Date: November 11, 2021

R E S U M E

1. PERSONAL DETAILS

Full Name: Bourhan Tashtoush
Date and place of birth: 04.05.63 JORDAN
Marital status: Married
Phone numbers: 00962797667178
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- https://www.researchgate.net/profile/Bourhan_Tashtoush
- https://scholar.google.com/citations?user=ly31pmUAAAAJ&hl=en
- Tashtoush, Bourhan - Author details - Scopus
- Stanford University World's Top 2% Scientists. http://dx.doi.org/10.17632/btchxktzyw

2. ACADEMIC DEGREES

Ph.D. 1995, Mechanical Engineering, Concordia University, Montreal, Canada
MSc. 1991, Mechanical Engineering, University of Jordan, Amman, Jordan
MSc 1987, Mechanical Engineering, Odesa Academy of Refrigeration, Odesa, Ukraine

3. ACADEMIC APPOINTMENTS

1. Sept. 2021-Present-Profssor, JUST, Jordan
2. Nov. 2020- Sept. 2021- Dean, Faculty of Engineering, Sohar University, Oman
3. Dec. 2018-August 2020, Head Energy Systems and Renewables, GORD Institute, GORD
4. 2018-2020- Member of Al-Hussain Bin Tala University Board of Trustees- Jordan
5. Sept. 2018-Dec. 2018, Visiting Professor, Mechanical Engineering, TUB-Germany
6. Sept. 2011-August 2018, Professor, Mechanical Engineering, JUST-Jordan
7. Sept. 2009-August 2011, Visiting Professor, Mechanical Engineering, KFUPM- Saudi Arabia
8. Sept. 2008-August 2009, Visiting Professor, Mechanical Engineering, METU NCC-Cyprus
9. June 2006-August 2008, Professor, Mechanical Engineering, JUST-Jordan
10. Sept. 2002-May 2006, Associate Professor, Mechanical Engineering, JUST-Jordan
11. Sept. 2001-August 2002, Associate Professor, Mechanical Engineering, ASU-Jordan
12. May 2000-August 2001, Associate Professor, Mechanical Engineering, JUST-Jordan
13. January 1995-April 2000, Assistant Professor, Mechanical Engineering, JUST-Jordan

4. PROFESSIONAL EXPERIENCE (outside academia)

1. Dec 2018-August 31, 2020, Head Energy Systems and Renewables, GORD-Qatar
2. 2005-2015, Freelance consultant for GASCO and ADNOC, Trainer
3. 2002-2006, Consultant at JORDASHE Factory at Al-Hasan Industrial Zone in Jordan
4. 1998-2001, Senior Mech. Eng.- KAHP-JUST-Jordan

5. RESEARCH INTERESTS

Solar heating and cooling, absorption and ejector systems, Refrigeration and air conditioning in residential and commercial buildings, Renewable Energy, Energy Conversion, , Refrigeration and water chillers, Dynamic modeling of HVAC systems, Thermodynamics/Fluid Mechanics, New refrigerant mixtures and Nano refrigerants, Energy and Environmental Management, Solar ejector cooling and Organic Rankine Cycle, PV and PVT systems, Hybrid solar refrigeration systems with TEG and TEC, Transcritical refrigeration cycles, exergy and exergoeconomic analysis of refrigeration systems, Thermal storage systems, evaporative cooling technology, and buildings air conditioning systems.

6. TEACHING EXPERIENCE

1. Energy Conversion, Undergraduate
2. Renewable and Sustainable Energy, Undergraduate,
3. Solar Energy, Undergraduate
4. Fluid mechanics, Undergraduate
5. Thermodynamic, Undergraduate
6. Building Mechanical Systems, Undergraduate
7. Engineering Mechanics (Statics and Dynamics), Undergraduate
8. Introduction to Mechanical Engineering, Undergraduate
9. Engineering Drawing, Undergraduate
10. Applied Engineering Mathematics, Undergraduate
11. Compressible Fluid Flow, Undergraduate
12. Solar Energy and application, Undergraduate
13. Numerical Engineering Analysis, Undergraduate
14. Heat and Mass Transfer, Undergraduate
15. Heat Transfer Laboratory, Undergraduate
16. Gas Turbine Theory, Undergraduate
17. Refrigeration and HVAC systems, Undergraduate
18. Flight Stability and Control, Undergraduate
19. Mechanical and HVAC Systems for Architects, Undergraduate
20. Refrigeration, Undergraduate
21. Solar Systems Design, Graduate
22. Design of Thermal Systems, Graduate
23. HVAC Systems Design for Architects, Graduate
24. Advanced Engineering Mathematics, Graduate
25. Advanced Engineering Mathematics for Mechatronics, Graduate
26. Intermediate Heat Transfer, Graduate
27. Intermediate Fluid flow, Graduate
28. Intermediate Numerical Analysis, Graduate
29. Advanced Refrigeration, Graduate
30. Seminar, Graduate

7. University ACTIVITIES

1. 2020-2021, Dean, Faculty of Engineering, Sohar University-Oman
2. 2019-2020, Head Energy Systems and Renewables, Doha -Qatar
3. 2015-2017, President of JUST Prof Society
4. 2012-2013, Director of Consultative Center/JUST
5. 2004-2006, Vice Dean / Faculty of Graduate Studies
6. 2003-2004, Chairman of Mech. Eng. Dept.
7. 2015-2016, Faculty of Engineering representative in the University Council
8. 2013-2015, Consultative Center Council
9. 2010-2018, Member of University Tender Committee
10. 2013-2015, PV Solar Plant Tender Committee
11. 2014-2016, Incinerator tender Committee
12. 2008-2012, Heating System Tender Committee
13. 2004-2006, Faculty of Graduate Studies Council

8. DEPARTMENTAL ACTIVITIES

1. 1995-Present, Mechanical Engineering Departmental Council
2. 2015-2016, Mech. Eng. Dept. Council representative in the Faculty of Engineering Council
3. 2000-2018, Graduate Studies Departmental Committee.
4. 2005-2006, Faculty of Engineering Council
5. 1996-2015, Mech. Eng. Department Research Committee
6. 1998-2010, Faculty Research Committee Member

9. PUBLIC PROFESSIONAL ACTIVITIES

1. 2018-2020, Al-Hussain Bin Tala University Board of Trustees
2. 2017-2019, Equivalency Certificate Committee, Ministry of Higher Education, Jordan
3. 2017-2019, Energy and Environment Commission in the Scientific Research Fund
4. 2010-Present, Reviewer for QNF NPRP
5. 2016-2019, Energy, water, and environment sector committee Scientific Research Fund
6. 2006-2018, Intel ISEF Judge in Jordan
7. 2002-2012, Jordanian Higher Committee for Standards and Regulations
8. 2010-2019, President of Al-Huson Public Initiative
9. 2000-Present, Reviewer for more than 15 International Scientific Journals
10. 2001, Chairman of the government committee to rehabilitate the IPC in Jordan
11. 2001. Committee Head to review the necessary Workshop equipment for maintenance of KAHP

10. Reviewer for the following journals

Applied Energy, Energy Conversion and Management, Applied Thermal Engineering, International Journal of Refrigeration, Energy, International Journal of Thermal Sciences, International Journal of numerical methods in heat and fluid flow, Computational fluid mechanics, Heat and Mass Transfer Journal, Transport in Porous Media, International Journal of Heat and Mass Transfer, Acta Mechanica, Energy Reports, Energies, Applied Sciences, and Energy and Built Environment.

11. MEMBERSHIP IN PROFESSIONAL SOCIETIES

1. 1987-Present, Jordanian Engineering Association
2. 2018-Present, ASHRAE
3. 2019-Present Association of Energy Engineers (AEE)

12. FELLOWSHIPS, AWARDS, AND HONORS

1981-1987, Full scholarship to get an undergraduate degree from the Ministry of Higher Education
1987, The M. Sc. Award of Honors
1991-1994, Full scholarship to get a Ph.D. in Mech. Eng. At Concordia University
1992-1994, Concordia Graduate Fellowship 6 terms
2019, Best Oral Presentation at GCGW 19, Doha, Qatar.

13. GRADUATE STUDENTS

Completed MSc Theses

1. Husam Qaseem, 2020, Integrated system of absorption cooling technology with thermoelectric generator powered by solar energy, Bourhan Tashtoush.
2. Abbas Metani, 2020 Self-Powered Solar Ejector Cooling System Supplied by Thermoelectric Generators, Bourhan Tashtoush, M. AlNimr
3. Jigar Chudasama, 2019, Exergy and Exergoeconomic analysis of a cogeneration hybrid solar Organic Rankine Cycle with ejector, Bourhan Tashtoush, Tetyana Morozyuk
4. Motaz Billah, 2019, Thermodynamic analysis and parametric optimization of a solar Organic Rankine Cycle with variable geometry ejector, Bourhan Tashtoush
5. Mohammad Khasawneh, 2018, Investigation of the effect of Nano-refrigerant on ejector cooling cycle, Bourhan Tashtoush, Moh'd Al-Nimr.
6. Mai Bani Younes, 2017, Performance study of the solar ejector to select the best refrigerant, Bourhan Tashtoush.
7. Ali Al-Oqool, 2016, Experimental study of water-based cooling system effect on the performance of photovoltaic module, Bourhan Tashtoush
8. Ahmad Jaradat, 2016, modeling and simulation of the thermoelectric device for heating, cooling and electricity generation in Jordan, Bourhan Tashtoush, M. Alnimr
9. Saja Al-Rifai, 2015, modeling and simulation of solar ejector cooling system using TRNSYS software, Bourhan Tashtoush.
10. Mostafa Jaradat, 2010, Experimental study of a solar adsorption refrigeration unit, Bourhan Tashtoush
11. Ahmad Maqableh, 2008, Magnetic effect on blood flow through multi-stenosis arteries, Bourhan Tashtoush
12. Zaid Duwairi. 2007, Hyperbolic heat conduction and thermal resonance in a cylindrical electric conductor with annular cross-section, Bourhan Tashtoush
13. Anas Al Azzam. 2006, The analysis of the respiratory system characteristics using numerical techniques, Bourhan Tashtoush.
14. Othman Smadi, 2003, Heat and fluid flow of blood through multi-stenosis artery with viscous dissipation, Bourhan Tashtoush
15. Adnan Jaradat, 2002, Heat transfer analysis of stretching flows of Non-Newtonian fluids with suction or injection, Bourhan Tashtoush, Z. Kodah
16. Mohammad Shdeifat, 2001, Experimental study of the performance characteristics of some selected refrigerant mixtures to replace Freon R12, Bourhan Tashtoush, M. Tahat
17. Tariq Migdadi, 2000, Forced convection in power-law fluids in a flow between two flat disks, Bourhan Tashtoush.
18. Maher Abu Al-Assal, 2001, Feasibility study of refrigeration adsorption solar unit, Bourhan Tashtoush
19. Rabiah Al Tahat, 2001, Conjugate forced heat transfer in converging ducts, Bourhan Tashtoush.

