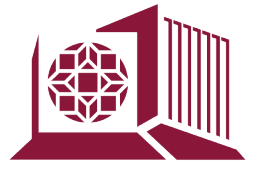


جامعة قطر  
QATAR UNIVERSITY



كلية الهندسة  
COLLEGE OF ENGINEERING



# CHEMICAL ENGINEERING DEPARTMENT NEWSLETTER

SPRING 2024  
ISSUE 13

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## WELCOME

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# Greetings from the New Head of the Department



Dear colleagues and friends,

It is my distinct pleasure to be writing my first note as chair of Qatar University's Department of Chemical Engineering. On behalf of the entire department, I would like to express our gratitude to Prof. Majeda Khraisheh for her dedicated service as the previous head of the department.

As we move forward, I am excited about the opportunities to advance the department's interests and celebrate our accomplishments together. The new College of Engineering building has brought us closer, allowing for increased collaboration and interaction among us.

It is with mixed emotions that we share the news of Prof. Ibrahim Abu Reesh's departure at the end of this academic year. Since joining us in 2011, Prof. Abu Reesh has made significant contributions to teaching and research within the department. We wish him the best in his future endeavors.

I am pleased to highlight some upcoming events organized by the department, including the 20th Annual Plant Design competition in collaboration with Qatar Energy LNG on Tuesday, 7th May 2024. Additionally, we are pleased to announce that The 4th International Congress of Engineering and Technology (ICET) will feature the 6th International Gas Conference and The 4th World Energy Storage Conference (WESC) on December 2-5, 2024.

Thank you for your continued support and dedication to our department.

I look forward to our continued collaboration and success.

Dr. Mohammed J. Al-Marri  
Chair and Associate Professor  
Department of Chemical Engineering

## 'Thank you' message from the former head of the department



When I began this journey as the head of our department, I could not have foreseen the incredible growth, achievements, and the close-knit community we would build. It has been an honor and a privilege to lead such a talented, dedicated, and passionate group of individuals. Together, we have not only sustained but also significantly enhanced our department. Our journey has been marked by numerous milestones achieved by the collective efforts of each member—faculty, TAS, Technicians, administrative staff, and our brilliant students.

One of our most prominent accomplishments lies in our consistent climb in subject rankings. Our focused efforts to enhance research output, strengthen academic programs, and foster an environment of academic excellence have contributed to the substantial rise in our subject rankings. This achievement not only reflects our commitment to academic rigor but also demonstrates our capability to compete on a global scale.

Our journey has been highlighted by the extensive changes to our curriculum. The meticulous restructuring of our curriculum has been instrumental in preparing our students to meet the challenges of a rapidly evolving field. Our new graduate programs and MSc in Gas Process Engineering was a great achievement and addition to our graduate programs.

Securing the prestigious ABET accreditation stands as a testament to our dedication to academic excellence and adherence to the highest standards. The accreditation signifies our commitment to providing an education that meets the stringent criteria for quality and consistency. It validates the hard work of our faculty and staff in continuously improving the quality of our educational programs and fostering an environment of continuous learning and development.

These achievements have not been solitary; they have been the fruits of our collective efforts, from the unwavering commitment of our faculty to the unyielding support of our administrative staff, and the enthusiasm and determination of our students.

I am confident that the department is in a prime position to continue its upward trajectory. Our accomplishments in subject rankings, curriculum enhancement, and ABET accreditation serve as a solid foundation for future growth and success.

I extend my deepest gratitude to each one of you for your dedication, hard work, and support in achieving these remarkable milestones. I am immensely proud of what we have accomplished together and am certain that the department will continue to flourish.

I eagerly anticipate the future successes and groundbreaking advancements that our department will undoubtedly achieve. Thank you for making these past seven years an inspiring and fulfilling chapter in my professional life.

With warm regards and best wishes,  
Prof Majeda Khraisheh

# NEWS

## QU names winners of 6th ChemE Car Competition for High School Students 2023



Khalifa Secondary School, Qatar Science and Technology Secondary School, and Ibn Taymya Secondary School were named first, second and third place winners in their category at the recent closing ceremony of the 6th ChemE Car Competition for High Schools.

