn how to formulate mathematical models (algebraic equations, ODEs, PDEs) and apply appropriate numerical techniques for root-finding, linear systems, interpolation, regression, numerical differentiation and integration, and solution of initial- and boundary-value problems. Emphasis is placed on error analysis, stability and convergence, and the practical implementation of algorithms using programming tools (e.g., MATLAB/Python). Students interpret and validate numerical results, compare methods, and document their work in a professional technical format.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
<tr><td>2 Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Explain various numerical methods.
CLO1.2 PLO 1.2. Identify various numerical integration techniques
CLO2.1 PLO 2.1 Apply the fundamental theory of numerical modeling with ODE
CLO2.2 PLO 2.2 Apply the Numerical methods to solve Engineering and scientific problems</td></tr>
<tr><td rowspan="3">3 Brief list of topics to be covered</td><td>No</td><td colspan="2">List of Topics</td><td>Contact Hours</td></tr>
<tr><td>1.</td><td colspan="2">Modeling, Computers, and Error Analysis: Mathematical Modeling and Engineering Problem Solving, Programming and Software, Approximations and Round-Off Errors, Truncation Errors, and the Taylor Series.</td><td>3</td></tr>
<tr><td>2.</td><td colspan="2">Roots of Equations: Bracketing Methods, Open Methods,</td><td>6</td></tr>
</table>

		Roots of Polynomials	
	3.	Linear Algebraic Equations: Gaussian Elimination, LU Decomposition, and Matrix Inversion, Special Matrices and Gauss-Seidel iteration methods	6
	4.	Curve Fitting: Least-Squares Regression, Interpolation, Fourier Approximation	6
	5.	Numerical Differentiation and Integration: Newton-Cotes Integration Formulas, Integration of Equations, Numerical Differentiation	6
	6.	Ordinary Differential Equations: Runge-Kutta Methods, Stiffness, and Multistep Methods, Boundary-Value and Eigenvalue Problems	6
	7.	Partial Differential Equations: Finite Difference for Elliptic Equations, Finite Difference for Parabolic Equations, Finite volume method.	6
	8.	Matlab Programming as a tool for Numerical Methods	6
		Total	45
4 Any other information	**Course Assessment***		

	Activity	Assessment% (Marks)
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7168-ME-3</td><td>Course Name</td><td colspan="2">Photovoltaic Energy Systems</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">2/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr. Sultan Al-Shehri</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
1. Chetan Singh Solanki., Solar Photovoltaic: “Fundamentals, Technologies and Application”,3 rded.,PHI Learning Pvt., Ltd., 2017
a. Other supplemental materials:
• Messenger, Roger, and Amir Abtahi. Photovoltaic systems engineering. CRC press, 2017. ISBN : 9781439802922
• Smets, Arno H. M., et al. Solar energy: the physics and engineering of photovoltaic conversion, technologies and systems. UIT Cambridge Ltd., 2016. ISBN: 978-1906860325
• Mukerjee, A. K., and Nivedita Thakur. Photovoltaic systems: analysis and design. PHI Learning, 2014. ISBN: 978-8120340174
• Balfour, John, et al. Introduction to photovoltaic system design. Jones & Bartlett Learning, 2013. ISBN: 978-1409624675</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course provides an applied and quantitative study of photovoltaic (PV) energy systems, with emphasis on stand-alone configurations. Students learn solar geometry, resource assessment, and PV device behavior, then use mathematical models to estimate irradiance on tilted surfaces, predict PV energy yield, and size system components. The course covers PV module characteristics, balance-of-system (BOS) components (batteries, charge controllers, inverters, wiring, protection), and design of stand-alone PV systems under technical, economic, and regulatory constraints. Students apply analytical and digital tools to design, model, and evaluate PV systems, including cost and performance calculations and consideration of relevant codes and safety practices.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td colspan="2">Language of instruction</td><td>English</td></tr>
<tr><td colspan="2">Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Identify the sun position at any given location and time
CLO1.2 PLO 1.2. Compare sun path diagrams
CLO2.1 PLO 2.1 Estimate the energy generation of PV system
CLO2.2 PLO 2.2 Design a stand-alone PV system by estimating the load, sizing and selecting the batteries, sizing and selecting the PV modules, charge controller and inverter.</td></tr>
</table>

7. Brief list of topics to be covered	No	List of Topics	Contact Hours
	1.	The Solar Resource : solar spectrum, sun position, sun path diagrams, solar and clock times, clear sky insolation on a collecting surface, solar radiation measurements, resource of solar data.	3
	2.	Photovoltaic Materials and Electrical Characteristics : semiconductor physics, generic PV cell circuit model, modules and arrays, I-V curves, impact of temperature, shading impacts, crystalline silicon technologies	6
	3.	Thin-film PV. array cell, p-n junction, structure, I-V characteristics of a PV module, maximum power point.	6
	4.	Grid-Connected PV Systems : I-V Curves of simple loads and batteries, interfacing with the utility, system sizing, economic considerations.	6
	5.	Stand-Alone PV Systems : load estimation, batteries and their properties, array and battery sizing.	6
	6.	Hybrid-PV systems, case study of PV powered water pumping.	6
	7.	Mechanical Considerations: material properties, mechanical system requirements, design and installation guidelines, forces acting on PV arrays, array mounting systems design mechanical load and stress.	6
	8.	Forces acting on PV arrays, array mounting systems design mechanical load and stress.	3
	9.	Codes and standards Related to PV Systems: National Electric Code (NEC) and IEEE Standard 1547.	3
		Total	45

8. Any other information

Course Assessment*

Activity	**Assessment% (Marks)**
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7169-ME-3	**Course Name**	Geothermal Energy
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	2/1		
3. Course Instructor	Dr. Saleel		
4. Textbook, title, author, and year	**Textbook:** 1. Geothermal Energy Systems: Exploration, Development, and Utilization. Ernst Huenges (Editor), Patrick Ledru (Editor). ISBN: 978-3-527-64061-2. August 2011 2. Geothermal Energy: Sustainable Heating and Cooling Using the Ground, Editor(s):Marc A. Rosen, Seama Koohi-Fayegh, 2016 Print ISBN:9781119180982 |Online ISBN:9781119181002 |DOI:10.1002/9781119181002 © 2017 John Wiley & Sons, Ltd. 3. Geothermal Energy: From Theoretical Models to Exploration and Development. Stober, Ingrid, and Kurt Bucher. Springer, 2013**a. Other supplemental materials:** 4. Sheldon, P. (2005) Earth's Physical Resources: An Introduction (Book 1 of S278 Earth's Physical Resources: Origin, Use and Environmental Impact), The Open University, Milton Keynes 5. Smith, S. (2005) Water: The Vital Resource (Book 3 of S278 Earth's Physical Resources: Origin, Use and Environmental Impact), The Open University, Milton Keynes		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course provides a scientific and applied introduction to geothermal energy and its use for heating, cooling, and power generation. Students examine geothermal resources, ground temperature profiles, and heat transfer in soils and rocks, and learn how ground-source heat pumps and other geothermal systems are designed and operated. Emphasis is placed on simple mathematical modeling of heat extraction/injection, estimation of energy output and system efficiency, and assessment of environmental and economic performance. The course also addresses thermal energy storage, site suitability, and the opportunities and limitations of geothermal energy deployment in different contexts.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes

6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Describe geothermal energy and its applications CLO1.2 PLO 1.2. Identify the usage of geothermal energy in buildings CLO2.1 PLO 2.1 Explain the principles of geothermal energy for cooling CLO2.2 PLO 2.2 Analyze Environmental and economic considerations in geothermal energy application.
7. Brief list of topics to be covered	(see table below)
8. Any other information	**Course Assessment***

7. Brief list of topics to be covered

No	List of Topics	Contact Hours
1.	**Introduction to Geothermal Energy:** thermal structure of the earth, history of geothermal energy use, geothermal energy resources, applications of geothermal energy, fundamentals of thermodynamics, heat transfer, and fluid mechanics that are related to geothermal energy systems.	6
2.	**Background and Technologies**: components of geothermal energy systems such as heat pumps, heat exchangers, heating, ventilating, and air conditioning (HVAC) equipment and energy storage units.	6
3.	**Underground Thermal Energy Storage:** Common types of underground TES are described: soil and earth bed; borehole; aquifer; rock cavern; container/tank; and solar pond.	6
4.	**Geothermal Heating and Cooling:** heating in winter and cooling in summer, in partial or full manners. Geothermal energy as a heat source for electricity generation and heating.	9
5.	**Geothermal Well Systems**: Hydrothermal Systems, Geothermal Doublets, Enhanced-Geothermal-Systems, Hot-Dry-Rock Systems, Deep-Heat-Mining, Drilling Techniques for Deep Wellbores, Geophysical Methods, Exploration and Analysis.	6
6.	**Renewability and Sustainability of Geothermal Energy Systems:** Role of geothermal energy systems to play as a contributor to sustainable development.	6
7.	**Environmental Issues Related to Deep Geothermal Systems:** Advantages and disadvantages, limitations, worldwide status of geothermal resource utilization	6
Total		45

Course Assessment*

Activity	**Assessment% (Marks)**
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7170-ME-3	**Course Name**	Advanced Fluid Mechanics
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	2/1		
3. Course Instructor	Dr. Saleel		
4. Textbook, title, author, and year	**Textbook:** 1. Applied Fluid Mechanics (7th Edition) by Robert L. Mott, Joseph A. Untener (Pearson,2014), ISBN -0132558920 **a. Other supplemental materials:** 1. Advanced Engineering Fluid Mechanics, Muralidhar K and Biswas G, Narosa, Latest Edition. ISBN: 978-81-8487-385-6 2. Introduction to Fluid Mechanics, Robert F. W and McDonald T. A, John Wiley & Sons, Latest Edition. ISBN: 978-1-119-60376-4		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This graduate course provides an advanced treatment of fluid mechanics with emphasis on rigorous mathematical formulation and solution of fluid flow problems relevant to engineering applications. Students derive and manipulate the Navier–Stokes equations, apply them to internal and external flows, and analyze laminar, turbulent, steady, and unsteady regimes. Topics include boundary-layer theory, potential flow, turbulence modeling, and transient phenomena such as water hammer. Analytical methods, similarity solutions, and introductory numerical approaches are used to obtain velocity, pressure, and shear-stress distributions. The course strengthens students' ability to model, analyze, and interpret complex fluid flows using fundamental principles and modern computational tools.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Express governing equations of fluid motion CLO2.1 PLO 2.1 Apply Navier Stokes equations in different forms on flow between two plates, through pipes, and through annulus. CLO2.2 PLO 2.2 Calculate the flow properties for potential flow and unsteady flow.		
7. Brief list of topics to be covered			

No	List of Topics	Contact Hours
1.	**Basic concepts and fundamentals** (Definition and properties of fluids, Path Lines, Streamlines, and Stream Functions, Langragian and Eulerian description, Vorticity	6

		and Circulation.	
	2.	**Governing Equations of Fluid Motion** (Reynolds transport theorem, Integral and differential forms of governing equations: mass, momentum and energy conservation equations, Navier-Stokes equations, Euler's equation, Bernoulli's Equation).	6
	3.	**Navier Stokes Equations** (in Cartesian, cylindrical, and spherical coordinates, Couette flow, in pipes, between two plates)	6
	4.	**Potential flow** (Vorticity and circulation, Irrotational flow , source flow, sink flow, free vortex flow, superimposed flow patterns, source and sink pair, Doublet, flow over circular cylinder, source and sink pair in a uniform flow).	9
	5.	**Boundary layer** (Exact and approximate solution of laminar boundary layer, Turbulent boundary layer (approximate solution using 1/7 power velocity profile, pressure gradient in boundary layer flow, boundary layer separation and its control).	6
	6.	**Unsteady flow** (discharge with varying head, unsteady flow in pipes, variation of pressure wave in pipes (water hammer), surge tank).	6
	7.	**Turbulent flow** (Statistical Approach—One-Point Averaging, Zero-Equation Turbulent Models, One-Equation Turbulent Models, Two-Equation Turbulent Models, Stress-Equation Models, Equations of Motion in Fourier Space, Large Eddy Models)	6
		Total	45
8. Any other information	**Course Assessment***		