20. Ahmad Alhayajneh, 2000, Development of air-conditioning systems on the basis of combined evaporative water and air coolers, Bourhan Tashtoush, M. Tahat
21. Essam Abu Ershaid, 2000, Heat transfer from a wavy surface subjected to variable heat flux, Bourhan Tashtoush.
22. Abed El-Fattah El-Zairy, 1999, Manufacturing of Jameed using spray drying process, Bourhan Tashtoush, Riyad Shaker

Ph.D. Theses

(a) completed

1. Jing Luo, 2018-2020, Transcritical Heat-Driven Compression Refrigeration System with CO_2, Bourhan Tashtoush, Tetyana Morozyuk.
2. Karima Megdouli, 2012-2015 Novel ejector-expansion CO_2 cascade refrigeration system, Bourhan Tashtoush, Mouna Elakhdar

(b) In progress

1. Rania Hammemi, 2019- Present, Exergoeconomic analysis and multi objective optimization of a solar-based cogeneration system, Bourhan Tashtoush, L Kairouani.
2. Narjes Bechir,2020-Present, Performance investigation of Two Configurations in the CO_2 transcritical vapor compression refrigeration system, Ridha Chargui, Bourhan tashtoush
3. Naima Benmakhlouf, 2020-Present, Experimenta and 2D modeling of Leather hydro-viscoelastic convective drying, Ridha Chargui, Bourhan Tashtoush

MSc Theses In Progress

1. Qusai Al Refai, 2020-Present. A hybrid solar pond / transparent photovoltaic system, Bourhan Tashtoush, M. Al-Nimr
2. Songa, Iscah, 2021-Present. Exergoeconomic Analysis and Optimization of an Autonomous Variable Area Hybrid Ejector Cooling System in Harsh Climate. Bourhan Tashtoush, Tetyana Morozyuk.

14. SPONSORED LONG-TERM VISITORS AND POST-DOCTORAL ASSOCIATES

1. Sept. 2018- Dec 2018, Visiting Professor, Mechanical Engineering, TUB-Germany
2. Sept. 2009-August 2011, Visiting Professor, Mechanical Engineering, KFUPM- Saudi Arabia
3. Sept. 2008-August 2009, Visiting Professor, Mechanical Engineering, METU NCC-Cyprus
4. Sept. 2001-August 2002, Visiting Professor, Mechanical Engineering, ASU Amman- Jordan

15. RESEARCH GRANTS

Competitive

2013, SRF (Scientific Research Fund) in Jordan, $150k, Solar ejector cooling system for residential and small-scale commercial buildings in Jordan: Experiments, Modeling, and cost-benefit analysis, Bourhan Tashtoush, Aiman Alshare.

2013, KADDB, $10k, Design of PV Solar system to power AC unit for an academic staff office at JUST, Bourhan Tashtoush

2012, SDR JUST, $15k. Computational simulation of blood flow in multistenosis arteries, Bourhan Tashtoush.

2010, KACST, $35k, Optimum design and performance of a two-phase flow vapor pump for solar absorption chiller"2010

2010, RE, $35k, Intermittent solar refrigeration systems for the ice making, cold stores, and solar-assisted Air conditioning systems, Bourhan Tashtoush

16. PUBLICATIONS

Theses

1. **Bourhan Tashtoush**. The effect of non-uniform bleed and cylindrical chamber width on converging cylindrical shock wave stability, PhD. in Mechanical Engineering, Concordia University, Canada, 26 May 1995.
2. **Bourhan Tashtoush**. A new approximate analytical solution for A heat transfer problem in a Trombe wall, M.Sc. in Mechanical Engineering, the University of Jordan Amman, 1991.
3. **Bourhan Tashtoush**. Design of Solar air conditioning absorption Unit of 20 kW for Jordanian Climate. M.Sc. in Mechanical Engineering, Odessa Academy of Refrigeration 1987

Refereed Papers in Indexed Professional Journals

1. Narjes Bechir, Ridha Chardui, **Bourhan Tashtoush**, Meriam Lazaar. Performance Analysis of a Novel Combined Parabolic Trough Collector with Ejector Cooling System and Thermoelectric Generators. Journal of Energy Storage, (2021). In Press.
2. Ridha Chargui, **Bourhan Tashtoush***, Sami Awani. Experimental Performance and Comparative Study of a Novel Design of a Parabolic Trough Solar Collector. Int J Energy Res. 2021;1–20. DOI: 10.1002/er.7267
3. Alabas Hasan, Basheer Mugdadi, Moh'd A. Al-Nimr, **Bourhan Tashtoush***. Direct and Indirect Utilization of Thermal Energy for Cooling Generation: A Comparative Analysis. Energy Volume 238, Part C, 1 January 2022, 122046. https://doi.org/10.1016/j.energy.2021.122046
4. **Bourhan Tashtoush***, Nilson Chilengwe, Mohammad Musthafa, Yousef al Horr. An Experimental Evaluation of Indirect Direct Evaporative Cooling Unit for Hot Climate. International Journal of Global Warming (2021):24 (3-4), 237-260. https://doi.org/10.1504/IJGW.2021.116708
5. Sami Awani, Ridha Chargui, **Bourhan Tashtoush***. Experimental and Numerical Evaluation of a New Design of a Solar Thermosyphon Water Heating System with Phase Change Material. Journal of Energy Storage. Journal of Energy Storage 41 (2021) 102948.
   https://doi.org/10.1016/j.est.2021.102948

6. Sameh Agrebi, Ridha Chargui, **Bourhan Tashtoush***, Amenallah Guizlan. Comparative performance analysis of a solar assisted heat pump for greenhouse heating in Tunisia. Int. Journal of Refrigeration, 2021. 10.1016/j.ijrefrig.2021.06.004
7. **Bourhan Tashtoush***, Karima Megdouli, Towhid Gholizadeh, *Elhadi Deka*. Exergoeconomic Analyses of a Cement Plant Waste Heat Recovery in a Novel Combined Power and Refrigeration Cycle. International Journal of Design & Nature and Ecodynamics, Vol. 16, No. 3, June, 2021, pp. 251-260. https://doi.org/10.18280/ijdne.160302
8. **Bourhan Tashtoush***, Husam Qaseem. An Integrated System of Absorption Cooling Technology with Thermoelectric Generator Powered by Solar Energy. Journal of Thermal Calorimetry 2021, DOI:10.1007/s10973-020-10512-5
9. Jing Luo, Tatiana Morosuk*, George Tsatsaronis, **Bourhan Tashtoush**. Exergy-based evaluation of a waste heat driven tri-generation system with CO2 as the working fluid. International Journal of Exergy 34 (1), 50-75 (2021). https://doi.org/10.1504/IJEX.2021.112035
10. Ridha Chargui, **Bourhan Tashtoush**. Thermoeconomic Analysis of Solar Water Heaters Integrating Phase Change Material Modules and Mounted in Football Pitches in Tunisia. Journal of Energy Storage 33 (2021) 102129. https://doi.org/10.1016/j.est.2020.102129
11. Aiman Alshare, **Bourhan Tashtoush**, Safwan Altarazi, Hossam Al-Khalil. Performance, efficiency, and economic analysis of a 5 MWP Photovoltaic field in northern Jordan, Case Studies in Thermal Engineering 21, October 2020, 100722. https://doi.org/10.1016/j.csite.2020.100722
12. **Bourhan Tashtoush**, A.b.R. Algharbawi, Parametric Exergetic and Energetic Analysis of a Novel Modified Organic Rankine Cycle with Ejector, Thermal Science and Engineering Progress 19 (2020) 100644, https://doi.org/10.1016/j.tsep.2020.100644
13. **Bourhan Tashtoush,** Tatiana Morosuk, Jigar Chudasama. Exergy and Exergoeconomic Analysis of a Cogeneration Hybrid Solar Organic Rankine Cycle with Ejector. *Entropy* 2020, *22*(6), 702; https://doi.org/10.3390/e22060702
14. **Bourhan Tashtoush***, Karima Megdouli, Mouna Elakhdar, Ezzedine Nehdi, Lakdar Kairouani. A Comprehensive Energy and Exergoeconomic Analysis of a Novel Transcritical Refrigeration Cycle. *Processes* **2020**, *8*(7), 758; https://doi.org/10.3390/pr8070758
15. Y. Al Horr, **Bourhan Tashtoush***, N. Chilengwe. Experimental Analysis of the Cooling Performance of A Fresh Air Handling Unit. AIMS Energy 8(2), (2020):299-319. doi: 10.3934/energy.2020.2.299
16. Al Horr Yousef, **Bourhan Tashtoush *,** Nelson Chilengwe. Experimental Analysis of Mist Injection and Water Shower Indirect Evaporative Cooling in Harsh Climate. International Journal of Heat and Technology 38(1) (2020):240-250. https://doi.org/10.18280/ijht.380126
17. Moh'd Al-Nimr, **Bourhan Tashtoush***, Abas Metani. A Novel Hybrid Solar Ejector Cooling System with Thermoelectric Generators. Energy 198 (2020) 117318
18. Y. Al Horr, **Bourhan Tashtoush***, C. Nelson, M. Musthafa. Operational Mode Optimization of Indirect Evaporative Cooling in Hot Climates. Case Studies in Thermal Engineering, Volume 18 April 2020, 100574
19. **Bourhan Tashtoush*,** Yousef Nayfeh. Energy and Economic Analysis of a Variable-Geometry Ejector in Solar Cooling Systems for Residential Buildings. Journal of Energy Storage Volume 27, February 2020, 101061

