



U.S.-Pakistan Centre for Advanced Studies in **Energy**

National University of Sciences and Technology

INTRODUCTION

The core mission of the Centre is to efficiently address and implement the E3 criteria (Energy, Environment and Economy) for sustainable societal development. The Centre is going to create an ecosystem for addressing energy requirements by influencing policy makers, developing technologies, human resources and mobilizing communities for energy conservation. The Centre for Energy Systems lately titled as U.S.-Pakistan Centre for Advanced Studies in Energy (USPCAS-E) was launched in June 2011 to provide impetus to energy sector programs and support and consolidate related activities/ projects with a view to contributing to national economy in times of energy crisis. It was inaugurated on January 9, 2012. Collaborating partners from Canada, USA, UK, RSA and KSA warmly participated in the event. The Centre aims at providing sustainable supply of energy at affordable rates with greater share of renewable in the energy mix to reduce environmental footprint. The centre's vision resides in setting up pilot plants to demonstrate the feasibility of specific programs in the various energy sectors.



OVERVIEW

The U.S.-Pakistan Centre for Advanced Studies in Energy (USPCAS-E) aims to focus on applied research relevant to Pakistan's energy needs and serve as a bridge between the government, industry, and academia and undertake sustainable policy formulation. USPCAS-E is a partnership between the National University of Science and Technology (NUST), Islamabad; University of Engineering and Technology, Peshawar (UET); and U.S. partner Arizona State University (ASU). At the end of the project, the Centres at NUST and UET will be sustainable hubs to address energy related issues. Collaboration between the partner USPCAS-E universities and the Higher Education Commission of Pakistan will help ensure institutionalization and sustainability of USPCAS-E.

OBJECTIVES

- Help Pakistan unleash its enormous potential for economic growth
- Become Pakistan's premier energy think-tank and engage stakeholders in both industry and government
- Improve relevance and quality of curricula, strengthen use of effective teaching methods, and upgrade graduate programs
- Enhance responsiveness of university research and graduates' skills to public and private sector needs
- Focus on cutting-edge applied research & finding indigenous solutions to challenges
- Build a nationwide network for energy professionals by establishing and facilitating channels for interaction including networking sessions, workshops, and exchange programs
- Increase access to higher education in energy-related professions for women and economically disadvantaged students
- Establish channels to facilitate local and international networking in the energy sector
- Emerge as financially self-sustained national hub for energy issues

RESEARCH AGENDA

Provide leadership, research, support, and policy development for conventional and renewable energy, and emerging technologies from a variety of platforms, such as

- State of the art methods to enhance existing energy and power system utilization
- Emerging solar, energy storage and fuel cell technologies
- Advance the usage of biomass/biofuels for power generation
- Efficient thermal power plants with carbon mitigation and nuclear energy research.
- Energy efficient and green building research
- Wind resource assessment and power generation through advance tools and technology
- Advance turbomachinery design and development for various energy conversion systems
- Energy policies leading to cost-conscious, responsible development of Pakistan's energy resources and commitment to environmental quality.
- Energy efficient transport technologies
- Emphasis on SMART Grid Research, FACTS devices and Hardware in the loop for grid
- Explore instrumentation and measurement issues for modern power systems

POST GRADUATE DEGREE PROGRAMS

The Post-Graduate program at USPCAS-E aims to provide access to higher education in energy-related professions for women and economically disadvantaged students across Pakistan; by internationally competitive multi-disciplinary graduate training, with improved relevance and quality curricula and by use of effective teaching methods. The Centre builds a nationwide network for energy professionals by establishing and facilitating channels for interaction including world class research laboratories, library, networking sessions, seminars, workshops, and international exchange programs.



DEPARTMENT OF ENERGY SYSTEMS ENGINEERING

Energy Systems Engineering will cover wide spectrum of energy processes, from the academic research lab through the industrial large-scale reactor to the essence of life. The importance of this program is to emphasis upon the important factors related to recent energy production processes and give knowledge about the social and economic importance of energy production processes.

MASTERS IN ENERGY SYSTEMS ENGINEERING

The MS Energy Systems degree program offers excellent opportunities to the graduates to serve in national and international institutions, research, planning and development departments of the energy ministries, energy companies, industries, and education and research institutions. It will impart baseline knowledge and train professionals to become entrepreneurs and start up their own small to medium scale enterprises in the diverse energy fields, apart from opportunities in the diverse renewable energy sector.

