



*Joint European Summer School on Fuel Cell,
Electrolyser, and Battery Technologies
JESS 2019*

*Week 1 - Introductory Courses
16 – 20 September 2019*

*Hotel Amarilia,
Vouliagmeni, Athens, Greece*



sponsored by



INTRODUCTION

The increase in energy production from renewable sources creates a demand for energy storage technologies. Storage and conversion can be accomplished electrochemically: in batteries or through electrolysis and fuel cells. Therefore, these technologies are poised to play a major role in the energy supply infrastructure of the near future.

The Joint European Summer School JESS 2019 addresses these issues by offering high quality graduate level courses on selected topics of fuel cells, electrolyser, and battery technologies. This series of summer schools has been ongoing since 2004 and targets an audience of **university students** (MSc and PhD levels), and **post-doctoral researchers**. We also welcome more **experienced researchers and engineers** wishing to review these technologies and expand their general knowledge, for instance, to suit a newly acquired position or collect credits for a Continuous Professional Development (CPD) scheme. The topical content is tailored to the needs of a diverse audience: **newcomers to the field, experienced students, and young professionals** working at the forefront of fuel cell, electrolyser, and battery applications.

Week 1 (16 – 20 Sept 2019) offers three introductory courses to

- High temperature fuel cells and electrolysers (SOFC and SOE),
- Low temperature fuel cells and electrolysers (PEM and alkaline),
- Battery technology.

During the first week of Summer School, the main focus will be on the scientific and technological aspects. Starting from the fundamental principles of electrochemistry and thermodynamics, the entire spectrum of materials, design and balance of plant will be covered both from a scientific and an engineering point of view. In addition to the lectures, the participants will be asked to join in student projects where the content of the lectures is applied to a case study to be presented at the end of the week.

These courses are accredited at the three universities organising the Summer School and each carry 3 ECTS points (see below).

The following week (Week 2) will offer the Modelling Master Class, and modules on Fuel Cell Vehicles, Business Development and Innovation, and Hydrogen Safety for more advanced students (please refer to the separate programme). The two weeks are conducted independently of each other and students can choose the courses most appropriate to their studies.

NETWORKING WITH EXPERTS IN THE FIELD

The school draws on the knowledge and expertise of a carefully selected group of lecturers currently working at the leading edge of fuel cell, hydrogen, and battery research and development in Europe and associated to universities, national research centres, and industry.

Informal networking is a key element of science and scientific work in general. JESS offers ample opportunity for networking with peers and seasoned scientists. Students will be asked to give a short introduction to themselves and briefly present the research work they are doing (or expect to be doing).

CERTIFICATE OF ATTENDANCE

A Certificate of Attendance will be issued to all students of JESS. This Certificate of Attendance can be used for acquiring CPD points. The courses are accredited at the Technical University of Denmark and the universities of Aachen and Birmingham. On taking the optional final exam of their respective course, students can be attributed 3 ECTS points (10 credits in the UK system) for use in their studies.

ORGANISING COMMITTEE

Prof Rüdiger-A. Eichel (Forschungszentrum Jülich, Germany)

Prof Jens Oluf Jensen (DTU Energy Conversion, Denmark)

Prof Robert Steinberger-Wilckens (U Birmingham, United Kingdom)

LECTURERS

The following distinguished lecturers have already confirmed their participation in JESS 2019:

Jens Oluf Jensen	Technical University of Denmark
Robert Steinberger-Wilckens	University of Birmingham, UK
Hans Kungl	Research Centre Jülich, Germany
Ico Vinke	Research Centre Jülich, Germany
Anke Hagen	Technical University of Denmark
Artur Majewski	University of Birmingham, UK
Karin Kleiner	Technical University of Munich, Germany
Sebastien Martinet	CEA, France
Shangfeng Du	University of Birmingham, UK
Lars Nilausen Cleemann	Technical University of Denmark
Marcelo Carmo	Research Centre Jülich, Germany
Gareth Keeley	Research Centre Jülich, Germany
Oliver Posdziech	SunFire, Germany

You can find brief CV's of the lecturers, programme updates, and information on past events on the JESS web site: <http://www.jess-summerschool.eu>

The current status of the programme with the general lectures for all participants and the specialised talks has been included in this brochure.