20. Jing Luo, Tatiana Morosuk*, George Tsatsaronis, **Bourhan Tashtoush.** Exergetic and economic evaluation of a heat-driven compression refrigeration system with CO2 as the working fluid under hot climatic conditions. Entropy **2019**, 21, 1164
21. Y. Al Horr, **Bourhan Tashtoush*, N.** Chilengwe, M. Musthafa. Performance Assessment of a Hybrid Vapor Compression and Evaporative Cooling Fresh Air Handling Unit Operating in Hot Climates. *Processes* **2019**, *7*(12), 872
22. K. Megdouli*, H. Sahli, **BourhanTashtoush**, M. Elakhdar, E. Nahdi, A. Mhimid, L. Kairouani. Theoretical research of the performance of a novel enhanced transcritical CO_2 refrigeration cycle for power and cold generation. Energy Conversion and Management Volume 201, 1 December 2019, 112139
23. Mouna Elakhdar*, Hanene Landoulsi, **Bourhan Tashtoush**, Ezzedine, Nehdi Lakdar, Kairouani. A combined thermal system of an ejector refrigeration and Organic Rankine cycles for power generation using a solar parabolic trough. Energy Conversion and Management Volume 199, 1 November 2019, 111947
24. **Bourhan Tashtoush***, Almutaz ballah R. Algharbawi. Parametric Study of a Novel Hybrid Solar Variable Geometry Ejector Cooling with Organic Rankine Cycles. Energy Conversion and Management Volume 198 15 October 2019, 111910
25. **Bourhan Tashtoush*,** Ali Al-oqool, Factorial analysis and experimental study of water-based cooling system effect on the performance of photovoltaic module, JEST 16(7) (2019): 3645-3656
26. **Bourhan Tashtoush*,** Mai Bani Younes, Comparative thermodynamic study of refrigerants to select the best environment-friendly refrigerant for use in a solar ejector cooling system. M. Arab J Sci. Eng (2019) 44(2): 1165-1184
27. Qais Khasawneh, **Bourhan Tashtoush***, Anas Nawafleh, and Bayan Kan'an, Techno-Economic Feasibility Study of a Hypersaline Pressure-Retarded Osmosis Power Plants: Dead Sea–Red Sea Conveyor. *Energies 11 (11)* 2018, *11*(11), 3118
28. M. Elakhdar*, **Bourhan Tashtoush**, E. Nehdi, L.Kairouani, Thermodynamic analysis of a novel Ejector Enhanced Vapor Compression Refrigeration (EEVCR) cycle. Energy Volume 163, 15 November 2018, Pages 1217-1230
29. **Bourhan Tashtoush*,** M. Al-Nimr, M. Khasawneh, Investigation of the effect of Nano-refrigerant on the performance of an ejector cooling. Applied Energy 206 (2017) 1446–1463
30. Moh'd A. Al-Nimr, **Bourhan M. Tashtoush*,** Mohammad A. Khasawneh, and Ibrahim Al-Keyyam, A Hybrid Solar Thermal Collector / Thermo Electric Generation System, Energy, Vol. 134, 1 September 2017, Pages 1001–1012
31. K. Megdouli*, **Bourhan Tashtoush**, N. Ejemni, E. Nahdi, A. Mhimid, and L. Kairouani, Performance analysis of a new ejector expansion refrigeration cycle (NEERC) for power and cold: Exergy and energy points of view, Applied Thermal Engineering 122 (2017) 39–48
32. Megdouli*, **Bourhan M. Tashtoush**, E. Nahdi, L. Kairouani and A. Mhimid, Performance analysis of a combined vapor compression cycle and ejector cycle for refrigeration cogeneration, International Journal of Refrigeration, vol. 74 (2017)
33. K. Megdouli*, **Bourhan M. Tashtoush**, E. Nahdi, A. Mhimid, L. Kairouani, Thermodynamic analysis of a novel ejector-cascade refrigeration cycles for freezing process applications and air-conditioning, Int. Journal of Refrigeration 70, 2016
34. A. Alshare and **Bourhan Tashtoush***, Simulations of Magneto Hemodynamics in stenosed arteries in diabetic or anemic models, Computational and Mathematical Methods in Medicine 1-13, Jan 2016
35. **Bourhan Tashtoush***, A. Alshare, and S. Alrifai, Hourly Dynamic Simulation of

Solar Ejector Cooling System using TRNSYS for Jordanian Climate, Energy Conversion and Management, 100 August (2015) 288-299

36. M. Alnimr, **Bourhan Tashtoush*** and A. Jaradat, Modeling and simulation of a dual usage of thermoelectric device in a heat pump and electricity generation for Mediterranean Climate. Energy 90 Part 2 (2015) 1239-1250

37. **Bourhan Tashtoush*,** A. Alshare, and S. Alrifai, Performance study of ejector cooling cycle at critical mode under superheated primary flow, Energy Conversion and Management, 94 (2015) 300-310

38. Aiman Sharo**, Bourhan Tashtoush*,** Hosam Odat, Computational Modeling of fluid Flow of Non-Newtonian Blood Flow Through Stenosed Arteries in the Presence of Magnetic Field, Journal of Biomechanical Engineering 11/2013; 135(11):114503-6

39. Ghassan M. Tashtoush**, Bourhan M. Tashtoush*,** and Mustafa M. Jaradat. Experimental Study of a Solar Adsorption Refrigeration Unit, Factorial Analysis, Smart Grid, and Renewable Energy, 2012, 3, 126-132

40. **Bourhan Tashtoush*** and A. Magableh. Magnetic field effect on heat transfer and fluid flow characteristics of blood flow in multi-stenosis arteries. Heat and Mass Transfer Journal, vol.44(3). pp 297-304, (2008)

41. H. M. Duwairi*, Rebhi. A. Damseh, **Bourhan Tashtoush**. Transient mixed convection along a vertical plate embedded in porous media with internal heat generation and oscillating temperature, *Chemical Engineering Communications* 194 (11), pp. 1516-1530, 2007

42. RR Shaker*, RY. Jumah, **B. Tashtoush,** and A.F. Zraiy. Manufacture of Jameed using a spray drying process: a preliminary study. International Journal of Dairy Technology 52(3):77 – 80 August 2007

43. H. M. Duwairi*, R.A. Damseh, **Bourhan Tashtoush,** Transient non-boussineq MHD free convection flows over a vertical surface. Int. J. of Fluid Mechanics Research, v33, pp137-152 (2006)

44. **Bourhan Tashtoush***. Magnetic and buoyancy effects on melting from a vertical plate embedded in saturated porous media. Energy Conversion and Management 46 (2005) 2566-2577**)**

45. **Bourhan Tashtoush*,** M. Molhim, and M. Al-Rousan. Dynamic model of an HVAC system for control analysis. Energy, The International Journal, 30 (2005) 1729-1745.

46. **Bourhan Tashtoush*,** H.M. Duwairi. Transient mixed convection with internal heat generation and oscillating plate temperature. Acta Mechanica, vol. 174, No3-4, February (2005), 185-199

47. **Bourhan Tashtoush,** H.M. Duwairi* and Ahmad Al-Salaymeh, Hydromagnetic flow on a power-law stretching surface with suction and injection of non-Newtonian fluid, Int. J. of Heat and Technology, vol. 23, no. 1, pp. 55-60, 2005

48. H.M. Duwairi***, Bourhan Tashtoush,** R. Damseh. On heat transfer effects of a viscous fluid squeezed and extruded between two parallel plates. Heat and Mass Transfer vol. 41, no. 2, pp. 112-117 (2004)

49. **Bourhan Tashtoush*** and M. Al-Odat. Magnetic field effect on heat and fluid flow over a wavy surface with variable heat flux. Journal of Magnetism and Magnetic Materials, Vol. 268, pp 357-363 (2004)

50. **Bourhan Tashtoush***. Reply to Comments on 'Analytical Solution for the Effect of Viscous Dissipation on Mixed Convection in Saturated Porous Media,' Transport in Porous Media 41, 197–209, 2000. Transport in Porous Media 53(3) December (2003):371-372

51. **Bourhan Tashtoush***, M. Tahat, and M.A. Shdeifat. Experimental study of new refrigerant mixtures to replace R12 in domestic refrigerators. Applied Thermal Engineering, 22 pp. 495-506, (2002)

52. **Bourhan Tashtoush***, Mahmoud Tahat, Ahmed Hayajneh, Victor Mazur, and Doug Probert. Thermodynamic behavior of an air conditioning system employing combined evaporative-water air coolers. Applied Energy, 70, pp 305-319, (2001)

53. **BourhanTashtoush***, Z. Kodah, and A. Al-Ghasem. On thermal boundary layer of a non-Newtonian fluid on a power law stretched surface of variable temperature with suction or injection. Heat and Mass Transfer, 37, pp. 459-465, (2001)

54. **Bourhan Tashtoush***, Mahmoud Tahat, and Doug Probert. Heat Transfer and radial flows via a viscous fluid squeezed between two parallel disks. Applied Energy, 68, 275-288, (2001)

55. **Bourhan Tashtoush*** and E. Abu-Irshaid. Heat and fluid flow from a wavy surface subjected to a variable heat flux. Acta Mechanica, 152, No. 1pp. 1-8 (2001)

56. **Bourhan Tashtoush***. Heat and mass transfer analysis from vegetable and fruit products stored in cold conditions. Heat and Mass Transfer, 36, pp. 217-221, (2000).

