Advance your skills

Power Plant Engineering

Postgraduate Diploma

What will I gain

A qualification which will develop high level specialist skills required to deal with specific challenges faced by those working in, or entering, the power plant industry.

How will I learn these skills?

Courses are taught in block sessions to cater for working individuals. The content for the course is taught partly online and partly through face-to-face interaction. Candidates will be required to attend 1 week of lectures for each course taken.

PROGRAMME STRUCTURE

To qualify for the diploma, candidates are required to complete a minimum of 120 credits and a total of 8 courses of which 6 are compulsory courses.

Candidates have the option to select 2 elective courses from any of the specialisation centres of the Consortium Partner Universities. Unless otherwise stipulated, the courses are offered at the University of Cape Town.

All courses can be taken for CPD points.

Minimum qualifications needed

BSc/BScEng/BTech in a science related field with undergraduate courses in thermodynamics and a minimum final year mark of 60%.

COMPULSORY COURSES

- **Overview of the Power Plant Industry**
- **Power Plant Systems Analysis**
- **Power Plant Boilers**
- **Systems Engineering**
- **Mechanical Behaviour of Materials**
- **Leadership in a Technical Environment**

ELECTIVE COURSES

- **Turbine Plant Engineering**
- **Vibrations**
- **Intelligent Systems**
- **Condition-based Maintenance**
- **Control Systems**
- **Maintenance Logistics**
- **Maintenance Practice**
- **Reliability Engineering**
- **Renewable Energy Systems**
- **Renewable Energy Policy**
- **Thermal Energy Systems**
- **Introduction to Solar Energy**
- **Nuclear Reactor Technology**
- **Nuclear Engineering I**
- **Reactor Safety**

For more information please visit:

www.mecheng.uct.ac.za

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Department of Mechanical Engineering

Postgraduate Diploma in Power Plant Engineering: Courses offered

OVERVIEW OF THE POWER PLANT INDUSTRY

The aim of the course is to establish a balanced understanding of the global energy domain, enhancing student contextual understanding of material contained in other courses within the PGDip in Power Plant Engineering. World energy outlook. Integrated Energy Plan. Types of power generation plant. Environmental impact and sustainability. Renewable energy resources. Nuclear power generation. Energy efficiency and demand side management. Energy industry and economics. Power generation mix and the IRP. Economics of power generation

POWER PLANT SYSTEMS ANALYSIS

The aim of the course is to lay the theoretical foundations of thermofluid process modelling applied to power plants, based on the fundamentals of thermodynamics, fluid mechanics and heat transfer. Introduction to thermofluid systems analysis. Overview of fundamental concepts. Conservation laws for fluid control volumes. Components charateristics - Pipe and duct flows. Components charateristics - Pumps, fans and turbomachinery. Components charateristics - Furnaces, boilers and heat exchangers. Simplified analysis of important thermofluid processes. Integrated systems analysis and modelling - steady state. Integrated systems analysis and modelling - dynamic

POWER PLANT BOILERS

The aim of the course is to lay the theoretical foundations for the modelling and analysing the performance of boilers that are encountered in a typical coal fired power plant. The focus falls on the combustion, thermodynamics, heat transfer and fluid mechanics encountered in the boiler, and how these processes are controlled.

Boiler types and configurations, fuels and combustion, furnace heat transfer, two-phase flow heat transfer and hydraulics, superheater and reheater heat transfer, draft system hydraulics and air pre-heaters, furnace controls, fouling and slagging, erosion and corrosion, commissioning and acceptance testing of boilers.

SYSTEMS ENGINEERING

This course will present the discipline of Systems Engineering, with focus on the application in power plants. Students will understand the system life cycle as portrayed by the V diagram, and the various technical management processes involved will be a core focus. Some aspects covered will be: Functional Analysis; Requirements Management; Configuration Control; Risk management; and Systems Engineering Management Plan.