SCHEME OF STUDIES

CORE COURSES		
COURSE CODE	COURSE TITLE	CREDITS
ESE 804	APPLIED SOLAR ENERGY	03
ESE 809	MODELLING OF ENERGY SYSTEMS	03
ESE 820	ENERGY AND ENVIRONMENT	03
ESE 821	ENERGY RESOURCES AND TECHNOLOGIES	03
TOTAL	12	
ELECTIVE COURSES (ANY FOUR)		
COURSE CODE	COURSE TITLE	CREDITS
ESE-800	CLEAN COAL TECHNOLOGIES	03
ESE 802	PHOTO BIOREACTOR ENGINEERING & BIO-PROCESSING	03
ESE 811	SOLAR ENERGY	03
ESE 812	ENERGY MANAGEMENT IN BUILDINGS	03
ESE 813	ENERGY ECONOMICS AND POLICY	03
ESE 814	FUEL CELLS	03
ESE 815	THIN FILMS	03
ESE 816	DEVELOPMENT AND EVALUATION OF ENERGY PROJECTS	03
ESE 817	WIND ENERGY	03
ESE 818	POWER DISTRIBUTION SYSTEMS	03
ESE 819	ENVIRONMENT IMPACT ASSESSMENT	03
TEE 801	ADVANCED THERMODYNAMICS	03
ESE 801	BIOFUEL ENGINEERING	03
ESE 822	GEOTHERMAL ENGINEERING	03
ESE 823	THERMAL HYDRAULICS	03
ESE 824	NUCLEAR ENERGY ENGINEERING	03
ESE 825	HYDROPOWER ENGINEERING	03
ESE 826	INDUSTRIAL CATALYSIS FOR ENERGY SYSTEMS	03
CSE 801	COMPUTATIONAL FLUID DYNAMICS	03
EEE 812	ADVANCED POWER SYSTEM PROTECTION	03
EEE 801	CLEAN ENERGY GENERATION, INTEGRATION AND STORAGE	03
EEE 811	ELECTRIC POWER QUALITY	03
EEE 814	ADVANCED POWER ELECTRONICS	03
TEE 803	CONVENTIONAL AND RENEWABLE ENERGY POWER PLANTS	03
TEE 814	ENVIRONMENTAL ISSUES OF FOSSIL FUEL POWER PLANTS	03
TEE 815	ADVANCED HEAT AND MASS TRANSFER	03
TEE 816	FUELS AND COMBUSTION	03
TEE-820	PROCESS INTENSIFICATION	03
ESE-803	PHOTOVOLTAIC DEVICES	03
ESE-810	COMPUTER APPLICATION IN ENERGY SYSTEMS	03
ESE-828	ENERGY STORAGE SYSTEMS	03
RM-899	RESEARCH METHODOLOGY	02
ESE 899	THESIS	06

Eligibility Criteria

- B.E. in any engineering discipline recognized by PEC OR M.Sc. / BS (04 years) in Chemistry / Physics / Electronics / Environment
- Graduate Assessment Test
- Interview at the Centre

PHD IN ENERGY SYSTEMS ENGINEERING

The Ph.D. in Energy Systems Engineering program is being started for academic research and development in public and private sector commensurate with the needs of allied industries. It is essential to produce scientists who will make significant contributions in the productive research and development in the vast domains of science and engineering especially in the field of energy production. The courses have been designed keeping in view the latest market demand and encompasses a broad area covering advanced requirements for the development of energy generation and conversion materials.

SCHEME OF STUDIES

The duration of the PhD Energy Systems Engineering program will be according to the existing policy of NUST for PhD. The main program requires a minimum of 18 credit hour (CH) course work and a 30 CH research which will be counted towards the thesis.