The event took place in Qatar University on Monday 20 February 2023, and it was organized by the Department of Chemical Engineering and College of Engineering (CENG) in collaboration with its AIChE (American Institute of Chemical Engineers) student chapter. Ten high schools in Qatar participated in this year's edition.

The competition aims to encourage creativity and innovation among students and also to reach out to high school students to motivate them towards studies in chemical engineering. The competition required participants to design and race a small car that is operated through chemical processes and carrying a load of water (0-500g) for a distance of between 15-30 meters. Teams were given information of the load amount and distance about 2 hours before the competition. This year the load was 150 g and the target distance was 15.0 meters.

In the lead-up to the competition that started in October 2022, the Department of Chemical Engineering team offered several sessions for the participating schools to guide them on competition guidelines, rules, and safety regulations in addition to the main phases they need to go through to accomplish their car designs and calibration tasks.

This competition aims to provide high school students about the field of engineering through innovative hands-on learning. The goal is to motivate students to pursue their future careers in science and engineering fields, which coincides with Qatar National Vision 2030.



Commenting on the competition, Prof. Majeda Khraisheh said: “It is exciting to see that almost 70 students participated this year from high schools in this event. Today was truly an exciting day for us. It was nice to see the students deeply engaged in the competition and to see their teachers guiding and supporting their efforts. We like to extend our gratitude to the principals and administration of the ten participating independent schools; and we look forward to seeing them back again next year”. “One of the main goals of the competition is to see how students overcome the technical challenges they face as they prepare for the race. All student teams worked well together to address these challenges.”, she added. ■



# NEWS

## 24th Gulf Engineering Forum 2023: Advancing Environmental Engineering and Sustainability in GCC Nations



The 24th Gulf Engineering Forum took place from 7th March- 9th March 2023 in Doha with extensive panel discussions and the presentation of research papers on important topics such as trash recycling, digital transformation, and lowering carbon footprint in GCC nations. The forum intended to gather together a variety of experts and specialists to raise and discuss engineering issues related to the environmental sector and areas of sustainability by using the best cutting-edge solutions, contemporary technologies, and designs to implement environmentally friendly engineering projects that maintain sustainability.

Under the Ministry of Municipality, Gulf Engineering Federation, and Qatar Society of Engineers three-day conference at the Sheraton Hotel was hosted on "Environmental Engineering and Sustainability" under the patronage of the Prime Minister Sheikh Khalid bin Khalifa bin Abdulaziz Al Thani.



The opening ceremony was attended by Minister of Municipal and Rural Affairs and Housing of Saudi Arabia H E Majid bin Abdullah Al Hogail, Assistant Undersecretary for Urban Planning Affairs and at the Ministry of Municipality and Chairman of the Higher Organizing Committee of the 24th Gulf Engineering Forum Eng Fahd Muhammad Al Qahtani, Secretary-General of the Gulf Engineering Union Eng Mohammad Ali Al Khuzai, Minister of Municipality H E Dr. Abdullah bin Abdulaziz bin Turki Al Subaie and Secretary General of the Federation of Arab Engineers Dr. Adel Al Hadithi.

Department of Chemical Engineering from Qatar University is proud to be a part of it. Eng. Tooba Qureshi under the assistance of Dr. Fares Almomani and Dr. Majeda Khraisheh were a part of this event to present their recently published study on “Cost and Heat Integration Analysis for CO<sub>2</sub> Removal Using Imidazolium-Based Ionic Liquid-ASPEN PLUS Modelling Study”. ■

# NEWS

## Qatar University's Engineering Week 2023: Inspiring the Future Engineers



Engineering Week had been held in-conjunction with the activities of the Open Day of Qatar University 2023 from 7th to 9th of February 2023. This event guides the high school students and Qatari community on the importance of engineering in the growth and development of the State of Qatar. This annual three-day event was enriched with providing high school students with insights into undergraduate programs in the College of Engineering programs and allow them to visit the booths displaying information about the various programs and experience by participating through the colleges' competitions and activities.