57. **B**R. Y. Jumah*, **Bourhan Tashtoush,** R. R. Shaker, and A. F. Zraiy. Manufacturing parameters and quality Characteristics of spray Dried Jameed. International Journal of Drying Technology 18(4&5), pp. 967-984, (2000)

58. **Bourhan Tashtoush***, Z. Kodah, and A. Al-Ghasem. Heat transfer of non-Newtonian fluid on a power-law stretched surface with suction or injection for uniform and cooled surface temperature. International Journal of Numerical Methods for Heat and Fluid Flow, vol. 10, n5, pp385-395, (2000)

59. **Bourhan Tashtoush***. Analytical solution for the effect of viscous dissipation on mixed convection in saturated porous media. Transport in Porous Media 41: pp 197-209, (2000)

60. **Bourhan Tashtoush*** and Z. Kodah. No-slip boundary effects in non-Darcian mixed convection from a vertical wall in saturated porous media. Analytical solution. Heat and Mass Transfer, 34 pp. 35-39, (1998)

61. A. Shariah*, B. Shalabi, A. Rousan, and **Bourhan Tashtoush.** Effects of absorptance of external surfaces on heating and cooling loads of residential buildings in Jordan. Energy Convers. Mgmt. Vol. 39, No. ¾, pp. 273-284, (1998)

62. A. Shariah*, **Bourhan Tashtoush,** and Akram Rousan. Cooling and heating loads in residential buildings in Jordan. Energy and Buildings 26, 137-143, (1997)

63. B. Jubran, M. Hamdan, **Bourhan Tashtoush*,** and Awad Mansour. An Approximate Analytical Solution for the Prediction of Transient Response of the Trombe Wall. Int. Communication Heat Mass Transfer, V 20, pp. 567-577, (1993)

64. H. M. Duwairi*, Rebhi. A. Damseh, T. A. Al-Azab, **Bourhan Tashtoush**, Thermophoresis Particle Deposition -Thermal Radiation Interaction on Mixed Convection from Vertical Surfaces Embedded in Porous Medium, Chemical Engineering Journal, (2008)

65. RR Shaker* and **Bourhan Tashtoush**. Modeling of Yogurt viscosity during the coagulation process. Egyptian Journal of Dairy Science. Volume 28 No. 1, pp. 49-57, June (2000)

66. Awad Mansour, B. Jubran, and **Bourhan Tashtoush***. An approximate analytical solution to convective laminar heat transfer flow within the Trombe wall channel. Int. Comm. Heat and Mass Transfer, V18, pp. 151-161, (1991)

Review papers

Bourhan Tashtoush*, M. Al-Nimr, M. Khasawneh, A comprehensive review on ejector design, performance, and applications. Applied Energy, 240, (2019):138-172

Submitted papers

1. Haythem Sahli, Mouna Elakhdar, **Bourhan Tashtoush**, Ezzedine Nehdi. Analysis of a Hybrid Solar Absorption Cooling System with Thermoelectric Generator. Heliyon.
2. Rania Hammemi, Mouna Elakhdar, **Bourhan Tashtoush**, Ezzedine Nehdi. Multi-Objective Optimization of a Combined Solar Cogeneration System: Exergy and Exergoeconomic Analysis. Int. Journal of Refrigeration
3. **Bourhan Tashtoush***, M. Elakhdar, K. Megdouli. A novel solar combined multi-cooling and power generation system using Carbon Dioxide as a refrigerant. Energy Conversion and Management.
4. **Bourhan Tashtoush***, M. Elakhdar, K. Megdouli. Energy and exergo-economic study of a solar trigeneration system consisting of a parabolic solar collector with an Organic Rankine Cycle. Renewable Energy.
5. **Bourhan Tashtoush**, Mouna Elakhdar, Solar-powered absorption cooling system with thermoelectric generators. Energy Conv. and Management
6. Sameh Agrebi, Ridha Chargui, Amenallah Guizani, **Bourhan Tashtoush.** The energetic performance of a water-to-water heat pump assisted with solar thermal collectors for heating a glass greenhouse in Tunisia. Energy
7. Ridha CHARGUI, **Bourhan Tashtoush**, Sameh AGREBI. Performance Assessment of Solar Water Heater Systems for Heating of Football pitches in Tunisia: Experimental and Economic Feasibility. Sustainable Energy Technologies and Assessments
8. Ridha CHARGUI, Sami AWANI, **Bourhan Tashtoush**. Experimental evaluation of the thermal performance of Parabolic Trough Solar Collector using three test methods. Energy Conversion and Management

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12. B. Jubran, A. Mansour, M. Hamdan, and **<u>B. Tashtoush</u>**." A new Approximate Analytical Solution for the Prediction of the Thermal and Hydrodynamic Characteristics of the Trombe Wall". Presented at the 28th National Heat Transfer Conference and Exhibition, San Diego, California, USA, August 9-12, Topics In Heat Transfer ASME (1992)
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18. RESEARCH STATEMENT

My page on Google Scholar is:
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Citation indic	All	Since 2016
Citations	1717	1118
h-index	23	19
i10-index	34	27

Scopus
h-index: 21
citation 1079

My research has a strong interdisciplinary focus that combines theory and applications in areas of solar water heating systems, solar cooling and air conditioning systems, thermo-fluid science, evaporative cooling technologies, air conditioning applications, hybrid solar cooling systems, and transcritical refrigeration cycles. The objective of my research aims at improving the efficiency of energy storage and increasing the performance of solar air conditioning and refrigeration systems, and reduce electrical consumption and CO_2 emissions. The general area of my research is in solar heating and cooling and thermal storage systems, and transcritical refrigeration cycles. My research approach emphasizes exploiting physical insights in a mathematically rigorous manner with experimental verification of the theoretical data. Over the past few years, my research can be categorized into the following areas with some overlap:

1) Solar heating and cooling and hybrid systems
2) Evaporative cooling technologies
3) Transcritivcal refrigeration cycles

Solar heating, cooling, and hybrid systems

In the past few months, I was working on the project of solar water heating for football pitches and greenhouses in Tunisia. Thermal storage systems with phase change material were developed and a paper was recently published in the Journal of Energy Storage. Another paper on heating of the greenhouses has been also accepted with minor modification in the International Journal of Refrigeration [1, 2]. In the meantime, we are developing new designs for thermal storage systems using Parabolic Trough Collectors. A hybrid solar water heating system with a thermoelectric generator system has been developed and a paper is being prepared to be submitted for publication.

Another work is being conducted on the development of a new design of a hybrid solar absorption refrigeration system using evacuated tubes. An innovative contribution of my work is the establishment of a new perspective on the design and analysis of solar ejector cooling systems and hybrid energy systems for power and refrigeration effect generation. I was awarded a project funded by the Jordanian Scientific Research Fund. The project was completed, and the outcome was four papers published in international indexed and refereed journals, and one article was presented at an international conference. Three master students worked on the project and finished their master's thesis. The solar ejector system was designed, modeled using TRNSYS and EES Professional Software. The experimental setup was built at the Jordan University of Science and Technology (JUST) campus to verify the theoretical results.

The operational ejector modes can be summarized in three modes, namely, the critical, subcritical, and malfunction modes. The value of the backpressure is essential in the critical mode of operation to ensure that there is no occurrence of shock waves in the ejector mixing area. From gas dynamics theory, the critical pressure is a function of the refrigerant type and its specific heat ratios. The malfunction mode occurred when the backpressure is equal to the primary supply pressure, and the ejector ceases to operate.

The ejector mixing section can be at either constant pressure or constant area, which is determined by the location of the diverging nozzle exit plan, as illustrated in Figure 1 (a) and (b), respectively. When the nozzle exit is located before the section of the constant area, then the ejector is of constant pressure mixing type. While, when it is located at the mixing area entrance, the ejector is of constant area-mixing nature.

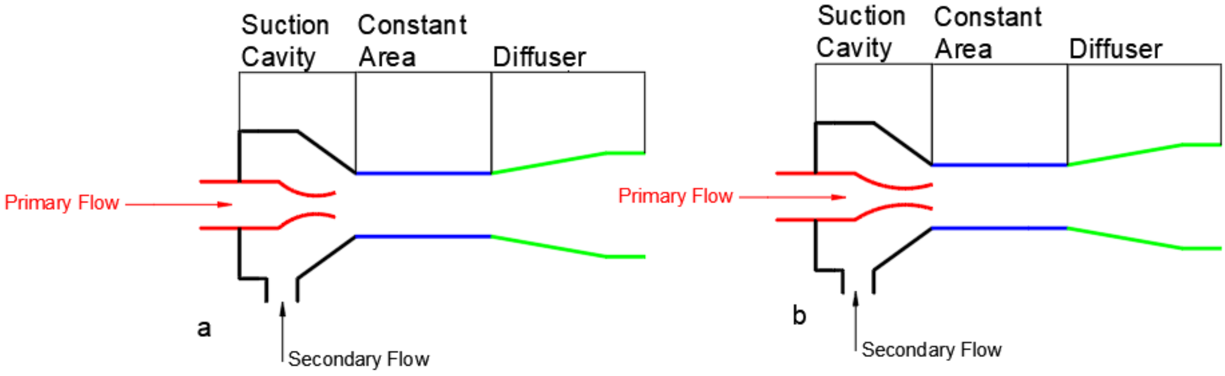

Figure 1 Ejector with constant (a) pressure (b) area mixing sections

The 1-D thermodynamic model is used for the ejector with the critical operational mode and constant pressure mixing chamber.

A second project that I am working on is the use of evaporative cooling technology in air conditioning applications for residential buildings in harsh climates. A few papers are already published and more yet to come on this topic. The use of such technology in dry and hot environments reduces the electrical consumption of air conditioning equipment by more than 35%.
Furthermore, a PV system was experimentally studied to drive a one-ton refrigeration system installed at JUST Campus. KADDB funded the project, and a team of undergraduate students worked on its installation. Later, a master's student conducted research work on the effect of a water-based cooling system on the PV module performance and efficiency under my supervision. Experimental and factorial analysis of the experimental data was carried out to investigate the most crucial parameter to be controlled in a water-based cooling system of a PV module. Several parameters were investigated like Maximum Allowable Temperature (MATD) and water mas flow rate, and a paper was published in an international journal. A novel hybrid solar ejector cooling cycle combined with an Organic Rankine cycle for generating power and refrigeration was conducted. The outcome of this research work was a paper was published in Energy Conversion and Management.

