Welcome...

The School is recognised as an international leader in engineering education, research and the application of knowledge to benefit society globally. It has established itself as a partner of choice for many world-leading institutions.

The School offers a rigorous engineering education in a distinctive general engineering environment, with world class fundamental and applied research and outstanding accredited undergraduate and postgraduate degree programmes.

Its size and general engineering philosophy supports a distinctive sense of community and diversity of perspectives. The School’s style of research fosters dynamic close engagement between researchers, industry and users. This mix of activities provides a stimulating and friendly environment in which students and researchers collaborate and flourish as individuals.

Professor Igor Guz,
Head of School of Engineering

Some of our university collaborations include:
- Harvard University, USA
- California Institute of Technology, USA
- University of California at Berkeley, USA
- University of California at Santa Barbara, USA
- Berlin Technical University, Germany
- Karlsruhe Institute of Technology, Germany
- Wuhan University, China
- Texas A&M University, USA
- Tokyo University of Science, Japan
- University of California, USA
- Tsinghua University, China
- École Polytechnique Fédérale de Lausanne, Switzerland
- Laboratoire des Écoulements Géophysiques et Industriels (LEGI) Grenoble, France
- ETH Zunch, Switzerland
- Indian Institute of Technology (Chennai), India

Some of our industry collaborations include:
- NASA, USA
- European Space Agency, France
- Bosch, Germany
- Halliburton, USA
- Deltares, Netherlands
- HR Wallingford, UK
- Mitsubishi Electric R&D Centre Europe, France
- Thales-Alenia Space, France
- Mozilla, USA
- Cisco Systems, Norway
- Dell-EMC, Ireland
- Simula Research Laboratory, Norway
- RTE, France
- Scottish and Southern Energy, UK
- CNES, France
- PEMEX, Mexico
Chemical & Materials Engineering

In chemical and materials engineering we develop and design processes and materials based on underpinning principles, mainly from chemistry, thermodynamics, and transport phenomena. It is a discipline that covers a wide spectrum of length and time scales: from intramolecular interactions at the Angstrom scale, via nano and micro-structured materials – for example liquid crystals – to industrial-scale chemical and bio process equipment. This is reflected by the research activities in the Chemical & Materials Engineering Research Group in the School of Engineering at the University of Aberdeen that are of a multiscale and multidisciplinary nature.

In surface chemistry and catalysis we optimize catalytic materials, mainly for application in energy conversion. In chemical reaction engineering we model complex reaction systems for process optimization. Separation and crystallization processes – that are modelled through population balance approaches – find application in production of pharmaceuticals. Carbon capture, storage and utilization is a main research focus, with an emphasis on enhancing energy-efficiency and on developing novel carbon utilization strategies. Energy generation in fuel cells as well as energy storage (in batteries) requires the development of advanced supramolecular materials. Finally, we develop sustainable innovative processes for producing chemicals and harvesting energy from biomass.

While most of the research is application driven, we also work on method development. On the experimental side this, for instance, relates to measuring thermodynamic properties; on the computational side to event-driven simulation methods as well as numerical methods for highly resolved multiphase flow simulations.

Areas of Expertise

- Catalysis
- Reaction engineering
- Kinetic modelling
- Biochemical engineering
- Multiphase Flow
- Transport processes
- Molecular dynamics and Granular dynamics
- Ionic liquids
- Energy storage / fuel cells

Facilities and Equipment

- A state of the art chemical engineering research lab
- Gas chromatographs
- Spectrometers
- Microwave facilities
- Micro activity-effy unit for measuring reaction kinetics
- Solubility measurements of gases and vapours in liquids
The Electrical and Electronic Engineering (EEE) Research Group advances fundamental knowledge and promotes new applications across a spectrum of EEE topics.