LOCATION & VENUE

Athens is the capital and largest city of Greece. Athens dominates the Attica region and is one of the world's oldest cities, with its recorded history spanning around 3,400 years. Classical Athens was a powerful city-state. A centre for the arts, learning and philosophy, home of Plato's Academy and Aristotle's Lyceum, it is widely referred to as the cradle of Western civilisation and the birthplace of democracy, largely due to the impact of its cultural and political achievements during the 5th and 4th centuries BC on the rest of the European continent. The heritage of the classical era is still evident in the city, represented by ancient monuments and works of art, the most famous of all being the Parthenon, considered a key landmark of early Western civilisation. The city also retains Roman and Byzantine monuments, as well as a smaller number of Ottoman monuments. It is home to two UNESCO World Heritage Sites, the Acropolis of Athens and the medieval Daphni Monastery. Landmarks of the modern era, dating back to the establishment of Athens as the capital of the independent Greek state in 1834, include the Hellenic Parliament (19th century) and the Athens Trilogy, consisting of the National Library of Greece, the Athens University and the Academy of Athens.

The hotel hosting the school is located only steps away from a sandy beach in the Vouliagmeni area, 17 km from Athens city centre and 19 km from Athens international airport. All rooms have individual controlled A/C, free WiFi internet access, hairdryer, mini fridge, LCD TV and DVD player. More details can be found at <http://www.amarilia.gr/>.

JESS 2019**High Temperature Fuel Cells and Electrolysers (SOFC and SOE)**

final programme

last changed 24/01/2019 (status 16/08/2019)

P ... plenary lectures (all students), St ... student presentations,
HT ... specialised lectures, HL ... high & low temperature courses**Monday 16/09/2019**

P.01	08:30	Welcome and General Introduction	Jens Oluf Jensen (DTU)
	09:00	Sustainable and Renewable Energy Future	Jens Oluf Jensen (DTU)
	09:45	coffee break	
P.02	10:00	Introduction to Fuel Cells and Electrolysis	Shangfeng Du (U Bham)
	11:15	break	
P.03	11:30	Thermodynamics and Efficiency of Electrochemical Cells	Jens Oluf Jensen (DTU)
	13:00	lunch	
P.04	16:00	Introduction to Batteries	Hans Kungl (FZJ)
	17:30	coffee break	
P.05	18:00	Introduction to Solid State Chemistry & Ionics	Ico Vinke (FZJ)
P.06	19:30	Introduction to the Students' Project	Shangfeng Du (U Bham)
	19:45	welcome reception (bar)	
	20:15	dinner	
St.01	21:15	Students' Introductions I	Lars Cleemann (DTU) / Josef Mertens (FZJ)

Tuesday 17/09/2019

HT.01	08:30	Electrolyte Materials for SOFC / SOEC	Artur Majewski (U Bham)
	09:45	coffee break	
HT.02	10:00	Fuel Electrode Materials for SOFC / SOEC	Artur Majewski (U Bham)
	11:15	break	
HT.03	11:30	Cell and Stack Designs for SOFC / SOEC	Ico Vinke (FZJ)
	13:00	lunch	
P.07	16:00	Characterisation Methods for Fuel Cell, Electrolyser and Battery Materials	Shangfeng Du (U Bham)
	17:15	coffee break	
P.08	17:30	Exercise on Characterisation, Electrochemistry and Thermodynamics	Shangfeng Du (U Bham)
	18:45	break	
St.02	19:00	Students' Introductions II	Lars Cleemann (DTU) / Josef Mertens (FZJ)
	20:30	dinner	

Wednesday 18/09/2019

HT.04	08:30	Air Electrode and Contact Layer Materials for SOFC / SOEC	Artur Majewski (U Bham)
	09:45	coffee break	
HT.05	10:00	Manufacturing of SOFC / SOEC	Ico Vinke (FZJ)
	11:15	break	
HT.06	11:30	Exercise on Materials / Design	Ico Vinke (FZJ)
	13:00	lunch	
	15:00	excursion	
	21:00	dinner	