Future Work

I am currently working on designing a significant research project on hybrid solar cooling systems, which includes the ejector cooling cycle combined with thermoelectric generators (TEG) and organic cycle. The combination of solar ejector cooling with TEG and/or ORC is an entirely new application context towards the best utilization of wasted low-grade energy. Energy, exergy, and exergoeconomic analysis will be carried out for these projects. In another project, a graduate student is working on investigating the performance of the application of TEGs and thermoelectric cooler (TEC) with solar absorption systems is investigated. A couple of papers are planned to be published in international journals as an outcome of these projects.
I am also involved in applied and collaborative projects dealing with cascade combined refrigeration systems for power and cold generation. An ejector is introduced into the transcritical cycle to improve its efficiency. Thermodynamic analysis based on the first and second laws of thermodynamic will be carried out for these systems. Several papers are expected as an outcome of these works to be published in international journals and conferences.
A new aspect of the research will be carried out in collaboration with fellow researchers from Germany on the topic of exergy and exergoeconomic analysis of nano refrigerants.
A new line of research has been initiated with Germany's research centre for aeronautics in the desalination of brackish water. A hybrid solar desalination unit with PVT and RO is being studied for the Meditarenion region. A designed pilot plant will be built in Germany and scale-up units will be installed in Jordan, the West Bank, and Gaza Strip.

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19. Teaching statement

I consider teaching as one of the most enjoyable ways to a lifelong learning experience and to discover the inner potential of students. Teaching gives a unique opportunity to share knowledge and exchange ideas in a conducive environment. While research enables us to explore knowledge and push it further, teaching helps us prepare minds for research. It is always my belief that teaching is the noblest profession that brings positive change in society. Every teaching lesson is a new way for an instructor to rediscover himself.

Teaching Experience

I started working as an Assistant Professor at the Jordan University of Science and Technology (JUST) in January 1995. The courses that I taught during my 25 years of experience are:

(a) On the undergraduate level

Engineering Mechanics (Dynamics), Introduction to Mechanical Engineering (For non-mechanical engineering students), Engineering Drawing, Engineering Mechanics, Applied Engineering Mathematics (I), Applied Engineering Mathematics (II), Fluid Mechanics I, Compressible Fluid Flow (Fluid Mechanics II), Numerical Engineering Analysis, Heat Transfer, Heat Transfer Laboratory, Gas Turbine Theory, Refrigeration, and HVAC systems, Solar energy, Energy conversion, and Design of thermal systems

(b) On the Master (Graduate) level:

Advanced Engineering Mathematics, Advanced Engineering Mathematics for Mechatronics, Intermediate Heat Transfer, Intermediate Fluid flow, Selected Topics in Fluid Mechanics and Heat Transfer (Advanced Refrigeration), Advanced numerical Analysis, Turbomachinery, Gas Turbines, Renewable, and Sustainable Energy, Energy Efficiency of thermal systems, and Seminars.

I was also working as a Senior Mechanical Engineer at King Abdullah Hospital Project at the JUST campus. It provided an excellent opportunity for me to enable students to understand the relevance of the coursework in real life. I also engaged in some classes for Architectural Engineering students at JUST, such as Mechanical systems, HVAC systems, and Building design.

I also delivered several workshops for engineers and technicians in the oil and gas industry. In particular, I was a trainer for GASCO and ADNOC in the UAE, SABIC and ARAMCO in Saudi Arabia, and Jordanian Refinery in Jordan. I conducted many workshops on air conditioning system design and cooling load calculations for students at JUST and fresh graduates in Jordan.

I presented a nice example of teaching well in a diverse classroom. Perhaps the single greatest change in my undergraduate teachings results from my recognition that some students worry about implicit bias in grading, and indeed, that they have a good reason to do so. Even when instructors are trying to be entirely free of common racial and gender biases, they still tend to be biased in favor of students who have done good work in the past and against those who have done poor work in the past. To overcome this issue, I requested students to include only their ID numbers and not their names on the papers of the exam. The anonymized submission is always the “default mode” in my classes, and this is an unbreakable rule. If students request a discussion of a progress report or a paper, or to comment on a draft, I am always glad to help.

The method of delivery of the courses depends on the learning outcome required. For example, in the class Refrigeration and heat engine, students need to study thermodynamic principles and fundamentals of heat engines, refrigeration & air conditioning. In another class, Renewable and Sustainable Energy, the students need to establish the fundamentals of energy and sustainable development, renewable & non-renewable energy, energy systems, climate change & energy, life cycle analysis, energy conservation & optimization, sustainability, and business, energy storage & management. To help students achieve the objectives and learning outcomes of these courses, the course material was divided into 4 modules to meet the program and course learning outcomes. In every module, a set of learning materials including lecture notes, H5P interaction videos, pre-recorded lectures, interactive quizzes, mock exams, practical components, and others were uploaded into the e-learning system on the university webpage. These were designed to help students review the materials quickly and regularly for the class. MS sessions were also held to discuss and explain the learning materials. Furthermore, the students were able to write their notes and ask questions during the tutorial sessions. In the midterm evaluation, it was clear that students used the materials and comprehend the content. This was successful in that they were abler to respond correctly to the problems of the test and could calculate the coefficient of performance. This allowed me to spend more time in the MS session to work on more complicated and engineering design problems.

Teaching Philosophy

It is always thought that a good teacher is that one who makes himself progressively unnecessary, and his role in the learning process should be that of a map for a wandering traveler. Once students know the basic concepts, a teacher should encourage them to be on their own, to question the known, find the unknown, and reason about it. A teacher needs to develop independent thinking ability among students, which is so crucial for research.

The courses should be made hands-on and highly interactive. The goal is not to make them a master of refrigeration equipment or renewable energy, rather my goal is always to teach them how to think like a programmer and to give them enough of a foundation in the refrigeration and air conditioning industry as well as renewable energy sectors that they would then be able to add whatever else they needed into their toolkit so that they could develop tools to help their work and research. doit@home experiments also help students to understand whatever concept they were struggling with.
I like teaching most when it is an interactive process in which both the students and I are involved in a quest for finding new directions to expand boundaries of knowledge. For this to happen, I continuously instill students' curiosity and keep them challenging. I believe that the teacher should not only impart knowledge but also let students obtain the joy of "discovering something new" through the learning process. As a teacher, it is vital to make each student realize his/her true potential and attain the highest goal possible by setting the highest standards for himself/herself. In addition, it is essential to make the students realize their duty to society or humanity in a broader sense. As the teacher-student relationship grows, together, they should recognize that all their efforts are towards unraveling Nature's secret and strive towards perfection.
Different types of learning methods shall be utilized to maximize the benefits of the teaching process. Project-based learning, Acting-based learning are various strategies to make class instruction more exciting and fun for students. I would also like to make use of technology for improving interaction among students and with the instructor outside the classroom.

Teaching Plan

My undergraduate degree is in Refrigeration, and Air Conditioning and my master's degree is in Thermal power systems. My Ph.D. degree is in Compressible fluid flow and gas dynamics. I think it is crucial to have a system-level perspective to get an appreciation for many things taught in classes. Without such a view, students are often lost, thinking they are studying in isolation or for purely academic interest. I am interested in making my students realize how their courses connect to a real-world problem and then enable them to solve them. My doctoral work has taught me to understand the core of the problem. This is crucially important as a simple, elegant, and beautiful solution is possible only when the issue is fully understood. Secondly, I have learned to grasp the essence of approaches followed by different researchers. Knowing what has been tried before and why it worked or did not work is an essential step in research. I wish to implement this in my classes by asking students to propose different ideas to solve a problem and apply them to learn why things work or do not work as expected. I think there is tremendous value to this approach. Learning is at its best when it is applied to solve a problem. I want my classes to provide both a broad overview of a topic and specialized knowledge in a specific domain. I will carefully draft homework assignments that will require students to apply concepts. In addition, I take my student evaluations very seriously. I have found that students respond well when they can see adjustments in the second half of the quarter because of input concerning the first half. For example, last semester, during my course of Renewable & Sustainable Energy, a few students suggested that I take the 5-10 minutes of class to review the key points of the day. I began to implement this useful suggestion in the next class period and have done that in other courses as well since that time. Another very helpful midterm student suggestion was to provide extra practice problems and mock exams for the refrigeration and air conditioning course.

Undergraduate and Graduate Teaching

I am interested in working with undergraduate students and teach basic courses in mechanical engineering. Preparing and teaching a primary class provides an opportunity to refresh concepts and keep the research in a proper perspective. I am capable of teaching undergraduate courses in thermodynamic, fluid mechanics, heat transfer, HVAC, etc. For graduate-level courses, my approach will be to provide a synergetic environment. I have taken many classes where interaction with my classmates was intellectually stimulating and rewarding. I always preferred classes where instructors allowed such free communication and encourage questions. I want to implement a similar approach in my classes. My desire to engage, challenge, and inspire growth in my students is not limited to the classroom. Over the time that I was working at JUST, METU and KFUPM, I worked with over a dozen undergraduates as a graduation project supervisor and advised them on their senior projects. My desire to collaborate with students translates into the research domain; many published research papers are co-authored with undergraduates as well as graduate students. It is my goal to share with students the awe and excitement, as well as the dedication and hard work that comes along with using research tools to ask and answer questions. More than ten of the undergraduates that I advised went on to graduate school, and many of them are currently working as colleagues at JUST or other universities.
To me, a good teacher is one who not only has a sound knowledge of the course he is teaching and has up-to-date information about the subject but also helps the students learn how to reason about concepts, be analytical thinkers, and be able to perform well while doing teamwork. I learned the above through experience.
I do believe in the value of mentoring students and this is most obvious in my engagement with honors undergraduate and my graduate students. I have offered multiple opportunities for collaboration and authorship to my graduate and undergraduate students. As can be seen from my list of publications, I have many students as co-authors in most of my research work, and the most cited papers are those with co-authorship of my students. In 2020 my article “A comprehensive review of ejector design, performance, and applications” had been selected as **2020 Highly Cited Paper** of *Applied Energy*. This article is co-authored with one of my best graduate students. In addition, I have graduate students who have joined NASA and working on projects of cryo refrigeration for robots to be sent to Mars, while other graduate students are by now Professors at Universities around the world. I tried to effectively communicate expectations, and provide timely feedback and structure for their progress in the program. I also tried to provide psychosocial support and I was always open about my successes and setbacks.