CORE COURSES		
COURSE CODE	COURSE TITLE	CREDITS
ESE 901	RECENT TRENDS IN ENERGY SYSTEMS ENGINEERING	03
ESE 902	SOCIO-ECONOMIC ASPECTS OF ENERGY SYSTEMS	03
ESE 999	DISSERTATION	30
TOTAL		36
ELECTIVE COURSES (ANY FOUR)		
COURSE CODE	COURSE TITLE	CREDITS
ESE 903	CONTEMPORARY MATERIALS FOR ADVANCED ENERGY	03
ESE 904	ADVANCED ENERGY MATERIALS: SYNTHESIS & CHARACTERIZATION	03
ESE 905	ADVANCED HEAT AND MASS TRANSFER	03
ESE 906	BIOMASS/COAL GASIFICATION	03
ESE 907	PHOTO CATALYSIS-ADVANCEMENT AND APPLICATIONS	03
ESE 908	NUCLEAR THERMAL HYDRAULICS	03
ESE 909	SMART GRID ARCHITECTURE	03
ESE 910	SMART POWER SYSTEMS	03
ESE 911	CARBON CAPTURE AND UTILIZATION	03
RM 899	RESEARCH METHODOLOGY	02
CHE 848	GASIFICATION PROCESSES	03
EME 803	COMBUSTION AND PROPULSION	03
EME 981	ADVANCED FUEL TECHNOLOGY	03
NSE 842	NANO MATERIALS FOR ENERGY APPLICATIONS	03
MSE 901	ADVANCED CHARACTERIZATION OF MATERIALS	03
NSE 931	ADVANCED SYNTHESIS AND FABRICATION TECHNIQUES	03

EME 901	ADVANCED ENGINEERING MATHEMATICS	03
ME 935	RENEWABLE ENERGY	03
ME 936	SOLAR TECHNOLOGIES	03
CSE 931	ADVANCED NUMERICAL METHODS	03
PHY 921	PLASMA PHYSICS	03
PHY 924	EXPERIMENTAL TECHNIQUES OF PHYSICS	03

Eligibility Criteria

- Previous academic record of the applicant, Interview conducted by USPCAS-E, NUST
- MS/ M.Phil. In Chemistry, Physics, Electronics and Environmental/ Energy Science OR MS in all HEC/ PEC recognized Engineering disciplines.
- GRE (general) or GRE (Subject/Engineering) by ETS (New Jersey) or GRE-Subject type test organized by the USPCAS-E NUST (with min of 70% score)

DEPARTMENT OF THERMAL ENERGY ENGINEERING

Pakistan's current energy mix roughly 68% is based on thermal sources like High speed diesel, furnace oil, heavy fuel oil, coal and natural gas. There is no specialized program in the country to cater the needs of thermal power generation. Conventional thermal power plants are considered to be not that energy efficient, in order to enhance the efficiency various technological breakthroughs are imperative. Cutting edge applied research is required not only in thermal fuels but also in areas such as advanced materials, combustion, thermal hydraulics, and thermodynamics.

Thermal Energy Engineering department is primarily focused on thermal energy technologies and systems and covers advanced aspects of energy system modelling, heat- and mass transfer, control engineering and experimental work with focus on different components and energy system aspects. The themes for the two semesters are particularly focussed on Thermal Energy and Process Engineering and in-depth understanding of the technologies and scientific disciplines involved in energy conversion, utilization and transport. The education is multidisciplinary and covers the integration of general engineering disciplines such as thermal systems, fluid dynamics, thermodynamics and thermal hydraulics.

MASTERS IN THERMAL ENERGY ENGINEERING

The degree program offers excellent opportunities to the graduates to serve in national and international institutions, research, and planning and development departments of the energy ministries, energy companies, industries, and education and research institutions. It will impart baseline knowledge and train professionals to become entrepreneurs and start up their own small to medium scale enterprises in the diverse energy fields, apart from serving in the predominant thermal energy mix sector.

SCHEME OF STUDIES

CORE COURSES		
COURSE CODE	COURSE TITLE	CREDITS
TEE 801	ADVANCED THERMODYNAMICS	03
TEE 802	DESIGN AND MODELLING OF THERMAL ENERGY SYSTEMS	03
TEE 815	ADVANCED HEAT AND MASS TRANSFER	03