Thursday 19/09/2019

P.09	08:30	Atomistic Modelling in fuel cell, electrolyser and battery research	Ivano Castelli (DTU)
	09:45	coffee break	
HT.07	10:00	System Technology for SOFC	Ico Vinke (FZJ)
	11:15	break	
HT.08	11:30	Degradation in SOFC / SOEC	Anke Hagen (DTU)
	13:00	lunch	
HT.09	16:00	Exercise on Degradation	Anke Hagen (DTU)
	17:00	coffee break	
HT.10	17:15	Exercise on System Technology	Robert Steinberger-Wilckens (U Bham)
	18:30	break	
St.03	18:45	Student project time	n/a
	20:00	dinner	

Friday 20/09/2019

HT.11	08:30	System Technology for SOEC	Oliver Posdziech (SunFire)
	09:45	coffee break	
HT.12	10:00	New Trends in SOFC / SOEC	Anke Hagen (DTU)
	11:15	break	
HL.01	11:30	Power to Gas, Fuels and Chemicals	Oliver Posdziech (SunFire)
	13:00	lunch	
St.04	16:00	Optional ECTS exams	
	17:00	coffee break	
St.05	17:15	Students' Project Presentations	Robert Steinberger-Wilckens (U Bham)
	18:45	break	
P.10	19:00	Farewell	Robert Steinberger-Wilckens (U Bham)
	20:30	gala dinner	

JESS 2019**Low Temperature Fuel Cells and Electrolysers (PEFC, alkaline & PEM)**

final programme

P ... plenary lectures (all students), St ... student presentations,
LT ... specialised lectures, HL ... high & low temperature courses

last changed 24/01/2019

Monday 16/09/2019

P.01	08:30	Welcome and General Introduction	Jens Oluf Jensen (DTU)
	09:00	Sustainable and Renewable Energy Future	Jens Oluf Jensen (DTU)
	09:45	coffee break	
P.02	10:00	Introduction to Fuel Cells and Electrolysis	Shangfeng Du (U Bham)
	11:15	break	
P.03	11:30	Thermodynamics and Efficiency of Electrochemical Cells	Jens Oluf Jensen (DTU)
	13:00	lunch	
P.04	16:00	Introduction to Batteries	Hans Kungl (FZJ)
	17:30	coffee break	
P.05	18:00	Introduction to Solid State Chemistry & Ionics	Ico Vinke (FZJ)
P.06	19:30	Introduction to the Students' Project	Shangfeng Du (U Bham)
	19:45	welcome reception (bar)	
	20:15	dinner	
St.01	21:15	Students' Introductions I	Lars Cleemann (DTU) / Josef Mertens (FZJ)

Tuesday 17/09/2019

LT.01	08:30	Electrolyte Materials for LT Fuel Cells and Electrolysers	Gareth Keeley (FZJ)
	09:45	coffee break	
LT.02	10:00	Catalyst and Kinetics for LT Fuel Cells and Electrolysers I.	Lars Nilausen Cleemann (DTU)
	11:15	break	
LT.03	11:30	Catalyst and Kinetics for LT Fuel Cells and Electrolysers II.	Lars Nilausen Cleemann (DTU)
	13:00	lunch	
P.07	16:00	Characterisation Methods for Fuel Cell, Electrolyser and Battery Materials	Shangfeng Du (U Bham)
	17:15	coffee break	
P.08	17:30	Exercise on Characterisation, Electrochemistry and Thermodynamics	Shangfeng Du (U Bham)
	18:45	break	
St.02	19:00	Students' Introductions II	Lars Cleemann (DTU) / Josef Mertens (FZJ)
	20:30	dinner	

Wednesday 18/09/2019

LT.04	08:30	Hydrogen Compression and Storage	Jens Oluf Jensen (DTU)
	09:45	coffee break	
LT.05	10:00	Cells, Bipolar Plates, and Stacks for LT Fuel Cells	Lars Nilausen Cleemann (DTU)
	11:15	break	
LT.06	11:30	Cells, Bipolar Plates, and Stacks for LT Electrolysers	Gareth Keeley (FZJ)
	13:00	lunch	
	15:00	excursion	
	21:00	dinner	

Thursday 19/09/2019

P.09	08:30	Atomistic Modelling in fuel cell, electrolyser and battery research	Ivano Castelli (DTU)
	09:45	coffee break	
LT.07	10:00	System Design and Operation for LT Electrolysers	Marcelo Carmo (FZJ)
	11:15	break	
LT.08	11:30	System Design and Operation for LT Fuel Cells	Jens Oluf Jensen (DTU)
	13:00	lunch	
LT.09	16:00	Challenges for LT Electrolysers	Marcelo Carmo (FZJ)
	17:00	coffee break	
LT.10	17:15	Challenges for LT Fuel Cells	Lars Nilausen Cleemann (DTU)
	18:30	break	
St.03	18:45	Student project time	n/a
	20:00	dinner	