Research in power system spans development of new devices, techniques for HVDC (High Voltage DC) Transmission, technologies for power electronics, high power transformers, DC circuit breakers and transmission systems. The HVDC Centre works with industry to influence development strategies and inform policy for building offshore electricity grid transmission networks.

Photonics research is investigating fundamental and applied aspects of new laser components, novel applications using subsea holographic cameras developed at the University, and fibre optic design. Practical work is supported by state-of-the-art laser equipment, and collaboration with international research partners.

The group has an established track-record in small terminal satellite systems. Projects working with the European aerospace industry are developing and testing novel networking technologies for satellite Internet.

Mechatronics and control research focuses on the design and control of nanopositioners, flexible robots and all aspects of vibration control. This multidisciplinary research contributes to projects across engineering research groups.

Research activities around Big Data include engineering of sensor devices and data analytics, with research in intelligent application of data mining techniques, and novel methods for automatically determining features of interest. Work ranges from exploring new problem areas and applications to small device platforms that will enable a connected Internet of Things (IoT).

There is a range of Internet Engineering research from architectural design of the Internet protocol stack, to design of new transport mechanisms, performance evaluation, network transparency, privacy, new applications and network manageability. Work using the Internet engineering testbed is contributing to both Open Source and industrial stakeholders, including active participation to international standardisation via the Internet Engineering Task Force (IETF).

**Areas of Expertise**

- Electrical Power Conversion
- High Voltage DC Transmission
- Internet Engineering for Protocols and Standards
- Network Performance Measurement
- Image and Video Processing/Transmission
- Sensor Networks; the Internet of Things
- Big Data and data mining techniques
- Mechatronics and Control
- Soft Robotics
- Photonics, Holography and Laser Applications
- Small Terminal Satellite Communications Systems

**Facilities and Equipment**

- Extensive simulation facilities supporting a wide range of tools and EEE packages.
- The Aberdeen High Voltage Direct Current (HVDC) research centre provides a platform for power systems, power electronics and control engineering.
- The Internet engineering testbed provides state of the art facilities, and a range of tools to coordinate and perform global measurement campaigns.
- The Internet of Things (IoT) testbed supports development of applications from low speed sensing to high speed TV delivery.
- State of the art laser laboratory facilities supporting subsea holographic camera development and new laser applications.
- The EEE group is a member of the European Satellite Network of Experts (SatNEx), providing long-lasting integration of key European research centres.
Mechanics of Fluids, Soils & Structures

The Mechanics of Fluids, Soils and Structures Research Group covers a spectrum of research across four major areas: (1) Environmental and Industrial Fluid Mechanics; (2) Soil Mechanics; (3) Structural Mechanics; and (4) Transport Studies.

Research in Environmental and Industrial Fluid Mechanics primarily focuses on (i) hydrodynamics of free-surface flows; (ii) mechanics of fluid-sediment interactions and transport; and (iii) thermophysical properties of fluids and metrology. These areas cover environmental and industrial flows at multiple scales, from sub-mm to kilometres. Studies of free-surface flows focus on open-channel flows, coastal processes, eco-hydraulics, flow-porous-bed interfaces, and liquid-solid impacts. Research on fluid-sediment interactions concentrates on sediment transport in unidirectional and oscillatory flows and on gravity currents.

Research in Soil Mechanics is focused on soil-structure interactions within two themes: (i) the dynamic behaviour of ground anchorage systems installed in soil or rock; and (ii) interactions between the seabed and bottom-moving objects (fishing gear or similar). Numerical and experimental approaches are used to understand and predict the impact of these activities on the environment.

Structures Research investigates fundamental and applied aspects of the design and analysis of structural systems, components, connections and materials, and evaluates the performance, condition and health of existing structural systems. The aim of the research is to make structures safer, more reliable, sustainable and efficient through enhanced fundamental understanding of how they work and how they can be practically improved.