TEE 816	FUELS AND COMBUSTION	03
TEE 899	THESIS	06
TOTAL		18
ELECTIVE COURSES		
COURSE CODE	COURSE TITLE	CREDITS
TEE-803	CONVENTIONAL AND RENEWABLE ENERGY POWER PLANTS	03
TEE-810	ADVANCED PROCESS ENERGY ANALYSIS & OPTIMIZATION	03
TEE-812	ADVANCED FLUID DYNAMICS	03
TEE 813	TURBOMACHINERY	03
TEE 814	ENVIRONMENTAL ISSUES OF FOSSIL FUEL POWER PLANTS	03
TEE 817	COMPUTATIONAL FLUID DYNAMICS FOR THERMAL ENERGY SYSTEMS	03
TEE 818	ADVANCED HEATING, VENTILATION AND AIR CONDITIONING SYSTEM (HVAC)	03
TEE 820	PROCESS INTENSIFICATION	03
TEE 821	ADVANCED THERMAL ENERGY STORAGE SYSTEMS	03
ESE 800	CLEAN COAL TECHNOLOGY	03
ESE 811	SOLAR THERMAL ENERGY	03
ESE 814	FUEL CELLS	03
ESE 816	ECONOMICS EVALUATION OF ENERGY PROJECTS	03
ESE 822	GEO THERMAL ENERGY	03
ESE 823	THERMAL HYDRAULICS	03
ESE 824	NUCLEAR ENERGY ENGINEERING	03
RM 898	RESEARCH METHODOLOGY	03

Eligibility Criteria

- B.E in Mechanical, Electrical (Power), Chemical, Industrial, Process, or equivalent OR
B.S (4-years) Or M.Sc. degrees in Physics
- Graduate Assessment Test (General)
- Interview at the Centre

PHD IN THERMAL ENERGY ENGINEERING

PhD Thermal Energy Engineering program at USPCAS-E is being started for academic research and development in public and private sector commensurate with the needs of allied industries. This program will address needs for academic and industry related research in thermal energy systems. The program signifies a combined approach of theoretical analysis, numerical techniques and experimental investigations in thermal energy applications. It will create new technical knowledge and skills required for achieving the better management of thermal energy systems, designing of efficient thermal energy systems and processes, utilization of renewable energy sources for thermal power generation and mitigation strategies for the effective reduction and control of environmental pollution due to thermal power generation.

SCHEME OF STUDIES

CORE COURSES			
COURSE CODE	COURSE TITLE		CREDITS
1	TEE-901	EMERGING TRENDS IN THERMAL TECHNOLOGIES	3
2	TEE-902	SUSTAINABILITY IN THERMAL ENERGY SYSTEMS	3
3	TEE-899	DISSERTATION	30
ADDITIONAL REQUIRED COURSE			
4	RM-899	RESEARCH METHODOLOGY	2
ELECTIVE COURSES			
5	TEE-903	PHASE CHANGE THERMAL PROCESSES	3
6	TEE-904	LASER DIAGNOSTICS FOR THERMAL ENGINEERING APPLICATIONS	3
7	TEE-906	ADVANCED COMBUSTION KINETICS	3
8	TEE-907	TECHNOLOGIES FOR ENHANCED HEAT TRANSFER	3
9	TEE-908	ADVANCE TURBO-MACHINERY APPLICATION	3
10	ESE-904	SYNTHESIS AND ANALYTICAL CHARACTERIZATION OF ADVANCED ENERGY MATERIALS	3
11	ESE-905	ANALYTICAL AND NUMERICAL TECHNIQUES IN HEAT TRANSFER	3
12	ESE-906	BIOMASS GASIFICATION	3
13	ESE-908	NUCLEAR THERMAL HYDRAULICS	3
14	ESE-913	CO ₂ CAPTURE, UTILIZATION AND SEQUESTRATION	3
15	MATH-901	ADVANCED ENGINEERING MATHEMATICS	3
16	ME-931	INTERNAL COMBUSTION ENGINE TECHNOLOGY	3
17	ME-884	CONVECTION HEAT TRANSFER	3
18	CSE-803	DATA ANALYSIS AND STATISTICS	3

Eligibility Criteria

- MS/M.Phil. in Energy System Engineering (Thesis in Thermal Engineering), Thermal Energy Engineering, Mechanical Engineering, Chemical Engineering, Nuclear Engineering, Physics, Aerospace Engineering, Thermal Power Engineering and Process Engineering

- Admission of the PhD student for the program will be based on GRE General (Criteria 60%) or GRE Subject/Engineering by ETS New Jersey or GRE organized by USPCAS-E (Criteria 70%), NUST, previous academic record of the applicant, and the interview conducted by USPCAS-E, NUST.