MECHANICAL BEHAVIOUR OF MATERIALS

The course is intended to give an understanding of the relationships between the structure of materials and their response to applied stress. This understanding is then used for problem solutions such as, materials selection for design (with particular emphasis on meeting the requirements for power plant) and failure analysis case studies.

Topics to be treated are:

Crystallography and bonding, Elastic and plastic deformation, Deformation and annealing mechanisms, Strengthening mechanisms, Steel metallurgy and heat treatment, Welding metallurgy, Time-dependent microstructure/property evolution (high temperature/high stress exposure), Corrosion and oxidation, Wear mechanisms (abrasion, erosion, slurry erosion), Stress concentration and Fracture mechanisms, Crack propagation, Factors affecting fracture toughness, Fatigue, Creep, LEFM

approach, Methods to improve toughness, Fracture toughness testing, Fracture surface feature identification, Failure analysis investigation, Failure case studies.

LEADERSHIP IN A TECHNICAL ENVIRONMENT

This course fosters the ability to influence a group of people towards a goal and to maximize their performance. The focus falls on cultivating a personal leadership philosophy, managing technical professionals and technical projects in a diverse environment, organizational theory and culture, strategic thinking, resource and supply chain management, ethics and the roles of managers and maintenance management and the ability to lead change.

Turbine Plant Engineering

The aim of the course is to 1) Lay the theoretical and practical foundations for the modelling and analysis of the performance of power plant equipment associated with the steam turbine, including condensers and feed heaters 2) Convey methodologies for the commissioning, acceptance testing and condition monitoring of these equipment.

Outline

1. Regenerative Rankine cycle overview
2. Steam turbines (types, function, thermodynamics, operation, control, condition monitoring)
3. Condensers
4. Feedwater heaters (open and closed, shell and header types)
5. Auxiliary equipment (ejectors, gland seals, oil system, water purification)
6. Valves

Vibrations

The course introduces modelling of dynamical systems for vibration analysis, analytical and computational solution techniques, interpretation of these solutions and vibration in real-world scenarios and machines. In addition, measurement of vibrating systems, with a focus on condition monitoring and the interpretation of this data is introduced. Formulation of equations of motion (Newtonian and Energy approaches), analytical and computational solution techniques, modelling of vibrating systems, condition monitoring.

Intelligent Systems - University of Pretoria

This module provides the theoretical background necessary to understand, research and develop real-world software and hardware systems that incorporate and exhibit intelligent behaviour. The module incorporates advanced theory from fields such as Artificial Intelligence, Computational Intelligence, Machine Learning, Pattern Recognition and Signal Processing. Core topics of the module include: Bayesian Theory, Neural Networks, Kernel Methods, Graphic Models, and Numerical Bayesian Methods.

Condition-based maintenance - University of Pretoria

Theory and practical applications of condition based maintenance techniques. Pitfalls of the various condition based maintenance techniques. Acoustic emission, wear debris monitoring, oil analysis, thermography and non-destructive testing, standards.

Control systems - University of Pretoria

Introduction to state space methods, full state feedback design, disturbances and tracking systems, linear observers, compensator design by the separation principle, linear quadratic optimum control, Kalman filter, linear quadratic Gaussian compensator. Prerequisite: A working knowledge of MATLAB/OCTAVE/Python

2017 timing: 08:30 – 16:30, 16 Feb, 30 March, 11 May

Maintenance logistics - University of Pretoria

Introduction to logistics, systems engineering and supportability analysis, inventory, aspects of logistical design,

LEAN Production, Facility Layout, Job Design and Work Measurement, Logistics from the development to the retirement phase, planning and scheduling, project management.

Maintenance practice - University of Pretoria

Failure characteristics and analysis. Maintenance economics – Budgeting and cost control. Life cycle partnering and maintenance contracting. Legal aspects and case study. Performance measurement and benchmarking. Maintenance programming – Network analysis. Variability analysis. Maintenance strategy, plan, and protocol design – a new look at RCM. Maintenance tactic selection techniques. Introduction to condition-based maintenance. Tribology and contamination control presented with case studies. Maintenance Maturity Indexing and Variable Relationships development.