Transport Studies are undertaken through the Centre for Transport Research (CTR, www.abdn.ac.uk/ctr), which is the focus for transport related research at the University. The CTR specialises in the sustainability of transport systems with emphasis on environment, society and technology. The Centre applies an inter-disciplinary approach to research and knowledge exchange, drawing on expertise from engineering, geography, psychology, sociology, economics and computing science.

Areas of Expertise

- Hydrodynamics of open-channel flows: turbulence structure and transport processes, hydraulic resistance, surface-subsurface flow interactions, sediment dynamics
- Coastal hydraulics: oscillatory boundary layer flow, sediment transport processes, swash hydrodynamics, sea wave interaction with structures and vegetation
- Porous media hydrodynamics: steady and unsteady, turbulent flows and transport processes
- Hydrodynamics of aquatic ecosystems: flow-organism interactions in rivers and coastal areas occurring at multiple scales
- Mathematical modelling in fluid dynamics: gas-cushioning in liquid-solid impacts, scaling law predictions, porous substrates
- Computational multi-fluids dynamics: multi-physics modelling, adaptive numerical methods, nuclear criticality, reactor physics, heat and mass transfers
- Thermophysical properties of fluids: fundamentals, metrology and instrumentation
- Fundamental and applied studies of structural systems, components, connections and materials
- Evaluation of performance, condition and health of structural systems
- Offshore geotechnics
- Trawl gear dynamics
- Transport studies: intelligent transport systems, transport network planning

Facilities and Equipment

- Aberdeen Open Channel Facility (AOCF)
- Aberdeen Oscillatory Flow Tunnel (AOFT)
- Aberdeen University Random Wave Flume (AURWF)
- Armfield Flume
- Open Channel Sediment Re-Circulation Flume
- Structure-testing Laboratory
- Geotechnics Towing Channel

Wave-sealed interactions are studied in the Aberdeen Oscillatory Flow Tunnel (AOFT, left), one of the few facilities of its kind in the world in which oscillatory flows with periods and amplitudes equivalent to flow under full-scale sea waves may be generated. Advanced acoustic and laser Doppler instruments are used for flow and sediment concentration measurements (right).

A robotic Particle Image Velocimetry System developed by the School is used in laboratory studies of flow dynamics, sediment transport and flow-ecosystem interactions. The system's unique features include flexibility to measure velocity fields at multiple locations and at various spatial scales, from roughness (left) to depth (right) scales.

In-situ study of river turbulence in the Lune River (Scotland) using an advanced Field Particle Image Velocimetry System developed by the School.

Laboratory studies of interactions between fishing gears and the seabed are conducted in a specially-designed geotechnical facility in the School's Geotechnical Laboratory.

Micro-Computed Tomography is used to study fluid flows in porous media at pore scale (microns). Results are upscaled to laboratory (cm) and field (km) scales.
Petroleum & Natural Gas Engineering

The Petroleum and Natural Gas Engineering Research Group focuses on scientific advances underpinned by fundamental and applied solutions to the challenges of oil and gas industry. We carry out research in: (i) Rock - fluid - chemical interaction; (ii) Reservoir Engineering, Modelling and Simulation; (iii) Petroleum Production, (iv) Well and Drilling Engineering, and (v) Geomechanics and Wellbore Integrity.

Research in rock - fluid - chemical interaction focusses on multiphase flow in porous media including application to the selection, design and analysis of improved/enhanced oil and gas recovery systems through chemical, steam, gas or microbial injection. Numerical and experimental techniques are employed to understand the underpinning physics that control the interaction between reservoir formation, hydrocarbon, and the injected fluid.

Research in reservoir engineering, modelling and simulation focuses on (i) advanced reservoir modelling and simulation, (ii) reservoir rock characterization using CT scanning and NMR, (iii) development of digital rock technology for multiscale reservoir modelling to optimise oil recovery.