	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7171-ME-3	**Course Name**	Wind Energy
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	2/1		
3. Course Instructor	Dr. Sultan Alqahtani		
4. Textbook, title, author, and year	**Textbook:** 1 James F. Manwell, Jon G. McGowan, Anthony L. Rogers, Wind Energy Explained: Theory, Design and Application, 2nd Edition,2010, Wiley ISBN: 978-0-470-01500-1 2 Wind Energy, Mathematical Problems in Engineering. 2013; DOI 10.1155/2013/759686		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course develops the fundamental principles and quantitative methods needed to analyze and design wind energy systems. Using thermodynamics, fluid mechanics, and basic mechanical and electrical engineering concepts, students study wind resource assessment, aerodynamics of horizontal-axis wind turbines, rotor and drivetrain performance, and electrical power generation from wind. Emphasis is placed on the momentum theory and Betz limit, blade element/momentum concepts, power curve analysis, and estimation of energy yield. Students perform calculations of wind statistics, turbine output, and simple economic indicators, and review current standards and practices in wind energy engineering.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 State the theory of the amount of motion and mass survival. CLO1.2 PLO 1.2. Outline Betz limits of the power factor of turbines' horizontal axis. CLO2.1 PLO 2.1 Analyze the properties of wind near the surface of the earth. CLO2.2 PLO 2.2 Analyze electricity generation through wind energy.		
7. Brief list of topics to be covered	(see table below)		

No	List of Topics	Contact Hours
1.	Introduction.	6
2.	Types of wind turbines.	6
3.	Properties of wind near the surface of the earth.	6
4.	Theory of the amount of motion and mass survival.	6

	5.	Limits of the power factor of turbines' horizontal axis	6
	6.	Suction turbines and lifting turbines.	6
	7.	Using a plant to increase the extracted capacity.	6
	8.	Generating electricity.	3
		Total	45
8. Any other information	**Course Assessment***		

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7172-ME-3	**Course Name**	Finite Element Method
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	2/1		
3. Course Instructor	Prof. Irfan Anjum Magami		
4. Textbook, title, author, and year	**Textbook:** 1. Finite element analysis: theory and application with ANSYS by Saeed Moaveni (4th Edition, Pearson Prentice Hall, 2015), ISBN 10: 0133840808 **a. Other supplemental materials:** Introduction to the Finite Element Method, Fourth Edition by J. N. Reddy, (McGraw-Hill Education, 2019), ISBN: 9781259861901		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course introduces the theory and application of the finite element method (FEM) for solving engineering and scientific problems involving complex geometries and boundary conditions. Students learn how to formulate governing differential equations in weak/variational form, construct element shape functions, derive element stiffness and load matrices, assemble global systems, apply boundary conditions, and interpret numerical results. The course focuses on 1D and 2D elements for structural, thermal, and simple fluid-flow problems, and emphasizes error estimation, mesh refinement, and the use of FEM software to analyze realistic engineering systems		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Acquire a thorough understanding of finite element formulations CLO2.1 PLO 2.1 Evaluate the solution obtained through the finite element method. CLO2.2 PLO 2.2 Apply the finite element method to complex problems in thermal and fluid analysis CLO3.1 PLO 3.1 Demonstrate the solution strategy as applied to problems having complex geometry and boundary conditions.		
7. Brief list of topics to be covered			

No	List of Topics	Contact Hours
1.	Introduction to the Finite Element Method	3
2.	Linear and Non-Linear Shape Functions	6

	3.	Finite Element Formulations	6
	4.	1-Dimensional Element	6
	5.	2-Dimensional Element	6
	6.	3-Dimensional Element	6
	7.	FEM applied to Structural Problems	3
	8.	FEM applied to Thermal Problems	3
	9.	FEM applied to Fluid Flow Problems	3
		Total	45

8. Any other information	**Course Assessment***	
	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7173-ME-3</td><td>Course Name</td><td>Energy Conversion</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td>3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="3">2/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="3">Dr.Saad As-Shehrani</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="3">Textbook:
Frank Krieth and D. Yogi Goswami, editors. Handbook of Energy Efficiency and Renewable Energy. CRC Press, 2007
a. Other supplemental materials:
Ahmed F. Ghoniem, Energy Conversion Engineering: Towards Low CO2 Power and Fuels New Edition, Cambridge University Press; New edition (January 13, 2022)</td></tr>
<tr><td>5. Specific course information</td><td colspan="3">a. Brief description of the content of the course (catalog description)
This course introduces the scientific principles and quantitative methods underlying energy conversion from primary sources into useful forms such as electricity, heat, and mechanical work. Students examine thermal, electrical, chemical, and nuclear energy, and study key conversion technologies including heat engines, power plants, fuel cells, batteries, and emerging energy systems (e.g., EVs, LNG vehicles, biofuels). Emphasis is placed on applying thermodynamics, basic electrochemistry, and simple performance models to estimate efficiencies, energy balances, and emissions, and to compare different energy conversion pathways for industrial and societal applications.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="3">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td>English</td></tr>
<tr><td>Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="3">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Identify renewable energy sources
CLO2.1 PLO 2.1 Evaluate the principles of nuclear energy, solar energy, geothermal energy, wind, tides and waves power.
CLO2.2 PLO 2.2 Examine the electrochemistry of fuel cells and batteries
CLO3.1 PLO 3.1 Demonstrate the solution strategy as applied to problems having complex geometry and boundary conditions.</td></tr>
<tr><td>7. Brief list of topics to be covered</td><td colspan="3"><table>
<tr><th>No</th><th>List of Topics</th><th>Contact Hours</th></tr>
<tr><td>1.</td><td>Introduction to Energy Conversion and Energy Resources</td><td>6</td></tr>
<tr><td>2.</td><td>Basic Thermodynamics for Energy Conversion Enthalpy, Heat Capacities, Reactions, Entropy, T-S, Other Types of Cycles</td><td>6</td></tr>
<tr><td>3.</td><td>Thermal Energy Conversion Systems</td><td>6</td></tr>
</table></td></tr>
</table>

	4.	Renewable Energy Conversion Overview	6
	5.	Chemical-to-Thermal and Chemical-to-Electrical Conversion	6
	6.	Electric Energy Conversion and Power Systems Context	3
	7.	Advanced and Emerging Energy Conversion Technologies	3
	8.	Environmental and Sustainability Assessment of Energy Conversion	3
	9.	Economic considerations and Environmental issues of Energy Conversion	3
	10	Integrative Analysis and Case Studies	3
		Total	45
8. Any other information	**Course Assessment***		