Reliability engineering - University of Pretoria

Introduction to probabilistic distributions, computation of system reliability, building reliability models and optimisation of system reliability; Fault Tree Analysis; Failure Modes, Effects and Criticality Analysis (FMECA), Monte Carlo Simulation; probability-based design.

Renewable energy systems - University of Stellenbosch

This course forms the foundation of the various modules in Renewable and Sustainable Energy Studies. It will provide course participants with an overview of the most significant renewable energy resources, concepts, technologies and challenges to overcome climate change and other sustainable development goals and an insight into the possible solutions to sustainable energy usage. Course participants will be able to recognise, understand and evaluate the different renewable energy resources available today and in the future.

Renewable energy policy - University of Stellenbosch

The South African White paper on Renewable Energy (RE) has set for itself a target of 10 000 GWh of renewable energy (RE) by 2013. It has identified solar, wind, biofuels, small-hydro, landfill-to-gas and other renewable energy sources as development potential in South Africa. The course participant will get to understand how the policy environment influences the financial aspects and project design of RE initiatives in South Africa. The participant will get to be familiar with a range of policy instruments, the financial structuring tools needed to attract investors, and how to use alternative financial sources, like carbon finance, outside of the commercial financial institutions to ensure financial viability of projects.

Thermal energy systems - University of Stellenbosch

The course consists of a study of the conventional energy systems that contribute to the total energy mix throughout the world today. The course will give an insight into the current world supply and demand for conventional energy including consumption of various end-users. The supply and demand for conventional energy in South Africa will also be covered. The contribution made by each of the systems supplying the energy mix to the major industrialized countries will be discussed. For each of the major systems, the methods of energy generation and production as well as the supply networks will be covered.

Introduction to solar energy - University of Stellenbosch

The course consists of a study of both Photovoltaics (PV) and Solar-thermal technologies for generating electricity from sunlight. The principles, manufacturing technologies, efficiencies, advantages and limitations of various PV cells will be considered. The students should be able to design a manufacturing plant as well as practical installations of various PV components in a cost

effective way. The different solar-thermal systems will be introduced with the basic heat transfer and thermodynamics principles that apply. Both bulk electricity generation and smaller stand alone systems will be covered.

Nuclear Reactor Technology - North West University

The purpose of this module is to introduce students from a non- engineering discipline (B.Sc or B.Tech) to nuclear power reactor technology. The module will give a broad overview of the different types of nuclear power reactors, LWR (PWR and BWR), HWR and GCR (AGR and HTR). The module will also cover the main technological elements of each type of reactor (fuel elements and core, main components, etc.). Aspects of reactor operation, reactor control and stability, will be covered, including elementary concepts of reactor fuel and core design, core loading, spent fuel and radioactive waste management.

Nuclear Engineering I - North West University

Atomic and nuclear physics, interaction of radiation with matter, nuclear reactors and nuclear power, neutron diffusion and moderation, nuclear reactor theory, the time dependent reactor, heat removal from nuclear reactors, radiation protection, radiation shielding, reactor licensing, safety and the environment.

Reactor Safety - North West University

The main purpose of this module is to impart to the student sound knowledge, training and skills in nuclear reactor safety. The main objective is to familiarise the student with the essential principles of nuclear power plant safety, reactor siting, reactor licensing, and radiation doses from nuclear power plants, reactor accidents and accident risk analysis, as well as environmental radiation protection requirements. The main areas of nuclear reactor safety cover multiple barrier reactor design to prevent the escape of radioactivity into the environment. This involves the safe design of the fuel, cladding material, the closed coolant system, the reactor vessel and the containment. Reactor control and reactor emergency shutdown systems are presented in the course. The three levels of safety, including suitable site location and essential evacuation procedures in case of an accident, are all an integral part of the course.