The Department of Chemical Engineering had an active and clear role in this event. Where, the representatives' students of the Department of Chemical Engineering provided a detailed presentation on the concept of separation process such as cooling towers. The high school students were impressed and clearly interested in the demonstration and discussed their inquiries with the third- and fourth-year chemical engineering students. In addition, a group of faculty members from the Chemical Engineering Department had shared their rich experiences with the high school students.



Furthermore, the Department of Chemical Engineering was nominated to be one of the leading majors that offered a competition for high school students (male and female). The interaction of those students with the competition was excellent, and they showed great interest and curiosity to learn the activities' objectives, achieve it, and win it. This is a clear proof that demonstrated their passion. Eventually, a good discussion had been coordinated by the volunteering students from the Department of Chemical Engineering on potential jobs, the labor market, the nature of courses, and admission requirements which led to increase the knowledge and awareness of the importance of this Engineering discipline and the weight of the specialization and its impact on the scientific future of Qatar.

The event was very successful, the president of engineering students "AbdulAziz AbouEmter" said "I believe that we were able to reach that segment of society that, currently, needs support to know their academic orientations, refine their skills and knowledge, and set their goals for what is to come". He added, "I believe that we, as a family of students and faculty members of the Chemical Engineering Dept., were able to present the department and the community of Qatar university to the society and, most importantly, the high school students with various



Finally, the Chemical Engineering Department concluded this event by awarding the volunteers with certificates as recognition for their efforts and work for making this event successful, informative, and enjoyable for all participants. The awarded students were AbdulAziz AbouEmter, Assim Al-Ajali, Abdulla Al-Saadi, Asma Al-Mannai, Ohoud Al-Yafei, Dana Khalili, Maryam Hamad Al-Nuaimi, Sahar Ahmed, and Fatima Al-Obaidili. ■

# NEWS

## Knowledge Transfer between QAPCO and Senior Chemical Engineering Students



Eng Mohammed Alyafei, Eng Fahad Binghorab accompanied by Eng Ian Davies from Qatar Petrochemical Company (QAPCO) organized an introductory seminar to 50 senior students from Chemical Engineering Department on Monday, 25th September 2023. The discussion was mainly on improving the students' knowledge on the real-world industry' challenges as process engineer, QAPCO safety such as HAZOP, optimization of process and QAPCO's innovation. Eventually, this session significantly impacts ChemEng students' competency as Eng Alyafei and Eng Binghorab highlighted the positive examples in saving the cost of QAPCO by fresh engineers. ■

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# NEWS

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## Shell Global Solutions Chief Process Engineer, Mr. Frank van Breukelen presented at the First Department Seminar 2023



Mr. Frank van Breukelen, the Chief Process Engineer and Global Discipline Head in Shell Global Solutions International BV was the guest speaker in the dept of chemical engineering seminar series on Wednesday, 20 September 2023. His talk's title is "Powering Progress through Shell's Process Engineers". His talk emphasized that Process Engineering is key to Shell's success. Moreover, he highlighted the role of approximately 2,200 process engineers in Shell to lead the development and deployment of technology, asset design and realization, and support asset operations. During the presentation, more details were provided on Shell and the career paths of process engineers in Shell. ■