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7174-ME-3	**Course Name**	Energy Storage Systems
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	2/1		
3. Course Instructor	Dr. Saleel		
4. Textbook, title, author, and year	**Textbook:** Energy Storage: Fundamentals, Materials and Applications, Authors: Huggins, Robert, Springer International Publishing, 2016, Hardcover ISBN: 978-3-319-21238-8 **a. Other supplemental materials:** Engineering Energy Storage, OdneStokke Burheim,2017, Academic Press, eBook ISBN:9780128141014		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course introduces the scientific principles and engineering applications of energy storage technologies across thermal, mechanical, electrochemical, and hydrogen systems. Students study sensible heat, latent heat (phase change), thermochemical storage, flywheels, compressed air, and heat pumps, as well as electrochemical storage (batteries, redox flow batteries, supercapacitors) and hydrogen production, storage, and use. Emphasis is placed on quantitative performance analysis (energy density, power density, round trip efficiency, capacity, lifetime, and cost), and on evaluating technology suitability for different temperature ranges and applications, including transport. Case studies (e.g., Denmark) are used to assess the role of energy storage in low carbon energy systems and local contexts.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes

6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Discuss the application of thermal and mechanical energy CLO2.1 PLO 2.1 Compare advantages and disadvantages of different energy storage systems applied in a practical situation and compare the engineering problems in the real world CLO2.2 PLO 2.2 Apply sensible heat storage systems used for diurnal and interpersonal thermal energy storage CLO3.1 PLO 3.1 Assess potential of energy storage in the local context given case studies from the exemplar of the leading country, Denmark CLO3.2 PLO 3.2 Justify the role of electrical, bio-fuel, hydrogen, liquid air and flywheels in energy storage for transportation.
7. Brief list of topics to be covered	

No	List of Topics	Contact Hours
1.	Introduction.	6
2.	Thermal and Mechanical energy: flywheels, compressed air, heat pumps, vacuum solar thermal collector	6
3.	Thermal and Mechanical energy: thermo-chemical for application at different temperatures.	6
4.	Thermal and Mechanical energy: phase change materials for application at different temperatures.	6
5.	Electrochemical: Introduces students to the fundamental aspects of electrochemistry in order to differentiate between various types of batteries	3
6.	Electrochemical: to understand the working principles of flow redox batteries and supercapacitors.	3
7.	Electrochemical: to understand the working principles of supercapacitors.	3
8.	Hydrogen: Describes the advantages and limitations of hydrogen	3
9.	Hydrogen: Describes the roles of hydrogen in today's economy and in the future.	3
10	Hydrogen: describe the technologies for the production, storage and use of hydrogen. Finally the safety considerations are outlined.	3
11	Hydrogen: describe the safety considerations used for the production, storage and use of hydrogen	3
Total		45

8. Any other information

Course Assessment*

Activity	**Assessment% (Marks)**
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7175-ME-3	**Course Name**	Electrical Systems Related To Renewable Energy
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	2/1		
3. Course Instructor	Dr. Sultan Alqahtani		
4. Textbook, title, author, and year	**Textbook:** Electric Renewable Energy Systems. 1st Edition. Authors: Muhammad Rashid. eBook ISBN: 9780128006368. Paperback ISBN: 97801280404838 **a. Other supplemental materials:** Aldo Da Rosa, Fundamentals of Renewable Energy Processes, Elsevier Academic Press, 2005		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** Learn about Sources of renewable energy, Fundamentals of wind, wave, Solar thermal and photovoltaic, Hydraulic energy Selection and sizing of systems components, Technology of renewable energies Management and evaluation of the profitability of renewable energy projects and companies Common electrical renewable generation schemes; interfacing renewable energy to existing grid-connected power, Electrical Equipment and Systems, Detailed consideration of photovoltaic inverter battery systems, Design aspects of renewable electrical energy systems, Integration of renewables into the grid.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Identify the energy supply and demand, need for more energy CLO1.2 PLO 1.2. Discuss the cost and environmental impact of various Renewable energy sources (hydro, solar, wind, tidal, waves) CLO2.1 PLO 2.1 Construct power converter topologies for solar and wind. CLO3.1 PLO 3.1 Choose power quality and safety code for solar and wind systems.		
7. Brief list of topics to be covered			

No	List of Topics	Contact Hours
1.	Sources of renewable energy, Fundamentals of wind, Wave, Solar thermal and photovoltaic, Hydraulic energy, Electrical conversion system	6

	2.	Selection and sizing of systems components, Technology of renewable energies (solar, wind, hydroelectricity, Fuel cells, Geothermal), Management and evaluation of the profitability of renewable energy projects and companies	9
	3.	Common electrical renewable generation schemes; interfacing renewable energy to existing grid-connected power, single phase, three phase supply, circuits and power transformers.	6
	4.	Renewable energy Generators, and control, AC-DC converters, DC-DC converters, power transmissions and power systems.	6
	5.	Design aspects of renewable electrical energy systems: phases, fault analysis, flow study and system stability.	6
	6.	Control of photovoltaic technology: Power point tracking, PV characteristics, mode of operation of PV system	6
	7.	Integration of renewable energy systems into the grid: power generation, voltage control, power quality, regulations for connection.	6
		Total	45
8. Any other information	**Course Assessment***		

	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7176-ME-3</td><td>Course Name</td><td colspan="2">Energy Policy, Planning And Sustainable Development</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">2/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr.Ali Alqahtani</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
Understanding Energy and Energy Policy Dec 9, 2014 by Timothy F. Braun and Lisa M. Glidden
Energy Policy Analysis: A Conceptual Framework, Nov 15, 2012 by Michael S Hamilton
a. Other supplemental materials:
Energy Management Systems, Operation and Control of Electric Energy Transmission Systems Authors: Handschin, Edmund, Petroianu, Alexander, 1991</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course examines how energy policy, planning, and markets shape sustainable development at national and global levels. Students study the structure and operation of electricity and fuel markets, policy instruments (tariffs, subsidies, standards, carbon pricing), and regulatory frameworks for conventional and renewable energy. Emphasis is placed on quantitative evaluation of policy impacts using basic economic, environmental, and energy-system metrics (e.g., prices, costs, emissions, access, and reliability). Through case studies, students analyze the links between energy policy, economic development, environment, and social welfare, with particular reference to sustainable development goals.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Identify the need of good energy policy
CLO2.1 PLO 2.1 Evaluate the Cost and environmental impact of Power Conversion.
CLO2.2 PLO 2.2 Determine the compliance with power quality and safety code for solar and wind systems.</td></tr>
<tr><td rowspan="3">7. Brief list of topics to be covered</td><td>No</td><td colspan="2">List of Topics</td><td>Contact Hours</td></tr>
<tr><td>1.</td><td colspan="2">Introduction.</td><td>3</td></tr>
<tr><td>2.</td><td colspan="2">Energy policy and its importance</td><td>6</td></tr>
</table>