DEPARTMENT OF ELECTRICAL POWER ENGINEERING

The power sector of Pakistan is in doldrums for last couple of decades and is in dire need of reforms, good governance and qualified human resource. The country lacks competent and energetic workforce in this important sector in the industry as well as academia. Although many higher education institutes are offering degree programs in electrical engineering but power centric curriculum meeting the indigenous demands are offered at a few universities in Pakistan. The start of degree program at USPCAS-E is an attempt to fulfil this national requirement through human resource development and indigenous research. The significance of this degree program is to train the students with contemporary curricula about clean power production, economic dispatch and distribution of power, computational power flow, transient studies and studies pertaining to monitoring, control, and protection of power system and integration of renewable energy systems with convention power grid. In addition to that the students will also be exposed to state of the art Smart Grid and Electrical power engineering labs at the Centre during their research phase.

MASTERS IN ELECTRICAL ENGINEERING (POWER)

Electrical Engineering (Power) program is tailored to meet the indigenous needs of the ailing power sector of the country by nurturing the human resource in this field. The program is designed to equip the students with advanced and contemporary technical knowledge of electrical power systems and will enable them to better manage and govern the national power system. Primarily focus will be on electrical power and energy systems, and it covers advanced aspects of power system modelling, computational power flow analysis, high voltage engineering and dielectric studies, online monitoring and protection of electrical equipment with digital relays, transients, and energy measurement with smart meters and PMU.

SCHEME OF STUDIES

CORE COURSES		
COURSE CODE	COURSE TITLE	CREDITS
EEE 800	POWER SYSTEM OPERATION, CONTROL AND OPTIMIZATION	3
EEE 801	CLEAN ENERGY GENERATION, INTEGRATION AND STORAGE	3
EEE 802	ADVANCED POWER SYSTEM STABILITY AND TRANSIENT STUDIES	3
ESE 909	SMART GRID ARCHITECTURE	3
TOTAL		12
ELECTIVES COURSES		
COURSE NO.	COURSE TITLE	CREDITS

EEE-811	ELECTRIC POWER QUALITY	3
EEE-812	ADVANCED POWER SYSTEM PROTECTION	3
EEE 814	ADVANCED POWER ELECTRONICS	3
EEE 813	COMPUTER MODELLING OF ELECTRICAL POWER SYSTEMS	3
EE-861	ALTERNATING CURRENT ELECTRICAL MACHINES AND DRIVES	3
EEE-815	ELECTRIC POWER GENERATION TRANSMISSION AND DISTRIBUTION	3
ESE 803	PHOTOVOLTAIC DEVICES	3
ESE 824	NUCLEAR ENERGY ENGINEERING	3
ESE 813	ENERGY ECONOMICS AND POLICY	3
ESE-820	ENERGY AND ENVIRONMENT	3
ESE-817	WIND ENERGY	3
ESE-814	FUEL CELLS	3
EE-891	STOCHASTIC SYSTEMS	3
MATH-812	ADVANCED ENGINEERING MATHEMATICS	3
MATH-850	ADVANCED NUMERICAL ANALYSIS	3

Eligibility Criteria

- B.E/BS in Electrical, Electronics engineering
- Graduate Assessment Test (General)
- Interview at the Centre

PHD IN ELECTRICAL ENGINEERING (POWER)

Program is in approval phase and expected to be launched in Fall 2018

INTERNATIONAL AND NATIONAL PARTNERSHIPS

- **Arizona State University, USA**
- **Oregon State University, USA**
- **United Nations Industrial Development Organization (UNIDO)**
- **World Bank Group**
- **Collaborators at Purdue University (IUPUI)**
- **Fauji Fertilizer Corporation Limited**
- **ICI / AKZO Nobel**
- **Pakistan State Oil**

- **All Pakistan Textile Mills Association (APTMA)**
- **Alternative Energy Development Board (AEDB)**
- **Attock Refinery Limited**
- **Attock Generation Limited**
- **Sustainable Development Policy Institute (SDPI)**
- **Planning Commission of Pakistan**
- **National Steering Committee on Sustainable Energy for all**



EXPERIMENTAL AND SIMULATION FACILITIES

Research Facilities:

Fossil fuel Lab

Reliance on fossil fuels has had a harrowing effect on the climate which has stirred anxiety concerning the future of humanity on the planet. For as long we are to dig our energy from the ground, it must be utilized with utmost responsibility ensuring maximum efficiency and least pollution. The lab focuses on finding ways in which fossil fuels in the form of coal and oil can be used while circumventing the pitfalls of low quality and scarcity. Thar coal is considered to be a great source of energy for Pakistan and Fischer Tropsch synthesis shows a means of using that resource along with biomass in the form of liquid fuels. Liquid fuels are essential for our infrastructure to function and biomass gasification as well as plant oil extraction along with conversion to biodiesel and synthetic gasoline can provide renewable alternatives. The equipment available in the Fossil Fuels Research Lab include Elemental Analyzer, Hardgrove Grindability Tester, Fischer Tropsch Synthesis Plant, Gas Chromatograph, Autoclave, Oil Expeller along with Updraft and Downdraft Gasifiers.

Solar Energy Laboratory

The main goal of the Solar Energy laboratory is to educate students through research experiences in solar thermal, solar photovoltaic (PV), conventional energy utilization and energy auditing of buildings. The facility of mathematical simulations and modelling of the solar power including PV modules, concentrating PV and solar thermal power systems is also developed as a part of this lab. Such simulations/modelling help in exploring the impact of climate parameters by using weather data of diverse climatic regions as inputs. Moreover, this laboratory hosts the researchers working on the long-term reliability/stability of PV modules in local environmental conditions, which determines the life of PV modules and eventually the whole power system. To fulfil these aims, laboratory is equipped with variety of equipment such as: state-of-the-art equipment for energy audit of buildings, solar heat source vapour catalyst, solar irradiance measuring/monitoring devices, temperature/humidity monitoring data-acquisition systems, indoor/outdoor PV cell testers, PV testing kits to observe system health- and soft wares like PV* sol, HOMER and ASAP: the optical design software.

Advance Energy Materials & Systems (AEMS) Lab

AEMS Lab is currently equipped with state of art tools for processing and characterization of high quality and high efficiency materials for energy generation, conversion, and storage, etc. AEMS lab ultimately aims to develop materials and solutions for environmentally friendly and higher efficiency materials for assortment of applications. Tools available to lab give researchers an unprecedented control up to Nano-scales in terms of diversified processing and characterization where the exploration of new science and technology becomes a reality. Moreover, lab has got a great potential and capacity to solve the problems of industries such as steel, auto-manufacturing, chemical, petrochemical, surgical, defense, and tool manufacturing, etc.

Under the umbrella of AEMS Lab, facilities such as Microanalysis and Thermal Analyses, Vapor Phase Microfabrication & Plasma Manufacturing, Thermal Spray and Surface Engineering Facility, Wet-chemistry synthesis, Thermal Processing & Heat Treatment Facility, Powdered Materials Technology, Electrical & Electromagnetic Energy Source Processing, Opto-Electrical & Electro-Chemical Characterization, Mechanical Grinding and Machining Section, Computational Chemistry and Physics are available.

Energy Storage and Conservation Lab

The energy storage and conservation lab comprise of equipment, which can be used for batteries fabrication, batteries testing ranging from coin cell up to battery packs and modules, PEM fuel cell fabrication and testing, hydrogen storage and carbon capture testing. Moreover, lab has got a great potential and capacity to do all type of electrochemical characterization of materials for fuel cells and batteries application.

In Energy Storage and Conservation Lab, facilities such as Volumetric Sorption Analyser for gas adsorption studies, Coin Cell Battery Fabrication Line, Potentiostat with RRDE, PEM Fuel Cell Testing Station, Battery Testing System have been established.

Biofuel Lab

The lab manages the research activities in the area of bioenergy from organic substrates, Solid and liquid materials. The scope of lab is waste to energy conversion through biochemical processes i.e., Anaerobic digestion, Fermentation, Hydrolysis, biomass gasification, microbial fuel cells, Algae to

hydrogen and biodiesel production (Biomass and waste cooking oil). Under the umbrella of Biofuel Lab, facilities such as Gas chromatography, Photo-bio reactors, High-performance liquid chromatography, etc. are available.



Thermal Energy Engineering Research Laboratory

Thermal Energy Engineering Research Laboratory is designed to cater current and future applied research needs in thermal energy sector. The research in the laboratory will be concerned with questions related to industrial applications of thermodynamics, fluid mechanics and heat and mass transport. Using a combined approach of theoretical analysis, numerical calculations and experimental investigations, the department aims to develop new or advanced knowledge for application in industrial design. Main thrust areas of thermal energy engineering research lab are Engineering Thermodynamics, Fuel and Combustion, Thermal Hydraulics, Gas Turbine Technology, Thermal Energy Storage.