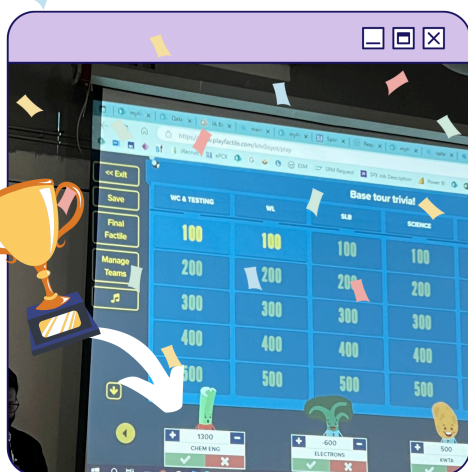
# EVENTS

## Schlumberger (Slb) Base Tour



On the 27th February, a group of Chemical and Electrical engineering students joined by their advisors: Dr. Zeinab Jawad and Eng. Badreddine Khelifi, visited Slb Base. The tour started off with a brief introduction about Slb company work and core values. After that, a tour around the base workshops was given. In the workshop areas, Slb engineers gave a detailed explanation about their work in each specific area. The visit was in three main workshop areas: Design and Maintenance, Wirelines, and Testing. Lastly, the tour was concluded with a trivia competition to test the knowledge gained by the students from the tour. The competition included questions about Slb, wirelines, well construction and testing, and other general engineering questions.

### The "CHEM ENG" team from Qatar University won the first place!



"It was a great opportunity to be in this field trip, and a great experience. The trip was very informative and all the people there were really friendly and helpful. I enjoyed seeing stuff we studied applied in real life."

Alreem Al-Musleh

"The tour was really enlightening, I got to see the industry for the first time, and learn from the engineers at Slb. Also, I got to learn about Slb new logo and the meaning behind it."

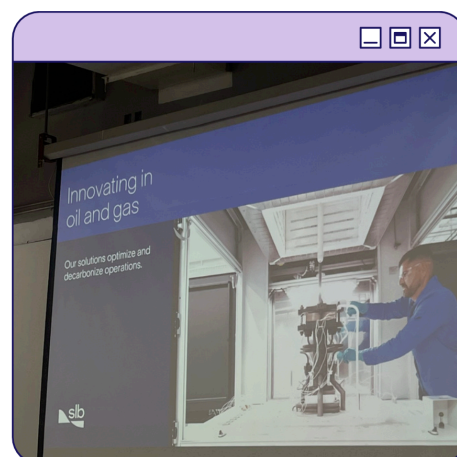
Maryam Al-Naimi

"The trip was a great opportunity to see the chemical engineers' sketches in reality! Also, Slb has good teamwork values and it was obvious without them talking about it. As an engineer, you should always care about teamwork because you cannot build an entire plant on your own! Moreover, as each employee talks I notice that Slb puts family first, which increases their loyalty to Slb."

Ruqaya Al-Sada

"Knowing the industrial sector has opened many doors for us as a future engineers. It built a clear vision of what I should do in the future and where to be. Besides, expanded my knowledge about the services and technology offered by Slb and where a chemical engineer fit in."

Mariam Dalloul



# CONGRATULATIONS

## Congratulations to Haneen Abdelrazeq on her successful PhD defense!



One of Qatar University's distinguished Ph.D. Students, Haneen Abdelrazeq successfully defended her Ph.D. dissertation entitled: "Optimizing Pilot-Scale Performance of Superhydrophobic Membranes by Direct-Contact Membrane Distillation" on May 2nd, 2023 in the Qatar University Research Complex. Haneen's research work was conducted under the supervision of Dr. Majeda Khraishah and the co-supervision of Dr. Mohammad Hassan. The research

was aligned with the latest innovative wastewater technologies and investigated the impact of synthetic brine on electrospun polystyrene and commercial polyethylene membranes using a bench-scale set-up, a high-tech DCMD pilot module, as well as optimization and numerical predictions using Python. Data obtained from the experimental work was compared with theoretical and predictive values, and similar trends in desalination performance were observed. The prediction model used in this study was effective in predicting the permeate flux as results have shown good agreement between the experimental results and the optimization model with an error between 8-13 %. In addition, the effect of varying brine concentrations on the desalination performance, the energetic performance, and the long-term impact of membrane fouling provided insights that are difficult to achieve through conventional bench-scale systems. Hence, this work involves a novel research approach at the large pilot-scale level.