	3.	Evaluation of sound energy policies	6
	4.	Evaluation of energy policy on human life.	6
	5.	Renewable energy policy	6
	6.	Electricity markets and policies	6
	7.	Why Economics Matters, Global Oil & Gas Markets	6
	8.	Energy policy and sustainable development	3
	9.	Energy policy and environment	3
		Total	45
8. Any other information	**Course Assessment***		

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7177-ME-3</td><td>Course Name</td><td colspan="2">Computational Fluid Dynamics</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">3/2</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr. Ahamad Saleel</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
▪ Sreenivas Jayanti, Computational Fluid Dynamics for Engineers and Scientists, Springer Netherlands, Hardcover ISBN 978-94-024-1215-4, 2018
▪ Atul Sharma, Introduction to Computational Fluid Dynamics: Development, Application and Analysis, Print ISBN:9781119002994, Wiley, 2017
a. Other supplemental materials:
▪ JiyuanTu Guan HengYeoh Chaoqun Liu, Computational Fluid Dynamics, 3rd Edition, A Practical Approach, Elsevier, 2018
▪ John F, Wendt, Computational Fluid Dynamics: An Introduction, Von Karman Institute Book, Springer; 3rd ed. 2009</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course introduces the theory and practice of Computational Fluid Dynamics (CFD) for simulating fluid flow and heat transfer in engineering systems. Students review the governing equations (conservation of mass, momentum, and energy), their discretization using finite-volume/finite-difference methods, and common spatial and temporal schemes. Emphasis is placed on grid generation, numerical stability and convergence, turbulence modeling, and verification and validation. Students “learn by doing” through programming simple CFD solvers and by using commercial software (e.g., ANSYS Fluent) to set up, run, and post-process simulations of practical problems, with attention to best practices and ethical use of CFD results.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO2.1 PLO 2.1 Employ theoretical knowledge gained into the practical use of commercial CFD codes and software
CLO2.2 PLO 2.2 Utilize state-of-the-art information technology and mathematical/statistical post-processing tools to interpret and communicate the CFD results
CLO3.1 PLO 3.1 Judge the use of CFD to solve engineering problems
CLO3.2 PLO 3.2 Evaluate reliable computational methodology for solving complex fluid flow and heat transfer problems.</td></tr>
</table>

7. Brief list of topics to be covered	**No**	**List of Topics**	**Contact Hours**
	1.	Introduction: Governing differential equations; Nature of coordinates; Discretization methods – Four basic rules – Aspects of numerical dissipation and dispersion – Artificial viscosity - Control volume formulation	3
	2.	Heat conduction problems; Steady and unsteady one-dimensional conduction – Multi-dimensional situations – Use of over relaxation and under relaxation – Geometric considerations and other coordinate systems – Source tern linearization – Irregular geometries.	9
	3.	Convection and diffusion: Solution of steady, one-dimensional, and multi-dimensional problems – One-way coordinates and false diffusion – Vorticity based methods – Staggered grid - Pressure and velocity corrections	6
	4.	The solution of Navier-Stokes equations for incompressible flows - SIMPLE and SIMPLER algorithms - Numerical methods for compressible flow equations – Solution of the transonic full potential equation –Unsteady transonic potential flow and Euler equations.	6
	5.	Numerical methods for boundary layer type equations – Inverse methods, separated flows, and viscous-inviscid interaction – Methods for internal flows and application to free-shear flows	9
	6.	Solving three-dimensional and unsteady boundary layers – Turbulent flow models and calculations –Modern developments in grid generation and finite-volume mesh generation	6
	7.	Automatic grid generation for complex geometry problems – Unstructured meshes and adaptive grids – Introduction to modern CFD relevant to supercomputers and parallel processors	6
		Total	45

8. Any other information	**Course Assessment***	
	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7178-ME-3</td><td>Course Name</td><td colspan="2">Optimization of Energy Systems</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">2/1</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr. Ali Anqi</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
Essentials of Thermal System Design and Optimization, Prof. C. Balaji, Aue Books, New Delhi in India and CRC Press in the rest of the world.
Design and optimization of thermal systems, Y.Jaluria, Mc Graw Hill, 1998.</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course introduces the theory and practice of optimization for energy systems. Students learn how to formulate mono- and multi-objective engineering optimization problems, select and apply appropriate optimization algorithms, and couple optimizers with simulation models of energy systems. Emphasis is placed on mathematical problem formulation (decision variables, constraints, objectives), local vs. global optimization methods, multi-objective trade-off analysis, robustness under uncertainty, and surrogate modeling to reduce computational cost. Students use numerical tools to optimize the design and operation of representative energy systems and communicate their results in a professional technical format.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Required</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO2.1 PLO 2.1 To formulate an optimization problem (mono-objective and multi-objective multi-parameter engineering optimization problem.
CLO2.2 PLO 2.2 Practice an appropriate optimizer (local vs global methods) for single or multi-objective problems.</td></tr>
<tr><td>7. Brief list of topics to be covered</td><td colspan="4"><table><tr><th>No</th><th>List of Topics</th><th>Contact Hours</th></tr><tr><td>1.</td><td>Introduction to Optimization in Energy Systems</td><td>3</td></tr><tr><td>2.</td><td>Mathematical Formulation of Optimization Problems</td><td>6</td></tr><tr><td>3.</td><td>Unconstrained and Constrained Optimization Methods</td><td>6</td></tr><tr><td>4.</td><td>Local vs. Global Optimization Algorithms</td><td>6</td></tr><tr><td>5.</td><td>Multi-Objective Optimization and Trade-Off Analysis</td><td>6</td></tr></table></td></tr>
</table>

	6.	Handling Uncertainty and Robust Optimization (Introductory)	6
	7.	Surrogate Modeling and Reduced-Order Models	3
	8.	Simulation–Optimization Frameworks for Energy Systems	3
	9.	Implementation Tools and Case Studies	3
	10.	Mini-Project and Reporting	3
		Total	45
8. Any other information	**Course Assessment***		