Research in petroleum production focuses on (i) the development of ultrasound technology for removal of scales in production tubulars, (ii) production optimisation in conventional reservoirs and unconventional shale reservoirs, (iii) flow assurance and (iv) corrosion of production tubulars. The emphasis of our research is on the development and use of new technologies, intelligent systems and automation to achieve a cost effective oil and gas production and transportation.

Well and drilling engineering research focuses on (i) the development of environmentally friendly drilling muds based on biodegradable materials and nanoparticles, (ii) formation damage due to interaction between reservoir rocks and drilling muds or oil field chemicals, and (iii) application of artificial intelligence to well design.

Research in geomechanics and wellbore integrity focuses on the mechanics of fracture of low strength geological materials and CO2 geological utilisation and storage. The research aims to develop safe and reliable approaches to oil and gas extraction from conventional and unconventional reservoirs.

Areas of Expertise
- Well design and integrity
- Drilling fluids: automation and formulation of environmentally friendly drilling fluids
- Reservoir characterisation, performance and simulation
- Production optimisation from conventional and unconventional shale reservoirs, including design of pilot-scale production rig.
- Methane production from natural gas hydrates in porous media
- Multiscale modelling and upscaling of multiphase flow in porous media and surface facilities
- Geomechanics of reservoir rock formation
- Enhanced / Improved oil and gas recovery
- Formation damage and stimulation
- Geological utilisation and storage of CO2
- Flow Assurance: wax, hydrates, asphaltene and scale inhibition (subsurface and facilities)
- Sustainable groundwater resources management

Facilities and Equipment
- MicroCT scanners
- LED Boom Stand Stereo Zoom Microscope with built-in Camera
- Modular coreflood rigs with custom-made Hassler cells, Teledyne ISCO 1000D pumps, and logged pressure transducers
- Advanced multipurpose EOR rig
- Aberdeen Tilted Lock Exchange Facility (ATLEF)
- Automated pilot-scale gas lift oil production rig
- Formation damage rig with custom-made Hydrostatic and Hassler cells for 1” and 1.5” diameter cores
- HPHT Autoclave capable of up to 200MPa and 200°C, and Cortest HPHT (100MPa, 200°C) autoclave (100MPa, 200°C) for corrosion studies
- A multipurpose enhanced oil recovery (EOR) rig developed at the School of Engineering is used in laboratory studies of different recovery methods associated with chemical, thermal and gas injection processes. The rig is unique in its ability to automatically switch between different EOR techniques, separate different phases and treat downstream waste gases for storage and disposal.
- A test station equipped with a stereoscope microscope to experimentally investigate multiphase flow systems through visual models. This provides better understanding and optimisation of enhanced oil recovery processes through hybrid thermal and chemical recovery methods.
- Microfluidic experiments are performed in the Subsurface Flow and Transport Laboratory to study enhanced oil recovery at the pore scale. Unlike conventional micromodels, our disposable microfluidic rock analogues conserve grain roughness and mineralogical heterogeneity.
- A multifunctional formation damage test rig designed and fabricated at the School of Engineering is being used to simulate practical drilling and production operation scenarios in shale, limestone and sandstone formations at reservoir conditions.
The Theoretical & Applied Mechanics Research Group is focused on (i) modelling and analysis of engineering systems exhibiting nonlinear responses, and practical applications of dynamics, control and condition monitoring; (ii) various aspects of micro- and nanomechanics, including solid mechanics (stability theory, wave propagation), mechanical engineering (structural mechanics) and material sciences (composite and nanomaterials); (iii) risk and reliability of structures and systems and (iv) design optimisation. The majority of the work of the group is strategically focused on the energy sector with many members of the group applying their expertise to industrial problems. The group hosts the Centre for Applied Dynamics Research (CADR), the Centre for Micro- and Nanomechanics (CEMINACS), and the Lloyd’s Register Foundation (LRF) Centre for Safety and Reliability Engineering.