Smart Grid & Power Systems Lab

Smart Grid is a new paradigm of power systems in which all the assets – generation, transmission, distribution and utility, are optimally controlled to achieve efficiency in energy and economy. This laboratory offers state-of-the-art facility for R&D in the enabling technologies for Smart Grid. The facility includes power grid simulator, protection relay development, high frequency transient and fault analysis, measurement and automation, power electronics and electric drives etc.

Combined Lab

Under the umbrella of Combined Lab, the following facilities have been established

1. UV-VIS-NIR Spectrophotometer
2. Simultaneous Thermogravimetry/ Differential Thermal Analysers (TGA/DTA)
3. Gas Chromatograph Mass Spectrometer (GCMS)
4. Atomic Force Microscopy (AFM)
5. DC-RF Sputtering System
6. X-ray Diffraction (XRD)
7. Scanning Electron Microscope (SEM) with Energy Dispersive X-ray Spectroscopy (EDS)
8. 'Mini' Sputter Coater and Glow Discharge System with Carbon coating option
9. Super Critical Fluid Extraction Facility
10. Subsonic wind tunnel with testing and development platform
11. Laser guided PCB plotter and designer for Rapid prototyping



SIMULATION FACILITY

IPSEpro, Trnsys, Polysun, Markal times, Ansys Fluent (CFD), LabVIEW, MATLAB, Simulink, Gaussian 9 Computational Chemistry Code, and others.



LIBRARY

The library is designed to meet the requirements of degree programs currently being offered at USPCAS-E. A large number of books are there to cover the domains of energy systems, thermal engineering, wind, solar, nuclear, photovoltaics, energy policy and economics. The library is digitally subscribed with HEC which gives access to online energy related journals. Two magazines namely national geographic and reader's digest are also in library's subscription list.

FACULTY

Dr. Zuhair S Khan

Professor, Acting Principal/ Dean

HoD Energy Systems Engineering

PhD (Kyoto Univ., Japan), MS Engineering
(Linkoping Univ., Sweden)

Specialization: Advanced Energy Materials &
Surface Engineering, Thin Films, Surface &
Coatings Technology.

Dr. Mohammad Bilal Khan

Professor

DIC/PhD, Imperial College-London, MS (USA)

Specialisation: Energy systems, Interface
Engineering, Polymer Engineering.

Dr. Adeel Javed

Assistant Professor

HoD Thermal Energy Engineering

PhD Gas turbine and Turbomachinery (TU
Delft, Netherlands), MSc Aerospace
Propulsion (Cranfield University, UK)

Specialization: Gas turbine performance,
Aero-Thermal aspects of Turbomachinery,
Computational Fluid Dynamics,
Experimentation

Dr. Kashif Imran

Assistant Professor

HoD Electrical Power Engineering

PhD Electrical Power Engineering, University
of Strathclyde, UK.

Specialization

Electrical Power Systems Engineering

Dr. Naseem Iqbal

Associate Professor

PhD Chemistry TU Vienna, Austria

Specialization: Catalysis, PEMFCs, Energy
Storage, Gas Adsorption

Dr. Adeel Waqas

Assistant Professor

PhD Energy Technology, Asian Institute of
Technology Thailand

Specialization: Solar Thermal, Passive
heating and cooling of Buildings

Dr. Nadia Shahzad

Assistant Professor

PhD Material Sciences, Politecnico di Torino,
Italy

Specialization: Nanostructured and
Photoactive Materials for Solar Energy
Application

Dr. Rabia Liaquat

Assistant Professor

PhD Environmental

Biotechnology/Microbiology,

QAU, Islamabad & The University of
Queensland, Australia

Specialization: Bio Energy

Dr. Muhammad Hassan

Assistant Professor

PhD and MS in Bio-environmental & Energy
Engineering, Nanjing Agricultural University,
China

Specialization:

Methane Enhancement Technologies,
Bioenergy Production from Agricultural

Dr. Parvez Akhter

Assistant Professor

PhD Solid State & Surface Physics, Sussex
University, UK

Specialization: Solid State & Surface Physics

Dr. Majid Ali

Assistant Professor

PhD (Nuclear Energy Science and
Technology), Harbin
Engineering University, China