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7179-ME-3</td><td>Course Name</td><td>Advanced Mathematics</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td>3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="3">3/2</td></tr>
<tr><td>3. Course Instructor</td><td colspan="3">Dr. Irfan Anjum Magami</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="3">Textbook:
Erwin Kreyszig Advanced Engineering Mathematics 10th Edition, Wiley; 10th edition (August 16, 2011)
a. Other supplemental materials:
▪ Stephen Andrilli& David Hecker : Elementary Linear Algebra, Third Edition, Academic Press, 2003.
▪ W. W. Bell: Special Functions for Scientists and Engineers, Dover Publications, 2004.
▪ Sokolnikoff and Redheffer – Mathematics of Physics and Engineering. 2nd edition McGraw Hill,1967.
▪ Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill International</td></tr>
<tr><td>5. Specific course information</td><td colspan="3">a. Brief description of the content of the course (catalog description)
This course develops advanced mathematical tools required for modeling and solving engineering and physical problems. Topics include key concepts in linear algebra (vector spaces, matrices, eigenvalues/eigenvectors), classification and solution methods for second-order partial differential equations (wave, heat, and Laplace equations), and an introduction to tensor calculus for continuum mechanics and field theories. Emphasis is placed on formulating engineering problems as mathematical models, applying analytical solution techniques (e.g., separation of variables, Fourier series, eigen function expansions), and using symbolic/numerical software to support analysis and visualization.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="3">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td>English</td></tr>
<tr><td>Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="3">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Define mathematical terms in linear algebra
CLO1.2 PLO 1.2. Explain different methods to solve Partial differential equations
CLO2.1 PLO 2.1 Apply different methods to solve second order PDE
CLO2.2 PLO 2.2 Practice operations with tensors.</td></tr>
<tr><td>7. Brief list of topics to be covered</td><td colspan="3">
<table>
<tr><th>No</th><th>List of Topics</th><th>Contact Hours</th></tr>
<tr><td>1.</td><td>Linear Algebra:Vector spaces, Basis, Dimension, Inner product spaces, Gram-Schmidth Process, Linear Transformations, Range and Kernel, Isomorphism, Matrix of transformations and Change of Basis.</td><td>11</td></tr>
</table>
</td></tr>
</table>

	2.	Series Solutions of ODE and Sturm-Liouville Theory: Power series solutions about ordinary point, Legendre equation and Legendre polynomials, Solutions about singular points; The method of Frobenius, Bessel equation and Bessel Functions. Sturm-Liouville problem and Generalized Fourier series.	11
	3.	Partial Differential Equations: First order PDEs, Linear equations, Lagrange method, Cauchy method, Charpits method, Jacobi method. Second order PDEs, Classifications, Formulation and method of solutions of Wave equation, Heat equation and Laplace equation.	12
	4.	Tensor Calculus: Line, area and volume integrals, Spaces of N-dimensions, coordinate transformations, covariant, contravariant and mixed tensors, fundamental operation with tensors, Quotient Law the line element and metric tensor, conjugate tensor, Christoffel's symbols, covariant derivative.	11
		Total	45

8. Any other information	**Course Assessment***	
	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7180-ME-3</td><td>Course Name</td><td colspan="2">Economic Aspects of Renewable Energy</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">4/2</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr. Ali Alqahtani</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
Kaltschmitt, Martin; Streicher, Wolfgang; Wiese, Andreas; (2007). Renewable Energy: Technology, Economics, and Environment. New York, NY. Springer BerlinHeidelberg
a. Other supplemental materials:
Komor, Paul, (2004). Renewable Energy Policy. Lincoln, NE. iUniverse, Inc.
Abdelhamid, Lilia; Bahmed, Lylia; Benoudjit, Azzeddine," Impact of renewable energies - environmental and economic aspects",Management of Environmental Quality; Bradford Vol. 23, Iss. 1, (2012).</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course examines the economic, environmental, and policy dimensions of renewable energy systems. Students learn to quantify energy outputs and costs; apply financial and economic evaluation tools (e.g., levelized cost of energy, net present value); and compare renewable options with conventional energy systems. The course integrates basic energy principles, technology characteristics, environmental impacts, and risk/uncertainty into economic decision-making. Emphasis is placed on using data and simple models to evaluate, compare, and select renewable energy projects under technical, economic, regulatory, and sustainability constraints.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Explain energy principles and how they relate to using renewable energy sources
CLO2.1 PLO 2.1 Analyze economic issues around renewable energy sources.
CLO2.2 PLO 2.2 Evaluate, assess and illustrate energy systems based on economic and environmental considerations.
CLO3.1 PLO 3.1 Justify the environmental impact and safety of each source of renewable energy.</td></tr>
<tr><td rowspan="2">7. Brief list of topics to be covered</td><td>No</td><td colspan="2">List of Topics</td><td>Contact Hours</td></tr>
<tr><td>1.</td><td colspan="2">Introduction: Overview of Economic Aspects of Renewable</td><td>3</td></tr>
</table>

		Energy systems	
	2.	Energy mathematics and basics for each type of renewable energy	6
	3.	Economics and environmental factors of each type of energy	6
	4.	Cost Components of Renewable Energy Systems	3
	5.	Time Value of Money and Project Cash Flow Analysis	6
	6.	Levelized Cost of Energy (LCOE) and Cost Indicators	6
	7.	Economic and Policy Instruments for Renewables	3
	8.	Environmental and Safety Aspects in Economic Evaluation	3
	9	Technology Specific Economic Characteristics	3
	10	Uncertainty and Sensitivity Analysis	3
	11	Ethical and Professional Issues in Renewable Energy Economics	3
		Total	45
8. Any other information	**Course Assessment***		

	Activity	Assessment% (Marks)
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7181-ME-3	**Course Name**	Energy Comfort in Buildings
2. Credit hours	3	**Contact hours**	3L = 3 per week
Level / Year	3/2		
3. Course Instructor	Dr.Salem Algarni		
4. Textbook, title, author, and year	**Textbook:** Energy Efficient Buildings, ISBN 978 – 51- 2875 – 5, Publisher: In Tech, 2017 **a. Other supplemental materials:** List Essential References Materials (Journals, Reports, etc.) Chen, Olivia , 2008,"Bamboo – Veiled Dormitory by Architecture BRIO", Inhabitat, Retrieved 2009. -Journal of Energy Comfort in Buildings		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This course introduces the principles and quantitative methods needed to analyze energy use and comfort in buildings. Students learn how to characterize building energy consumption, calculate thermal and electrical loads, and evaluate energy efficiency measures in HVAC and lighting systems. The course covers indoor thermal comfort concepts, building envelope performance, refrigeration and air-conditioning efficiency, lighting design, power factor, and basic economic analysis of energy use. Students use simple models and digital tools to estimate energy demand, optimize operating costs under different tariffs, and assess energy-saving options while maintaining occupant comfort.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Elective	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes
6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Comprehend the energy consumption in a building CLO2.1 PLO 2.1 Estimate the optimum cost of energy consumption. CLO2.2 PLO 2.2 Evaluate energy saving in refrigeration, air- conditioning and lighting processes.		