CADR, founded in 2003, has a strong focus on application theory of dynamical systems to science and engineering. The main strength of this Centre is a harmonious blend of theoretical and experimentally rich research in a broad spectrum of dynamics including smooth and non-smooth dynamical systems, elastic stability, chaos and vibration control, vibro-impact dynamics, nonlinear time series analysis, resonance enhanced drilling, and renewable energy.

CEMINACS, founded in 2004, has international reputation in modelling the behaviour of heterogeneous materials at different length scales. The work of the Centre is relevant to a wide range of key industrial sectors including aerospace, space, marine, automotive, electronic, defence, security and medicine, leading to improvements in design and reductions of fabrication and manufacturing costs.

LRF Centre, established in 2011, maintains a centre of excellence in the study of practical and theoretical problems related to the safety and reliability of engineering systems, with emphasis on the effects of human factors. The work of the Centre covers both the development and use of the fundamental risk and reliability concepts and also the practical problems in the industries related to (i) ageing assets, (ii) new technologies in extreme environments and (iii) reliability of renewable energy infrastructure.

Areas of Expertise
- Advanced Composite Materials and Structures
- Control and Condition Monitoring
- Design Optimisation
- Fluid-Structure Interaction
- Fracture Mechanics
- Hybrid Renewable Energy Systems
- Impact and Explosion Mechanics
- Materials Processing and Modelling
- Micromechanics and Nanomechanics
- Nonlinear Mechanical Systems
- Novel Materials for Subsea Applications
- Offshore Structure Decommissioning
- Resonance-Enhanced Drilling
- Risk and Reliability Analysis
- Solid Mechanics
- Structural Integrity
- Vibro-Impact Systems
- Wind Energy

Facilities and Equipment
- Resonance Enhanced Drilling and Drill String Dynamics Laboratories comprising:
  - Resonance enhanced drilling rig
  - Drill string dynamics and drill bit stick/slip rig
- LDS V806 and V725 vibration excitation systems (both with optional large load table)
- Instron 8500 250kN hydraulic testing system with fatigue capability
- Instron 1185 and 4483 tensile/compression testing machines
- Hounsfield HENV-0116 testing machine with environmental chamber
- Nikon XT225 microCT scanner
- Zeiss XRadia Versa 410 microCT scanner
- X-ray compatible material testing system

POSTGRADUATE RESEARCH

A unique experimental stand is designed to test nonlinear behaviour of drill-strings including stick-slip, bit bounce and whirling.

Resonance Enhanced Drilling (RED), a new downhole drilling technology offering significant cost reduction and smaller environmental footprint, is being commercialised.

An automated welding system for pipelines has been developed by the School as part of a Knowledge Transfer Partnership.

By a combined use of high-resolution X-ray microscopy and a micro testing stage, in-situ mechanical properties and progressive damage accumulation inside materials under tensile/compressive loads are probed.
National Decommissioning Centre

University of Aberdeen has partnered with the Oil & Gas Technology Centre (OGTC) to create the National Decommissioning Centre (NDC). This multi-million-pound centre of excellence has been established with the support of the Scottish and UK governments to bring researchers and industry together to tackle current and future challenges across the full decommissioning life cycle, from mature basin management through to late life and decommissioning.

The NDC is based at a dedicated research facility in Newburgh, 10 miles from the main University of Aberdeen campus, which includes state-of-the-art laboratories, hangar space, and R&D facilities for the design and development of decommissioning technology, as well as a high-tech digital visualisation suite.

The NDC works closely with universities, research centres and industry partners across the UK and internationally on multidisciplinary incorporating decommissioning technologies, predictive modelling, environmental assessment and the economics of decommissioning.

Over the next decade, around 100 platforms and 7,500 kilometres of pipeline on the UK Continental Shelf alone are forecast for decommissioning, with costs estimated to be £59 billion to 2050. The industry aims to reduce this figure by 35%, a target set by the Oil & Gas Authority.

Find out more at www.ukndc.com