Dr. Muhammad Zubair

Assistant Professor

Professional Doctorate of Engineering, TU Delft, Netherlands

MS Engineering (NUST)

Specialization: Process and Equipment Design, Thermal Engineering, Fuels and Combustion, Biofuels

Dr. Muhammad Bilal Sajid

Assistant Professor

PhD Mechanical Engineering, KAUST KSA

MSc Mechanical Engineering, UET Taxila

Specialization: Thermal Energy Engineering

Dr. Muhammad Aamir

Assistant Professor

PhD Chongqing University, China

Specialization

Engineering Thermophysics, Heat Transfer, Spray Cooling

Dr. Syed Muhammad Raza Kazmi

PhD, Power Electronics

Tohoku University Japan

Specialization: Wind and Solar Energy Conversion Systems

Dr. Hassan Abdullah Khalid

Assistant Professor

PhD Electrical Engineering (University of Laquila, Italy, MS Electrical Power Engineering, Chalmers University of technology, Sweden

Specialization

Power quality, Grid connected Converters

Dr Khawaja Arsalan Habib

Assistant Professor

PhD Electrical Power Engineering, University of Electronic Science and Technology of China, MSc. Embedded Intelligent Systems, University of Hertfordshire, UK

Specialization:

Innovative measurement and instrumentation solutions for modern power systems and Smart Grid, System identification and optimal sensor placement

Dr. Syed Ali Abbas Kazmi

Assistant Professor

PhD in Electrical (Power) Engineering from SungKyunKwan University (SKKU) South Korea, MS in Electrical (Power) Engineering, UET Peshawar, Pakistan

Specialization:

Smart Distribution Network Planning

Dr. Kafaitullah

Assistant Professor

PhD Energy Economics and Management, TU Twente, Netherlands

Specialization: Energy Policy

Engr. Akif Zia Khan

(Ex-Pakistan Leave for PhD)

Lecturer

BE Electrical Engineering, MS Electric Power Systems

Specialization: SMART Power Generation

Shahid Hussain Ansari

(Ex-Pakistan Leave for PhD)

Assistant Professor

MS, BS in Chemical Engineering

FUNDED ONGOING PROJECTS

The centre for advanced studies is working with multiple public and private and donor bodies on different applied projects in the field of energy. Details of the projects are given below:

- U.S.-Pakistan centre for advanced studies in energy funded by USAID
- Promoting sustainable energy production and use from biomass in Pakistan by UNIDO
- Development of environmentally tolerant materials and coatings for gas turbines for electric power generation and vehicular propulsion by HEC
- GTL FT synthesis facility with GC in collaboration with FFCL
- Enhanced hydrogen production from algae using artificial electron donors and inhibiting agents for ferredoxin NADP reductase by HEC
- Installation of solar-mapping instruments at NUST by World Bank
- Optimization and scale up of fixed bed reactor for pilot scale facility in collaboration with Syngfuels with China
- Biomass resource mapping, AEDB, World Bank
- Industrial grade multi-purpose test bed for electric machine characterization and control development project
- Smart solar hybrid ups with maximum power point tracking, efficient battery charging and voltage regulation grant
- Valorisation of biomass residues for methane production through anaerobic digestion technology: green energy recovery from waste
- Novel materials for secondary sodium-ion batteries and proton exchange
- Membrane fuel cells by Pakistan Science Foundation
- Liquid fuel production by coal/biomass derived syngas by USAID
- Integrated energy planning for Pakistan (ASU-NUST joint project)
- Industrial grade multipurpose test bed for electric machine characterization and control development (HEC-NRPU)
- Smart solar hybrid ups with MPPT, efficient battery charging and voltage regulation (HEC-NRPU)
- Design and development of condition monitoring test bed based smart solar micro grid – community empowerment through access to energy in rural areas of Pakistan (ASU-NUST joint project)
- Design and implementation of solar wind hybrid system for rural communities of Pakistan and Iran with the emphasis on energy efficiency
- Autonomous 11 kv distribution line fault localization system (NUST-USAID)
- Non-contact predictive fault analysis method for a utility transformer at DESCOS (HEC-SRGP)
- Catalyst development for electrochemical engines