Haneen was able to produce polystyrene-based and polymer-blended membranes with improved performance in direct contact membrane distillation that is superior to commercial filtration systems. Her work is the first to evaluate, predict, and optimize the desalination performance of electrospun polystyrene membranes at a pilot scale. The research findings highlight the effect of porosity on the efficiency of the DCMD pilot system with special emphasis on thermal and evaporation efficiency. The outcomes were published in the form of 5 articles in highly reputable Q1/Q2 journals in the field of polymer science, wastewater treatment, and membrane technology. Haneen also presented the results in conferences, and research seminars, and was awarded one student grant. In Qatar, Haneen won the 2nd place award in the National Arab Artificial Intelligence and Internet of Things with the entry topic: "Innovative water treatment systems in Qatar". ■

# CONGRATULATIONS

## Congratulations to Parisa Ebrahimi on her successful PhD defense!



Parisa Ebrahimi recently defended her Ph.D. dissertation on 25th May 2023 entitled “Catalyst Synthesis and Activity Evaluation for CO<sub>2</sub> Conversion using Reverse Water Gas Shift Reaction”. She has been working on this project for the past four years under the supervision of Dr. Anand Kumar and Prof. Majeda Khraisheh. The committee members who examined her defense session were Prof. Shaheen Al-Muhtaseb and Prof. Nimir Elbashir.

The following is a brief explanation of her work and the background of the research:

Recent climate changes have been primarily attributed to increasing CO<sub>2</sub> levels in the atmosphere by 60%, exacerbated by worldwide industrialization during the last century. In 2020, the global carbon dioxide content in the atmosphere hit a critical level of 409.89 ppm, while the average monthly reported concentration in September 2021 was 413 ppm, the highest level ever recorded. Unusual weather patterns, higher temperatures, the accelerated fading of sea ice, and acidification of the oceans are just a few of the detrimental environmental effects that are on a dangerous trajectory to getting even more pronounced. Carbon dioxide, on the other hand also provides opportunities for chemical production if considered as a cheap and abundant carbon source; and its chemical conversion to value-added chemicals and fuels not only minimizes CO<sub>2</sub> accumulation but also provides significant economic advantages. Forward and reverse water-gas shift (WGS/RWGS) reactions play a significant role in hydrogen production and carbon dioxide reduction, respectively. The efficiency of these reactions can be further enhanced by the use of a suitable catalyst. Transition metals are an effective alternative to noble metals, since they possess excellent catalytic properties for many of the reforming reactions, especially when incorporated into appropriate supports.

The primary objective of our research was to study appropriate transition metal-based catalysts, such as Cu and Ni, supported on reducible supports, such as CeO<sub>2</sub>, and non-reducible supports, e.g., La<sub>2</sub>O<sub>3</sub>, ZrO<sub>2</sub> for their performance in converting CO<sub>2</sub> into CO. Overall, our results showed that under the same experimental conditions, CeO<sub>2</sub> as support has better catalytic activity than La<sub>2</sub>O<sub>3</sub>, with 70% compared to 57% activity at 600 °C. However, the addition of Cu to La<sub>2</sub>O<sub>3</sub>-supported Ni catalysts improves CO selectivity and activity through the formation of stable alloys and improves the performance in the RWGS reaction by adjusting the reducibility of the active metals. Besides, the calcination temperature and amount of copper present in Cu/ZrO<sub>2</sub> catalysts have a significant effect on the CO<sub>2</sub> conversion performance of Cu/ZrO<sub>2</sub>, with the highest conversion of 37% observed at 600 °C for the catalyst with 2wt.% copper and calcined at 800 °C; however, increasing the metal loading to 5wt.% and calcination temperature to 1000 °C resulted in losing the catalytic activity. Other supports, such as cobalt oxide, may also be investigated in the future since it has some characteristics that make it effective for WGS reaction and is expected to perform well in RWGS reaction as well.