7. Brief list of topics to be covered

No	List of Topics	Contact Hours
1.	Introduction to Energy Use and Comfort in Buildings	3
2.	Building Envelope and Heat Transfer.	6
3.	Thermal Load Estimation	6
4.	HVAC Systems, Refrigeration, and Energy Efficiency	6
5.	Lighting Systems and Energy Use.	6
6.	Electrical Demand, Power Factor, and Load Profiles.	6
7.	Economic loading and operation of generation units.	6
8.	Use energy saving policies and use high economic	3

		equipment's and improve heat transfer processes.	
	9.	Tools for Building Energy Assessment	3
	Total		45
8. Any other information	**Course Assessment***		

	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7182-ME-3</td><td>Course Name</td><td colspan="2">Environmental Pollution</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">4/2</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr. Yunus Tatagar</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
Friis, Robert H. Essentials of Environmental Health. Jones and Bartlett, Inc., Sudbury, MA. ISBN No. 0-7637-4762-9.
a. Other supplemental materials:
Hill, Marquita K., Understanding Environmental Pollution, 2nd Edition. Cambridge University Press, Cambridge, UK. ISBN No. 0-5218-2024-3</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course introduces the scientific and engineering principles of environmental pollution, focusing on air, water, and soil contamination. Students examine sources and types of pollutants, transport and transformation processes, and dispersion mechanisms in the atmosphere and aquatic/terrestrial environments. Quantitative tools such as mass balances, simple dispersion models, and concentration–dose relationships are used to assess pollution levels and compare them with standards and guidelines. The course also reviews control technologies, remediation strategies, and relevant regulations, emphasizing environmental risk, public health, and professional responsibility in pollution prevention and control.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td colspan="2">English</td></tr>
<tr><td>Hardware/software usage</td><td colspan="2">For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Identify the Types of pollutants
CLO1.2 PLO 1.2. Employ the emerging technologies in different tasks to control environmental pollution
CLO2.1 PLO 2.1 Based on published literature, assess the pollution levels in comparison to those in international standards
CLO2.2 PLO 2.2 Identify pollutants, their sources, and vision in order to mitigate their negative effects.</td></tr>
<tr><td rowspan="2">7. Brief list of topics to be covered</td><td>No</td><td colspan="2">List of Topics</td><td>Contact Hours</td></tr>
<tr><td>1.</td><td colspan="2">Introduction to Environmental Pollution and Environmental Media</td><td>3</td></tr>
</table>

	2.	Types and Sources of Pollutants	6
	3.	Mass Balance and Fate and Transport Concepts	6
	4.	Air Pollution and Atmospheric Dispersion	6
	5.	Water Pollution and Mixing	3
	6.	Soil and Land Pollution	3
	7.	Pollution Control Technologies and Strategies	6
	8.	Environmental Regulations, Standards, and Guidelines	6
	9.	Risk, Health, and Impact Assessment Basics	3
	10.	Emerging Technologies and Pollution Prevention	3
		Total	45
8. Any other information	**Course Assessment***		

	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7183-ME-3</td><td>Course Name</td><td>Energy Management</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td>3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="3">4/2</td></tr>
<tr><td>3. Course Instructor</td><td colspan="3">Dr.Saleel</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="3">Textbook:
Energy Management Principles (Second Edition) , Applications, Benefits, Savings, Craig B. Smith and Kelly E. Parmenter ,ISBN: 978-0-12-802506-2
a. Other supplemental materials:
Guide to Energy Management, Seventh Edition 7th Edition by Barney L. Capehart Ph.D. CEM , Wayne C. Turner Ph.D. PE CEM , William J. Kennedy Ph.D. PE</td></tr>
<tr><td>5. Specific course information</td><td colspan="3">a. Brief description of the content of the course (catalog description)
This course introduces the principles, methods, and quantitative tools of energy management in buildings, industry, and infrastructure. Students learn how to characterize energy use in systems, construct energy balances, identify losses, and propose conservation measures. Topics include energy resources and conversion processes, energy auditing, efficiency improvement technologies, materials and systems for energy conservation and storage, and the environmental impacts of energy use (pollutants and greenhouse gases). Emphasis is placed on using data, simple models, and economic analysis to evaluate the technical and financial viability of energy management options, while considering their societal and environmental implications.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="3">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="3">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td>Language of instruction</td><td>English</td></tr>
<tr><td>Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="3">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Discuss the importance of managing energy
CLO2.1 PLO 2.1 Use low energy principles for domestic buildings and design.
CLO2.2 PLO 2.2 Apply environmental methods, energy efficiency and requirements for zero carbon homes and buildings.</td></tr>
<tr><td>7. Brief list of topics to be covered</td><td colspan="3">
<table>
<tr><th>No</th><th>List of Topics</th><th>Contact Hours</th></tr>
<tr><td>1.</td><td>Introduction to Energy Management and Conservation</td><td>3</td></tr>
<tr><td>2.</td><td>Principles and Organization of Energy Management</td><td>6</td></tr>
<tr><td>3.</td><td>Energy Auditing Methods</td><td>6</td></tr>
<tr><td>4.</td><td>Methods for evaluation of large and complex energy</td><td>6</td></tr>
</table>
</td></tr>
</table>

		systems and Energy system modeling.	
	5.	Understanding about Energy and user behavior	6
	6.	Energy Economics	3
	7.	Energy portfolio sustainability management	6
	8.	Business logics in modern energy systems	3
	9.	Environmental and Regulatory Aspects of Energy Management	3
	10.	Integrated Energy Management Plan	3
		Total	45
8. Any other information	**Course Assessment***		

Activity	Assessment% (Marks)
Mid Exams (Mandatory)	40% (40 Marks)
Quiz (Blackboard)	15% (15 Marks)
Project/Assignment/ Reports	15% (15 Marks)
Final Exam	30% (30 Marks)
Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