Over the past decade, I have supervised many masters and Ph.D. students. I co-supervised two female Ph.D. students graduated (Dr. Karima Megdouli and Jing Luo) who graduated and finished their degrees. I served as a chair, co-chair, or dissertation committee member who received their Master's and Ph.D.’s. Most of the graduate students are, by now, professors at several universities in the USA, UAE, Jordan, and other countries. I am currently supervising a Ph.D. student in Tunisia and co-supervising a master's student in TUB. I informally mentor a few junior women Ph.D. students at al Manar University in Tunisia.
During the past year, I have experience in conducting online teaching using the SULM system. interactive materials were uploaded to students with many videos to make the learning more attractive and the student feedback was very good. Below are the course profiles for the courses Renewable &Sustainable Energy, and Refrigeration and Heat engines.

COURSE PROFILE FORM

Faculty:	Engineering
Program	Electrical and Computer, and Chemical Engineering

Course Details

Course Code	ENGG4000	**Course Title**	Renewable & Sustainable Energy	**Course Level**	4
Duration/hours of learning	15 weeks / 9 hours per week of notional learning		**Credit Units**	2	
Semester of Delivery	Semester 1 ☒	Semester 2 ☐	Semester 3 ☐	**Academic Year:**	20/21
Course Coordinator	Professor Bourhan Tashtoush		**e-mail**	btachtouch@su.edu.om	
Teaching Staff	Professor Bourhan Tashtoush		**e-mail**	btachtouch@su.edu.om	
Teaching Assistant	Ms Moza Al-Qartoubi		**e-mail**	mqartubi@su.edu.om	
Course Moderator	Dr Mahmoud Younis		**e-mail**	myounis@su.edu.om	

Course Requirements

Compulsory Prerequisites	None	**Recommended Prerequisites**	None

Awards

Diploma ☐	Bachelor ☒	Higher Diploma ☐	Master ☐

Course Type:	Core ☒	Elective ☐

Course Aims

The course establishes the fundamentals of energy and sustainable development, renewable & non-renewable energy, energy systems, climate change & energy, life cycle analysis, energy conservation & optimization, sustainability and business, energy storage & management.

Course Objectives

The objectives of this course are to:

1- Provide the students with the fundamentals of renewable and sustainable energy.
2- Introduce renewable and sustainable energy system Life Cycle Analysis and principles of operation.
3- Familiarize students with energy sustainability metrics, energy conservation & optimization, sustainability and business, energy storage & management.

Guidelines on Grading and Standards of Assessment

Note: SU uses criterion-based assessment, thus, descriptors should be established so that students are clear about what is expected of them.

%	Grade	Descriptor
85 - 100	**4.0**	**Exceptional performance:** The student provided an exceptionally high quality of performance and through this demonstrated an exceptionally high standard of learning achievement in relation to the course learning outcomes.
75 - <85	**3.5 - <4.0**	**Excellent Performance:** The student provided a high quality of performance and through this demonstrated a high standard of learning achievement in relation to the course learning outcomes.
65 - <75	**3.0 - <3.5**	**Very good Performance:** The student provided a very good quality of performance and through this demonstrated a sound standard of learning achievement in relation to the course learning outcomes.

57.5 - <65	**2.5 - <3.0**	**Good Performance:** The student provided good quality of performance and through this demonstrated an acceptable standard of learning achievement in relation to the course learning outcomes.
50 - <57.5	**2.0 - <2.5**	**Satisfactory Performance:** The student provided an acceptable quality of performance and through this demonstrated an acceptable standard of learning achievement in relation to the course learning outcomes.
0 - <50	**0 - <2**	**Fail:** The student did not provide a quality of performance that demonstrated an acceptable standard of learning achievement in relation to the course learning outcomes.

Course Learning Outcomes (CLO)	**Program Learning Outcomes** (PLO)								
On successful completion of this course, you will be able to:	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**
1. Analyze qualitative and quantitative analytical skills on energy systems and engineering design.	☒				☒				
2. Calculate energy systems performance and identify sustainable development and its application in engineering projects.	☒	☒		☒	☒				
3. Design sustainable engineering solutions to energy problems.	☒			☒	☒				
4. Describe fundamental principles associated with energy systems and evaluate their application in engineering design and sustainable development.	☒	☒		☒	☒				

Teaching and Learning Activities

There are nine notation learning hours per week for this course. The course is designed around 4 modules and will be delivered using a Blended Learning approach. The course teaching and learning activities will include the following:

- Engaging students with live discussions for two hours every week.
- Teaching the students how to design and evaluate energy systems.
- Practical experiments will be done once a week for one hour, and these experiments will include the simulation of different energy systems.
- Engaging the student's live tutorials weekly.
- Completing mock test formative assessments to prepare for the summative assessments.

Course Teaching and Learning Activities		**Course Learning Outcomes** (CLO)
Live session	Mix of live synchronous sessions and core course notes and materials (reading materials/case studies etc.)	1,2,3,4
Lab	Practical component using software's.	1,2,3,4
MS Teams Tutorials	MS Teams tutorials and discussion forums	1,2,3,4
Discussion Forums	Remote study activities and practice exercises etc.	1,2,3,4

Course Assessment Methods

Assessment Method	**Description**	**Weight**	**Due Date**	**Course Learning Outcomes**

Assessment 1	During week 9 the students will have a mid-semester exam to measure the materials studied in the first half of the semester.	30%	Week 9	1,2,3
Assessment 2 (Lab Report)	Students will be exposed to some experiments. Students will then be requested to write reports on the experiments including theories, practical results, calculations, and conclusions.	20%	Durin g the semes ter	1,2,3
Final Assessment	At the end of the semester, students will have a final assessment contains a set of questions answered under examination conditions.	50%	Week 15	1,2,3,4

Course Policy

Academic Dishonesty and Misconduct

There is no tolerance at Sohar University for academic dishonesty and misconduct. The university expects all students to conduct themselves with dignity and to maintain high standards of responsible citizenship. It is the student's responsibility to address any questions regarding what might constitute academic misconduct to the course coordinator or academic advisor for further clarification. University Regulations on academic misconduct will be strictly enforced. Please refer to the Student Handbook for further details on plagiarism, academic honesty, and attendance regulations.

Attendance

The University statement of policy indicates that students must attend 70% of total class hours or they will be in violation of the attendance policy. It is also the student's responsibility to check their absence record that is available via intranet.

Ethical Conduct in Research for Coursework

For all courses that include a research component or final year project, the Project Supervisor must ensure that the SU Ethical Approval forms and procedures are completed where research will involve human subjects and/or the use of bio-hazardous materials. The relevant approvals must be sought before the project is given final approval.

Graduate Attributes	Learning & Teaching Methods	Assessment
Communication • Interpret, communicate and adapt information	Live sessions, tutorials, lab work, and problem-based learning.	Group reports, formative assessment
Information Technology • Select, use and interpret the appropriate information technology	Tutorial, lab, and homework problems solved using software's	Laboratory work and reports.
Numeracy • Use advanced cognitive and technical skills required to analyze and solve complex numeracy	Use of computer software to solve problems.	Assessments 1, 2, and final.
Creativity & Problem Solving • Apply theories in a given discipline or professional field in synthesizing and interpreting information.	Live synchronous discussion, tutorials, and lab	Laboratory work and reports, assessments 1 and final.
Team-working • Undertake advanced autonomous professional activities and/or adopt	Live sessions live tutorials and lab groups.	Laboratory work and reports.

leadership roles with full accountability for the management of tasks and their output		
Social & Ethic Responsibility • Apply advanced levels of time management successfully associated with advanced levels of responsibility and apply highly specialized entrepreneurial skills	Live synchronous discussion and tutorial sessions to consider social and ethical topics on energy systems and sustainability.	Laboratory work, reports, and assessments.
Critical Judgement • Manage learning tasks independently with an awareness of how new knowledge is developed and applied	Live synchronous discussion and tutorial sessions to consider relevant topics on how to judge energy systems.	Discussions with students during the live session.

Additional Course Information

The Course Coordinator and teaching assistant are available for consultation at times that are displayed on the SULMS. SULMS is also another venue for additional information about the course. Queries may also be emailed to the course coordinator and/or teaching assistant on their email, given above.

Outline Teaching Schedule

Week No.	Week Starting	Module Title	Teaching and learning activities
1	6/09/2020	Module 1: Renewable energy & solar radiation: • Renewable & non-renewable energy • Sustainable development • Solar radiation and energy	Live Synchronous Discussion Sessions. Live Synchronous Tutorial Sessions. Student Discussion Forum. Live Synchronous Lab Sessions.
2	13/09/2020		
3	20/09/2020		
4	27/09/2020	Module 2: Photovoltaic & solar thermal: • Solar cell and photovoltaic • Photovoltaic performance and applications • Thermal collectors and photovoltaic/thermal systems	Live Synchronous Discussion Sessions. Live Synchronous Tutorial Sessions. Student Discussion Forum. Live Synchronous Lab Sessions.
5	04/10/2020		
6	11/10/2020		
7	18/10/2020	Study Week	
8	25/10/2020	Module 3: Wind, hydro, and OTEC energy: • Wind energy systems • Hydro energy systems • OTEC energy systems	Live Synchronous Discussion Sessions. Live Synchronous Tutorial Sessions. Student Discussion Forum. Live Synchronous Lab Sessions.
9	1/11/2020		
10	8/11/2020		
11	15/11/2020	Module 4: Biomass, geothermal, and energy conservation: • Biomass, Hydrogen & Fuel Cells • Energy Conservation and Geothermal energy • Climate change and energy	Live Synchronous Discussion Sessions. Live Synchronous Tutorial Sessions. Student Discussion Forum. Live Synchronous Lab Sessions.
12	22/11/2020		
13	29/11/2020		

14	6/12/2020	Revision	
15	13/12/2020	Revision	
16	20/12/2020	Final Exam	

List Reading/References or Online Resources

Essential Reading:

- Da Rosa, A. V. (2012). *Fundamentals of renewable energy processes*. Academic Press.
- Everett, R., Boyle, G., Peake, S., & Ramage, J. (2012). *Energy systems and sustainability: Power for a sustainable future*. Oxford University Press.
- Quaschning, V. (2016). *Understanding renewable energy systems*. Routledge.