A total of 6 papers were published from this research and one is still under publication process. The publications are as follows:

1. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2020). A review of recent advances in water-gas shift catalysis for hydrogen production. *Emergent Materials*, 3, 881-917.
2. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2022). Thermodynamic assessment of effect of ammonia, hydrazine and urea on water gas shift reaction. *International Journal of Hydrogen Energy*, 47(5), 3237-3247.
3. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2022). A review of CeO<sub>2</sub> supported catalysts for CO<sub>2</sub> reduction to CO through the reverse water gas shift reaction. *Catalysts*, 12(10), 1101.
4. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2022). Analysis of combustion synthesis method for Cu/CeO<sub>2</sub> synthesis by integrating thermodynamics and design of experiments approach. *Results in Engineering*, 15, 100574.
5. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2022). Combustion synthesis of copper ceria solid solution for CO<sub>2</sub> conversion to CO via reverse water gas shift reaction. *International Journal of Hydrogen Energy*, 47(97), 41259-41267.
6. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2023). Combustion synthesis of lanthanum oxide supported Cu, Ni, and CuNi nanoparticles for CO<sub>2</sub> conversion reaction. *International Journal of Hydrogen Energy*, Published (In Press).
7. Ebrahimi, P., Kumar, A., & Khraisheh, M. (2023). Synergistic effect of zirconia oxygen vacancies and Cu nanoparticles on catalytic conversion of CO<sub>2</sub> to CO at low temperatures, (Under publication process).

Moreover, A number of conferences have also provided opportunities to present our work as oral or poster presentations and abstract publications such as AIChE (2021, 2022, 2023), ANM (2021, 2022, 2023), ACS (2022, 2023), AEM (2022), CSC (2022), ECCS (2021), NAM (2023), WCSAS (2022), etc. ■

# CONGRATULATIONS



## Winning Multiple Design Awards in CENG Capstone Design Competition 2023



College of Engineering organized the CENG Capstone Design Competition Version 1 on 11th June 2023, from 10:00 a.m.-12:00 pm. This competition recognized the efforts and innovations of senior students who worked on their projects in CENG programs.

In the chemical engineering department, the top four scoring teams of Senior Design Project II (CHME422) final presentation participated in the two main categories “Best Marketable Design Award” and “Best Prototype, Most Creative Design Award”.

For the Best Marketable Design Award, L58 represented by Farah Salameh, Hind Ben Youssef, and Raghad Hamdan supervised by Dr. Fadwa Eljaack competed by visualizing a video on the styrene production. Meanwhile, three teams represented the chemical engineering department in the Best Prototype, Most Creative Design category. They were, firstly, L61 (Arwa Sulaiman, Najla Al-Mulla, and Kaltham Hejji) advised by Dr. Donghyun Kim on formaldehyde production. Secondly, L05 (AbdulAziz AbouEmter, Walid Alsadi, and Abdulla Alsaadi) was supervised by Dr. Zeinab Jawad on the higher olefins production. Thirdly, L60 (Adilla Pires, Preetan Ghosh, and Manar Nouadria) was supervised by Dr. Anand Kumar on acetic acid production.

L60 and L61 equally won third place on the best prototype, most creative design award over the CENG programs. L60 discussed the production of acetic acid in Qatar. This project aimed to fulfill the world’s increasing demand for acetic acid and contribute to the growing economy of Qatar by designing a new acetic acid chemical plant under the name of CHEMACETIC. CHEMACETIC design plans on producing 411,720 MT/yr of acetic acid with over 99% purity, based on an existing methanol carbonylation process technology, ACETICA.

On the other hand, L61 highlighted the production process of Formaldehyde with a Biological Carbon Capture and Utilization Facility. The plant was designed to produce 45,000 MT/year of 37% formaldehyde solution. To mitigate the gas emissions in the plant, especially carbon dioxide which is one of the greenhouse gases that according to the Paris Agreement need to be reduced to lower the global temperature by 1.5 degrees. Qforma has decided to use the biological method of cultivating microalgae to capture the carbon. Furthermore, the biological method is selected as the flue gas temperature and composition are suitable for growing microalgae, and it yields high-value biomass that is processed into biofuels, protein for animal feed, bioethanol, and bioplastics. The cultivation system is chosen as biofilm photo-bioreactor PBR, which requires more than 90% less space than typical open systems and saves 83% of the water used. ■



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