<table>
<tr><td>1. Course Number</td><td>7184-ME-3</td><td>Course Name</td><td colspan="2">Desalination</td></tr>
<tr><td>2. Credit hours</td><td>3</td><td>Contact hours</td><td colspan="2">3L = 3 per week</td></tr>
<tr><td>Level / Year</td><td colspan="4">4/2</td></tr>
<tr><td>3. Course Instructor</td><td colspan="4">Dr.Ali Anqi</td></tr>
<tr><td>4. Textbook, title, author, and year</td><td colspan="4">Textbook:
• Advances in Water Desalination, Noam Lior, ISBN:9780470054598, John Wiley & Sons, Inc. 2013
• Introduction to Desalination Systems, Processes, and Environmental Impacts, Fuad Nesf Alasfour, ISBN: 9783527811618, Wiley-VCH, 2020
a. Other supplemental materials:
Emerging Technologies for Sustainable Desalination Handbook, Veera Gnaneswar Gude, Butterworth-Heinemann, ISBN 978-0-12-815818-0, 2018
Desalination Engineering: Operation and Maintenance, NikolayVoutchkov, McGraw-Hill Education, 2014</td></tr>
<tr><td>5. Specific course information</td><td colspan="4">a. Brief description of the content of the course (catalog description)
This course covers the theory and practice of major desalination technologies, including thermal processes (multistage flash, multiple-effect, vapor compression) and membrane processes (reverse osmosis, nanofiltration, membrane distillation). Students apply thermodynamics, mass and energy balances, and transport principles to model and evaluate desalination systems, estimate performance indicators (recovery ratio, specific energy consumption, gain output ratio), and perform basic economic comparisons. Environmental and sustainability aspects (brine management, energy use, integration with renewables) are also addressed, and simple computational tools are used for process calculations and performance analysis.</td></tr>
<tr><td>b. Prerequisites</td><td colspan="4">Nil</td></tr>
<tr><td>Co-requisites</td><td colspan="4">Nil</td></tr>
<tr><td rowspan="2">c. Required, Elective, or Selected elective</td><td rowspan="2">Elective</td><td colspan="2">Language of instruction</td><td>English</td></tr>
<tr><td colspan="2">Hardware/software usage</td><td>For Blackboard, online quizzes</td></tr>
<tr><td>6. Specific goals for the course</td><td colspan="4">a. Specific outcomes of instruction
By the completion of the course the student should be able to:
CLO1.1 PLO 1.1 Describe the principle work of various desalination systems.
CLO2.1 PLO 2.1 Compare alternative methods of desalination.
CLO2.2 PLO 2.2 Choose the appropriate desalination technology for a specified application.
CLO3.1 PLO 3.1 Assess the behavior and mechanism of various desalination systems.</td></tr>
<tr><td>7. Brief list of topics to be</td><td colspan="4">No | List of Topics | Contact</td></tr>
</table>

covered			Hours
	1.	Need for desalination, Composition of seawater, classification of desalination systems	3
	2.	Desalination using renewable energy Sources Solar stills	6
	3.	Humidification dehumidification (HDH) systems	6
	4.	Single effect evaporation, process modeling (single effect, vapor compression both thermal; TVC, and mechanical; MVC)	6
	5.	Multiple effect evaporation, process modeling	6
	6.	Mass and Energy Balances in Desalination Systems	6
	7.	Process Design Parameters and Performance Metrics	3
	8.	Reverse Osmosis	3
	9.	Membrane Distillation	3
	10	Economic Analysis	3
		Total	45

8. Any other information	**Course Assessment***	
	Activity	**Assessment% (Marks)**
	Mid Exams (Mandatory)	40% (40 Marks)
	Quiz (Blackboard)	15% (15 Marks)
	Project/Assignment/ Reports	15% (15 Marks)
	Final Exam	30% (30 Marks)
	Total	100% (100 Marks)

Mechanical Engineering Department

COURSE DESCRIPTION

1. Course Number	7185-ME-3	**Course Name**	Project
2. Credit hours	6	**Contact hours**	6L = 6 per week
Level / Year	3-4/2		
3. Course Instructor	Depends on topic		
4. Textbook, title, author, and year	**Textbook:** Energy Management Principles (Second Edition) , Applications, Benefits, Savings, Craig B. Smith and Kelly E. Parmenter ,ISBN: 978-0-12-802506-2 **a. Other supplemental materials:** Guide to Energy Management, Seventh Edition 7th Edition by Barney L. Capehart Ph.D. CEM , Wayne C. Turner Ph.D. PE CEM , William J. Kennedy Ph.D. PE		
5. Specific course information	**a. Brief description of the content of the course (catalog description)** This capstone course requires students to plan and execute an independent research or design project in the field of renewable energy and environment. Under faculty supervision, students identify a research problem or design challenge, review relevant literature, formulate research questions or design specifications, and develop appropriate experimental, analytical, and/or computational methodologies. The project involves data collection or model development, analysis and interpretation of results, and integration of engineering standards, sustainability principles, and realistic constraints (technical, economic, environmental, and societal). Students document their work in interim reports and a final written thesis/report, and defend their findings in an oral presentation, demonstrating readiness for professional practice or further study.		
b. Prerequisites	Nil		
Co-requisites	Nil		
c. Required, Elective, or Selected elective	Required	**Language of instruction**	English
		Hardware/software usage	For Blackboard, online quizzes

6. Specific goals for the course	**a. Specific outcomes of instruction** *By the completion of the course the student should be able to:* CLO1.1 PLO 1.1 Acquire thorough knowledge in the application of mathematical and scientific principles of the research area CLO1.2 PLO 1.2. Identify an area to pursue research and gain competency in professional practice. CLO2.1 PLO 2.1 Apply theoretical knowledge and practical skills to create novel and innovative solutions. CLO2.2 PLO 2.2 Compare the significant contributions in contemporary literature and to employ research techniques for the analysis of complex issues. CLO3.1 PLO 3.1 Work autonomously and on multidisciplinary teams and to demonstrate management and leadership capabilities. CLO3.2 PLO 3.2 Judge ethical issues and have a professional approach/modify the code of practice in solving engineering issues on the basis of sound principles and values.

7. Brief list of topics to be covered

No	List of Topics	Contact Hours
1.	Choose a topic and formulate a specific research question	10
2.	Collecting the required information (theoretical and experimental) for the research problem	12
3.	Preparation of preliminary experiments or formulating the required mathematical and/or the computational models	12
4.	Incorporation of engineering standards, realistic constraints, and other design considerations	11
5.	Preparing periodical reports that include an introduction about the project, its objectives, description of the experimental, mathematical, and/or computational models, and the obtained preliminary results	10
6.	Conducting experiments, running and implementing the mathematical and/or the computational models	12
7.	Analysis of the results and writing a complete final report	12
8.	Communication and publication of the work	11
	Total	90

8. Any other information

Course Assessment*

Activity	**Assessment% (Marks)**
Semester work	40% (40 Marks)
Report	25% (25 Marks)

	Oral Presentation Article preparation for publication in the Journal Total	25% (25 Marks) 10% (10 Marks) 100% (100 Marks)