Approved by:	**Date**	**Signature**
Course Coordinator	**Professor Bourhan Tashtoush**	
Program Coordinator	**Dr. Anas Qutaishat**	
Faculty Dean	**Professor Bourhan Tashtoush**	

COURSE PROFILE FORM

Faculty:	Engineering				
Program	Mechanical and Mechatronic Engineering				
Course Details					
Course Code	MECH4513	**Course Title**	Refrigeration and Heat Engines	**Course Level**	
Duration/hours of learning	16 weeks / 10 hours per week of notional learning		**Credit Units**	2	
Semester of Delivery	Semester 1 ☐	Semester 2 ☒	Semester 3 ☐	**Academic Year:**	2020-21
Course Coordinator	Prof. Bourhan Mohammad Tashtoush		**e-mail**	BTachtoush@su.edu.om	
Teaching Staff	Prof. Bourhan Mohammad Tashtoush		**e-mail**	BTachtoush@su.edu.om	
Teaching Assistant	Dr. Vinod Kumar		**e-mail**	vkumar@su.edu.om	
Technical Staff	Mr. Mohammed Mamari		**e-mail**	MMaamari@su.edu.om	
Course Moderator	Dr. Norie Akeel		**e-mail**	nakeel@su.edu.om	
Course Requirements					
Compulsory Prerequisites	MECH3508	**Recommended Prerequisites**	MECH3408		
Awards					
Diploma ☐	Bachelor ☒	Higher Diploma ☐	Master ☐		
Course Type:	Core ☒	Elective ☐			
Course Aims					
This course aims are to study thermodynamic principles and fundamentals of heat engines, refrigeration & air conditioning.					

Course Objectives

The objective of this course is to provide the knowledge of:

1. The principles of internal and external combustion engine cycles and their performance.
2. The theory of refrigeration of real-world situations and problems.
3. Psychrometry and psychrometric processes in air-conditioning.

Guidelines on Grading and Standards of Assessment

Note: SU uses criterion-based assessment, thus, descriptors should be established so that students are clear about what is expected of them.

%	Grade	Descriptor
85 - 100	**4.0**	**Exceptional performance:** The student provided an exceptionally high quality of performance and through this demonstrated an exceptionally high standard of learning achievement in relation to the course learning outcomes.
75 - <85	**3.5 - <4.0**	**Excellent Performance:** The student provided a high quality of performance and through this demonstrated a high standard of learning achievement in relation to the course learning outcomes.
65 - <75	**3.0 - <3.5**	**Very good Performance:** The student provided a very good quality of performance and through this demonstrated a sound standard of learning achievement in relation to the course learning outcomes.
57.5 - <65	**2.5 - <3.0**	**Good Performance:** The student provided good quality of performance and through this demonstrated an acceptable standard of learning achievement in relation to the course learning outcomes.
50 - <57.5	**2.0 - <2.5**	**Satisfactory Performance:** The student provided an acceptable quality of performance and through this demonstrated an acceptable standard of learning achievement in relation to the course learning outcomes.
0 - <50	**0 - <2**	**Fail:** The student did not provide a quality of performance that demonstrated an acceptable standard of learning achievement in relation to the course learning outcomes.

Course Learning Outcomes (CLO)	**Program Learning Outcomes** (PLO)										
On successful completion of this course you will be able to:	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11
1. Evaluate the thermal performance of air standard cycles such as Otto, Diesel, Dual, Stirling and Ericsson, etc.	☒	☒				☒		☒			
2. Calculate the cycle efficiency of steam turbine, gas turbine, and combined power cycles	☒	☒				☒		☒			
3. Assess the performance of internal combustion engines	☒	☒				☒		☒			
4. Determine the coefficient of performance of various aircraft refrigeration systems.	☒	☒				☒		☒	☒		
5. Estimate the thermal performance of basic and multistage vapor compression refrigeration systems, multistage evaporator refrigeration cycles, and vapor absorption refrigeration systems.	☒	☒		☒		☒		☒	☒		

6. Calculate the cooling and heating loads of various psychometric processes and air-conditioning systems.	☒	☒				☒	☒	☒		

Teaching and Learning Activities

The course is designed of four modules and will be delivered using a Blended Learning approach. There are 4 hours of synchronous live sessions (2 hours’ live discussion sessions and 2 hours' live tutorial sessions) through MS TEAMS supported by laboratory experiments. The course teaching and learning activities will include the following:

- Live synchronous discussion and tutorial sessions through MS teams
- Performing practical experiments on IC Engines and Refrigeration systems
- Engaging group work to calculate cooling loads on the air-conditioning system
- Practice exercises on compound refrigeration systems
- Hands-on training at the centralized air conditioning plant of SU

Course Teaching and Learning Activities		**Course Learning Outcomes** (CLO)
Synchronous sessions	The synchronous live discussion sessions on each topic are on gaining a conceptual understanding of the theory. Discussion sessions are presented for 2 hours weekly through the MS TEAM platform.	1,2,3 ,4,5, 6
Tutorials	Synchronous live sessions on problem-solving tutorials are given in 2-hour sessions once every week through MS TEAMS. There is a tutorial question sheet for each main topic that is made available to students at the beginning of the semester.	1,2,3 ,4,5, 6
Lab	Each student will be required to submit a report on lab experiments containing their findings.	1,3,5
Homework and discussions	Remote study activities and practice exercises etc.	2,4

Course Assessment Methods

Assessment Method	**Description**	**Weight**	**Due Date**	**Course Learning Outcomes**
Formative Assessment	Students will participate in formative assessments during discussion sessions and tutorial sessions	0%	3rd & 10th Week	1,5
Assessment 1	Students will have an assessment-1 during week 6/8 covering module 1 and module 2.	25%	6/8th week	1,2
Assessment 2 (Lab reports)	Lab experiments are aiming to provide students with opportunities to work hands-on on an industrial scale and lab-scale equipment. Students will be able to relate theoretical and practical concepts and apply learned engineering calculations. Lab reports are required to enable the student to achieve the learning outcomes.	25%	8th& 9th Weeks	1,3,5

Final Assessment	At the end of the semester, students will have a final assessment (essay type) that contains a set of questions answered under examination conditions.	50%	TBA	3,4,5,6

***All assignments must be submitted through Turnitin.**

Course Policy

Academic Dishonesty and Misconduct

There is no tolerance at Sohar University for academic dishonesty and misconduct. The university expects all students to conduct themselves with dignity and to maintain high standards of responsible citizenship. It is the student's responsibility to address any questions regarding what might constitute academic misconduct to the course coordinator or academic advisor for further clarification. University Regulations on academic misconduct will be strictly enforced. Please refer to the Student Handbook for further details on plagiarism, academic honesty, and attendance regulations.

Attendance

The University statement of policy indicates that students must attend 70% of total class hours or they will be in violation of the attendance policy. It is also the student's responsibility to check their absence record that is available via intranet.

Ethical Conduct in Research for Coursework

For all courses that include a research component or final year project, the Project Supervisor must ensure that the SU Ethical Approval forms and procedures are completed where research will involve human subjects and/or the use of bio-hazardous materials. The relevant approvals must be sought before the project is given final approval.

Graduate Attributes	Learning & Teaching Methods	Assessment
Communication • Interpret, communicate and adapt information	Live synchronous discussion and tutorial sessions and Lab experiments	Formative Assessments
Information Technology • Select, use and interpret the appropriate information technology	Live synchronous Tutorials and Lab experiments	Assessment-2
Numeracy • Use advanced cognitive and technical skills required to analyze and solve complex numeracy	Live synchronous tutorial sessions and Lab experiments	Assessment-1,2 and final Assessment
Creativity & Problem Solving • Apply theories in a given discipline or professional field in synthesizing and interpreting information.	Lab experiments and live synchronous tutorials sessions	Assessment-2 and final Assessment
Team-working • Undertake advanced autonomous professional activities and/or adopt leadership roles with full accountability for the management of tasks and their output	Performing practical experiments on IC Engines and Refrigeration systems	Assessment-2
Social & Ethic Responsibility • Apply advanced levels of time management successfully associated with advanced levels of responsibility	Live synchronous discussion sessions, and Performing practical experiments on IC Engines and Refrigeration systems	Assessment-1,2 and final Assessment

and apply highly specialized entrepreneurial skills		
Critical Judgement • Manage learning tasks independently with an awareness of how new knowledge is developed and applied	Live synchronous discussion sessions, and Lab experiments	Assessment-1,2 and final Assessment

Additional Course Information

The Course Coordinator and teaching assistant are available for consultation at times that are displayed on the relevant office notice board. SULMS is also another venue for additional information about the course. Queries may also be emailed to the course coordinator and/or teaching assistant on their email, given above.