Friday 20/09/2019

LT.11	08:30	Application of LT Fuel Cells and Electrolysers	Lars Nilausen Cleemann (DTU)
	09:45	coffee break	
LT.12	10:00	New Trends in LT Fuel Cells and Electrolysers	Jens Oluf Jensen (DTU)
	11:15	break	
HL.01	11:30	Power to Gas, Fuels and Chemicals	Oliver Posdziech (SunFire)
	13:00	lunch	
St.04	16:00	Optional ECTS exams	
	17:00	coffee break	
St.05	17:15	Students' Project Presentations	Robert Steinberger-Wilckens (U Bham)
	18:45	break	
P.10	19:00	Farewell	Robert Steinberger-Wilckens (U Bham)
	20:30	gala dinner	

JESS 2019**Introduction to Battery Technology**

final programme

last changed 08/08/2019

P ... plenary lectures (all students), St ... student presentations,
B ... specialised lectures**Monday 16/09/2019**

P.01	08:30	Welcome and General Introduction	Jens Oluf Jensen (DTU)
	09:00	Sustainable and Renewable Energy Future	Jens Oluf Jensen (DTU)
	09:45	coffee break	
P.02	10:00	Introduction to Fuel Cells and Electrolysis	Shangfeng Du (U Bham)
	11:15	break	
P.03	11:30	Thermodynamics and Efficiency of Electrochemical Cells	Jens Oluf Jensen (DTU)
	13:00	lunch	
P.04	16:00	Introduction to Batteries	Hans Kungl (FZJ)
	17:30	coffee break	
P.05	18:00	Introduction to Solid State Chemistry & Ionics	Ico Vinke (FZJ)
P.06	19:30	Introduction to the Students' Project	Shangfeng Du (U Bham)
	19:45	welcome reception (bar)	
	20:15	dinner	
St.01	21:15	Students' Introductions I	Lars Cleemann (DTU) / Josef Mertens (FZJ)

Tuesday 17/09/2019

B.01	08:30	Materials for Batteries - An Overview	Karin Kleiner (Diamond)
	09:45	coffee break	
B.02	10:00	History of Batteries and their application (Materials I)	Karin Kleiner (Diamond)
	11:15	break	
B.03	11:30	Modern Batteries (Materials II)	Karin Kleiner (Diamond)
	13:00	lunch	
P.07	16:00	Characterisation Methods for Fuel Cell, Electrolyser and Battery Materials	Shangfeng Du (U Bham)
	17:15	coffee break	
P.08	17:30	Exercise on Characterisation, Electrochemistry and Thermodynamics	Shangfeng Du (U Bham)
	18:45	break	
St.02	19:00	Students' Introductions II	Lars Cleemann (DTU) / Josef Mertens (FZJ)
	20:30	dinner	

Wednesday 18/09/2019

B.04	08:30	Challenges of future application (Materials III)	Karin Kleiner (Diamond)
	09:45	coffee break	
B.05	10:00	All Solid State Batteries	Hans Kungl (FZJ)
	11:15	break	
B.06	11:30	Metal-Air Batteries	Hans Kungl (FZJ)
	13:00	lunch	
	15:00	excursion	
	21:00	dinner	

Thursday 19/09/2019

P.09	08:30	Atomistic Modelling in fuel cell, electrolyser and battery research	Ivano Castelli (DTU)
	09:45	coffee break	
B.07	10:00	Transport Modelling of Batteries	Ivano Castelli (DTU)
	11:15	break	
B.08	11:30	Cell and Pack Designs for Batteries	Sébastien Martinet (CEA)
	13:00	lunch	
B.09	16:00	Manufacturing of Batteries	Sébastien Martinet (CEA)
	17:00	coffee break	
B.10	17:15	System Technology and Safety for Batteries	Sébastien Martinet (CEA)
	18:30	break	
St.03	18:45	Student project time	n/a
	20:00	dinner	