Outline Teaching Schedule

Week No.	Week Starting	Title	Teaching and Learning Activities
1	24/01/2021	Module 1: Introduction to Gas Power Cycles • Introduction • Gas Power Cycles • Vapor Power Cycles • IC Engines	• Live synchronous discussion sessions on Gas and vapor power cycles • Live synchronous Tutorial 1 # Gas and vapor power cycles • Students discussion forum.
2	31/01/2021		
3	07/02/2021		
4	14/02/2021		
5	21/02/2021	Module 2: Air Refrigeration cycles • Air Refrigeration Cycles. • Aircraft Refrigeration Systems	• Live synchronous discussion sessions on IC Engines, Air refrigeration cycles • Live synchronous Tutorial 2 # Air Refrigeration cycles • Students discussion forum
6	28/02/2021		
7	07/03/2021	Self-Study Week	
8	14/03/2021	Module 3: Vapor Compression and Vapor Absorption Refrigeration Systems • Vapor Compression Systems • Vapor Absorption Systems • Refrigeration System Components	• Live synchronous discussion sessions on simple and compound vapor compression systems and vapor absorption systems • Live synchronous Tutorial3 #: vapor compression systems • Lab 1# Load test on Petrol Engines • Lab 2# Load test on Diesel Engines
9	21/03/2021		
10	28/03/2021		

			• Lab 3# Vapor compression refrigeration system • Lab 4# Vapor absorption refrigeration system • Students discussion forum
11	04/04/2021	Module 4: Air-Conditioning Systems • Psychrometry • Psychrometric Processes • Air-conditioning Processes and Systems	• Live synchronous discussion sessions on psychrometric processes and Air-conditioning systems • Live synchronous Tutorial 4 # Air-conditioning systems • Students discussion forum
12	11/04/2021		
13	18/04/2021		
14	25/04/2021	Revision Week	
15	02/05/2021		
16	09/05/2021	Final Assessment	

List Reading/References or Online Resources

Essential Reading:

1. Wilbert Stocker, 2004, Refrigeration and air-conditioning, second edition, McGraw-Hill International editions.
2. R.S Kurumi, 2014, Thermal Engineering, Fifteenth Edition S Chand Publications.
3. Yunus A. Cengel, Michael A. Boles, 2008, Thermodynamics: An Engineering Approach, 6th Edition McGraw-Hill.

Recommended Reading/ Online Resources:

1. A. R. Trott and T. Welch, 2000, Refrigeration and air-conditioning**,** Third edition, Butterworth-Heinemann.

Approved by:	**Date**	**Signature**
Course Coordinator	**19-01-2021**	Prof. Bourhan Mohammad Tashtoush
Program Coordinator	**20-01-2021**	**Dr. Vinod Kumar**
Faculty Dean	**21-01-2021**	Prof. Bourhan Mohammad Tashtoush

BLENDED LEARNING COURSE REVIEW FORM

Faculty	Engineering	**Semester/Year**	**2/2020-21**
Course Title	Refrigeration and Heat Engines	**Course Coordinator**	Prof. Bourhan Tachtouch

Course Code	MECH4513	Course Moderator	Dr.Norie Akeel

COORDINATOR FEEDBACK

1. List some examples of what went well during the delivery of this course.

- Delivery of live sessions and tutorials through MS Teams was successful.
- Successfully conducted remote lab experiments and Simulations.
- Various activities and mini-projects were included.

2. List some of the difficulties faced during the delivery of this course. Indicate how these were addressed or might be for future delivery.

- Measures to control plagiarism during online assessments
- Few part-time students couldn't participate actively due to their work-related issues

3. What improvements are required to enhance the delivery of this course and improve student performance in the next delivery?

- Conducting laboratory experiments on campus
- Include more activities (simulations, remote lab experiments, etc.)

4. Comment on the overall adequacy of resources used to deliver this course.

Computer hardware & software	Adequate
SULMS (and MS Teams)	Adequate
IT infrastructure	Adequate
Equipment (camera, microphone, etc.)	Adequate
E-resources	Adequate

5. Indicate what additional resources are required to improve the next delivery of this course.

Assessments and lab experiments to be conducted on the campus.

6. Indicate any changes that were made in the course from last year and how effective these were.

	What changes were made in this aspect of this course this year?	How effective were the changes made?
Objectives	N/A	
Course Learning Outcomes	N/A	
Syllabus (course materials, etc.)	N/A	
Assessment type	Assessment 1: Essay type test Assessment 2: Lab reports	Students' learning was impressive in the MS Teams platform. Pre-recorded remote lab experiments helped them to apprehend the practical applications
Number of assessments	Three	Students learning was impressive in the MS Teams platform

Delivery methods (e.g. webinars, online advising, home experiment)	Live synchronous discussion sessions and, tutorials sessions, Pre-recorded remote lab experiments, and virtual experimental/simulation activities	Improved interaction and communication skills in the online platform
Other (indicate)	Virtual, Simulation Lab	Improved engagement of the students

ASSESSMENT AND GRADING

7. Indicate which assessment types were used.

☐	Multiple Choice Questions	☒	Report writing
☐	Gap-fills, short questions, matching-choices quizzes	☒	Problem-solving exercises
☒	Essay questions	☐	Presentations
☒	Turnitin Assignments	☐	Others (please indicate)

Comment on how effective the assessment type used was to measure student achievement of the outcomes.
The assessment methods used such as essay-type tests, pre-recorded remote lab experiments, virtual simulation experiments, and final exams were effective.

8. Indicate how the learning outcomes of the course were measured (%) in the assessment.

Course Learning Outcomes	**Assessment-1 (Essay Questions)**	**Assessments-2 (Turnitin)**	**Final Exam (Essay Questions)**
1. Evaluate the thermal performance of air standard cycles such as Otto, Diesel, Dual, Stirling and Ericsson, etc.	25	25	
2. Calculate the cycle efficiency of steam turbine, gas turbine, and combined power cycles	25		
3. Assess the performance of internal combustion engines		25	
4. Determine the coefficient of performance of various aircraft refrigeration systems.	50		
5. Estimate the thermal performance of basic and multistage vapor compression refrigeration systems, multistage evaporator refrigeration cycles, and vapor absorption refrigeration systems.		50	50
6. Calculate the cooling and heating loads of various Psychrometric processes and air-conditioning systems.			50

Comment on any changes needed for the next delivery of this course.
No

9. Indicate how graduate attributes were embedded in the mode of delivery and assessment of this course. (Write NA if not applicable for this course)

Graduate Attributes	**Teaching and learning**	**Assessment**

Communication	Live synchronous discussion sessions, tutorials sessions, Practical components activities	Assessment 2 (Lab reports), Formative assessment
Information Technology	Tutorials, homework problems, and Practical components activities.	Assessment 1, Assessment 2 (Lab reports) and Final Assessment
Numeracy	Live synchronous discussion sessions and tutorials sessions	Assessment 1, Assessment 2 (Lab reports), and Final Assessment
Creativity & Problem-Solving	homework problems and Practical components activities.	Assessment 1, Assessment 2 (Lab reports) and Final Assessment
Team-working	Practical components and live synchronous tutorials sessions	Assessment 2 (Lab reports) and Final Assessment
Social & Ethics Responsibility	Practical components.	Assessment 2 (Lab reports)
Critical Judgement	Live synchronous discussion sessions, tutorials sessions, and Practical components.	Assessment 1, Assessment 2 (Lab reports) and Final Assessment

Comment on any changes needed for the next delivery of this course.

- Include more activities and simulations in cooling load calculations

10. Indicate how feedback was provided to students on assessed work for this course.

- All assessment model answers were discussed with the students.
- Feedback for each student was provided through MS Teams and email upon their requests

11. Distribution of Grade/Marks and other Outcomes

Registered Student Nº.	Grade 4	Grade 3.5 - <4.0	Grade 3.0 - <3.5	Grade 2.5 - <3.0	Grade 2.0 - <2.5	Grade <2
19	0	2	7	6	4	0

12. Provide a summary of student performance and indicate how this compared to the previous academic year.

Item	**#**	**Comparison to Previous Academic Year**
Nº of the students registered in the course	19	☐ Same ☐ More Students ☒ Fewer Students ☐ NA (new course)
Nº of students withdraw from the course	0	☒ Same ☐ Increase ☐ Decrease ☐ NA (new course)
Nº of students taking a resit exam	0	☒ Same ☐ Increase ☐ Decrease ☐ NA (new course)
Mean % score overall	64	☐ Same ☐ Increase ☒ Decrease ☐ NA (new course)
The pass rate in the course	100 %	☒ Same ☐ Increase ☐ Decrease ☐ NA (new course)
Pass rate last year	100%	
Pass rate two years ago	100%	

STUDENT FEEDBACK

13. Provide the student feedback on how this course helped improve the following graduate attributes (Taken from the end of semester student survey)	**Average Score**	
	No of responses	**Av. score**
1. Written and spoken communication skills		
2. Ability to solve numeracy problems		
3. Ability to use IT in a study context		

4. Ability to be creative to solve a range of tasks and problems		
5. Ability to learn independently and use your initiative to develop new skills		
14. Provide the outcome of the student feedback on this course delivery (Taken from the end of semester student survey)	**Average Score**	
	No of responses	**Av. score**
1. Learning material provided		
2. Academic support from staff		
3. The SULMS		
4. Discussion forums (on SULMS and MS Teams)		
5. Live sessions in MS Teams		
6. Feedback on course assessment		
7. Academic advising		
8. IT support		
9. Library resources and support		
10. Information on the website		

QUALITY ENHANCEMENT

15. What quality assurance processes were used to ensure that course materials met the needs of the students?

- All course materials were moderated and approved by the Faculty and university moderation panels.
- Marking schemes were prepared.

16. What quality assurance processes were used in the assessment of students' work? (Example: marking schemas; peer-reviewing, moderation, use of Turnitin, double marking, etc…).

- SU assessment guidelines were followed.
- The assessments were marked as per the marking scheme.
- The assessments were moderated and approved by the University Moderation panel.

17. What strategies were used to ensure high levels of academic integrity in this course? (Example Turnitin, sequential MCQs, shuffling MCQs, etc.).

- Students were asked to type their answers instead of uploading files in SULMS. This has reduced the chances of cheating
- The essay type test had several different question sets using random selection and shuffling
- The assessments were submitted through Turnitin to check the plagiarism

18. List any areas of good practice (e.g. new/innovative teaching methods/assessments) to be shared across faculties.

- Use of pre-recorded remote lab experiments and virtual simulations.
- Use of mock assessment as a practice in the online system before the real assessment

Approved by:	Name	Date
Course Coordinator	Prof. Bourhan Tachtouch	25/05/2021
Program Coordinator	Dr. Vinod Kumar	25/05/2021
Faculty Dean	Prof. Bourhan Tachtouch	26/05/2021

REFERENCES

Name and address of 5 References:

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