Friday 20/09/2019

B.11	08:30	Beyond Lithium - Resource-Efficient Batteries	Ivano Castelli (DTU)
	09:45	coffee break	
B.12	10:00	Exercise on Materials (/ Design)	Ivano Castelli (DTU)
	11:15	break	
B.13	11:30	Spectroscopy and Diffraction – advanced characterisation techniques	Karin Kleiner (Diamond)
	13:00	lunch	
St.04	16:00	Optional ECTS exams	
	17:00	coffee break	
St.05	17:15	Students' Project Presentations	Robert Steinberger-Wilckens (U Bham)
	18:45	break	
P.10	19:00	Farewell	Robert Steinberger-Wilckens (U Bham)
	20:30	gala dinner	

HOW TO REGISTER

To register, fill in one of the forms attached at the end of this document, scan, and send to the e-mail addresses on the form. Or follow the registration links on the web site

<http://www.jess-summerschool.eu/JESS-2019>

The final deadline for registration is **31 August 2019**.

PARTICIPATION FEE

The registration fee is 1.485,- €/course and covers tuition fees, and accommodation in single room from Sunday 15 to Saturday 21 Sept. 2019. This includes full board (all meals and coffee breaks), the drinks reception, end-of-week banquet, and excursion. A tourist tax payment of €3 per night will be due at the hotel directly.

Double room occupancy is charged at 1.255,- €/course and person. Accompanying persons sharing a double room with a participant and not taking part in the lectures are charged at 620 € for the 6-day stay (including all meals and events).

All prices include Greek V.A.T.

An **Early Bird Discount of 150 €** is offered on registrations up until **30 April 2019**.

Participants wishing to arrive early or stay longer should make their own arrangements with our booking partner, Panhellas Tourism & Congress (see below). They can offer special rates for additional nights.

CORRESPONDENCE

For issues concerning registration and payment please contact Ms Manuela Drape-Stathoglou at Panhellas Tourism & Congress:

Mail to: manuela@panhellas.gr, Tel: +30 2810 300847.

She is also the contact person for any issues relating to the hotel, booking additional nights, and for questions about meals and the excursion.

If you have any dietary requirements with respect to food choice or food allergies, please contact Mrs. Drape in due time before the Summer School.

Lecturer information and arrangements - r.steinbergerwilckens@bham.ac.uk

Student and general information - J.C.Hooper@bham.ac.uk, Phone +44 121 414 5275.

CANCELLATION POLICY

To cancel your registration with JESS, send an email stating your intent to:
manuela@panhellas.gr

Refunds will be subject to a cancellation fee. If your request arrives by 01 September 2019, the registration fee will be refunded after the school applying a cancellation fee of 350,00 € off the processed registration fee.

No reimbursement will be made for cancellations received after 01 September 2019.

LIABILITY

The school secretariat and organisers cannot accept liability for personal accidents, loss of or damage to private property of participants and/or accompanying persons, either during, or directly arising from the JESS 2019. Participants should make their own arrangements with respect to health and travel insurance.

Reaching Amarilia Hotel from Athens international airport 'Eleftherios Venizelos'

By bus and/or/ metro

There is a bus service X96 from the arrivals terminal in Athens International Airport (Eleftherios Venizelos). The trip to the closest bus station to Amarilia Hotel (named 'Pegadakia') takes approx. 35-40 minutes and the cost is ~ € 5,00. From the bus station 'Pegadakia' you turn left onto the main avenue and walk 10 minutes before you turn right off the avenue into street Ag. Nikolaou and arrive at Amarilia Hotel, on the left side after 100 m.

You can also take the metro from the airport (blue line), change at 'Syntagma' to the red line to terminus 'Helleniko'. From there you can take a bus no. 122 to the stop 'Ag. Nikolaos' on the avenue close to the hotel. Walk back from the bus stop for about 20 m and turn left into Ag. Nikolaou. Or take a taxi from 'Helleniko' – about 5 to 10 minutes ride.

By car

You drive on the highway until the KOROPI - MARKOPOULO sign and you exit to the left. Then you follow the signs to GLYFADA and drive along the Vari - Koropi Avenue at the end of which there is a sign VOULIAGMENI where you turn left. After 300m, you reach a traffic light; you turn right in the small street 15m after the traffic lights, then right in the first street and then right to Agiou Nikolaou street. This is VOULIAGMENI area and it is where our hotel is located. The distance from the Airport is 19km (20 minutes driving distance).

By taxi

Either take one of the taxis from the airport or pre-book a taxi from Panhellas mail: manuela@panhellas.gr, Tel: +30 2810 300847.

Both will cost around € 50,00 (one way). This fee is not included in the registration fee and has to be paid separately.

Manuela Drape-Stathoglou can arrange for shared taxis, depending on when participants arrive. Please contact her in case you want to use this option.

The full address of the hotel is: Hotel Amarilia, 13 Agiou Nikolaou, 16671 Vouliagmeni, Greece



**Joint European Summer School for Fuel Cell, Electrolyser and
Battery Technologies – JESS 2019, WEEK 1**

Hotel Amarilia, Athens - Greece
16.-20.09.2019

Title	
Surname/Family Name/Last Name	
Name	
Gender	Male <input type="checkbox"/> Female <input type="checkbox"/>
University/Institute/Company Name	
Street	
Postal Code	
Town / City	
Country	
Vat Nr of University/Institute (if applicable)	
Phone	
E-mail	
Athens arrival date and time	
Athens departure date and time	
Remarks/Special requested	

I would like to sign up for the following module:

(You are allowed to register only for 1 Main Course, but you may change your course during the summer school)

<input type="checkbox"/>	Solid Oxide Fuel Cells & Electrolysers
<input type="checkbox"/>	Low Temperature Fuel Cells & Electrolyser
<input type="checkbox"/>	Battery Technology

REGISTRATION FEES

		Rate in Euro per person
In Single occupancy		Euro 1485,00
In Double occupancy		Euro 1285,00 per person
		EARLY BIRD REDUCTION (-EURO 150,00) FOR BOOKINGS UNTIL 31.03.2019
In Single occupancy		Euro 1335,00
In Double occupancy		Euro 1135,00 per person

In case of accommodation in a double room,
we need to know the name of the 2nd person, sharing the room

(*) An additional 'hotel tax' payment of €3 per night will be due to the hotel on arrival.

Accompanying persons sharing a double room with a participant and **not taking part in the lectures** are charged at 620 € for the 6-day stay (including all meals, events and the excursion).

Supplement for additional overnights: Before, after or between the school
Single room: Euro 90,00 per night (only with breakfast)
Double room: Euro 120,00 per night (only with breakfast)

Please book _____ additional overnight/s for the period
from _____ to _____ at Hotel _____

Supplement for private taxi transfer:

from Athens Airport to Amarilia Hotel or vice versa

for the rate of **Euro 57,00 per taxi per way** (max. 3 persons)

In case of arrivals or departure between 22:00-08:00, there will be a night supplement of Euro 15,00

Private Transfer Yes No

Date: _____ Flight Number: _____ Arrival Time: _____

Date: _____ Flight Number: _____ Departure Time: _____

Special Notes: _____

DEADLINE FOR REGISTRATIONS: 31.08.2019

TOTAL AMOUNT FOR ALL SERVICES: EURO _____

Payment by:

(PAYMENT MUST BE ARRANGED WITHIN 10 DAYS FROM THE DAY OF THE REGISTRATION. IF WE HAVE NOT RECEIVED ANY NEWS OR PAYMENT FROM THE APPLICANT, WE WILL PROCEED WITH THE CANCELLATION OF THE REGISTRATION)

A. Bank Deposit

PIRAEUS BANK
N.ERYTHREA – ATHENS
ACCOUNT NR.: 6728 – 113712 – 215 (PANHELLAS S.A.)
SWIFT – BIC: PIRBGRAA
IBAN: GR97 0171 7280 0067 2811 3712215

Account name – Panhellas S.A

Please do not forget to mention:

16.-20.09.2019 - JESS 2019 (1ST WEEK) – Name of the participant

B. Credit Card: (+3,5 % of the final amount)

I authorize Panhellas S.A. to collect the amount of Euro _____ from my credit card

VISA MASTER

Card no : _____

Exp. Date _____

Last three digits of the number at the backside of the card _____

Cardholder's Name _____

Date _____

In case of cancellation until 31.08.2019, a 3,5% bank charge will be granted and the rest of the amount will be reimbursed.

Please sent the registration to:

JESS 2019 – Secretary - Manuela Drape Stathoglou Manuela@panhellas.gr