MEC7233: Modelling and Optimization of Energy Technology

Hours per Semester				Weighted Total Mark	Weighted Exam Mark	Weighted Continuous Assessment Mark	Credit Units
LH	PH	TH	CH	WTM	WEM	WCM	CU
40	0	10	45	100	60	40	3

Course Description:

This course is focused on the basics of modelling with emphasis of process and process modelling; steady and unsteady state process modelling and simulation; role of modelling in technology transfer; mathematical modelling; statistical models; dimensional analysis and modelling

Course Objective:

Computer modelling and simulation has become a very important technology for assisting engineers with their non-trivial task of designing/analysing energy technology and environmental systems such that the result is low energy consumption, good indoor conditions and minimal impact on the environment in general. This course intended to provide the skill and competence with regard to modelling and simulation in Energy technology

Course Learning Outcome:

The goal of the course is that the students should learn methods for the modelling and simulation of physical plants with regard to energy technology.

Course Outline:

Why Modelling, Process and Process Modelling, (6 Hours)

- General Aspects of Modelling Methodology,
- The Life-cycle of a Process and Modelling,
- Modelling and Research and Development Stage,
- modelling and Pilot Stage, modelling and Detailed Engineering Stage,
- modelling and Operating Stage,
- Considerations About the Process Simulation, The Simulation of a Physical Process

Classification of Models (6 Hours)

- Steady-state Flow sheet modelling and Simulation,
- Unsteady-state Process modelling and Simulation,
- Molecular modelling and Computational Fluid Dynamics,
- Optimization Methods, Reliability of Models and Simulations,
- modelling and Simulation in Innovations, Role of modelling in Technology Transfer and Knowledge

Mathematical modelling Based on Transport Phenomena, (13 Hours)

- Development of a Mathematical Model of a process, Flow Models,
- Fundamental and Combined Flow Models,

- Examples of flow models,
- Flow modelling using Computational Fluid Dynamics,
- Complex Models and Their Simulators,
- Some Aspects of Parameters Identification in Mathematical modelling

Stochastic Mathematical modelling, (6 Hours)

- Introduction to Stochastic modelling, Mechanical Stirring of a Liquid,
- Numerical Application, Solid Motion in a Liquid Fluidized Bed,
- Statistical Models, Basic Statistical modelling, Characteristics of the Statistical Selection, Correlation Analysis, Regression Analysis, Experimental Design Methods.

Dimensional Analysis and modelling, (9 Hours)

- Dimensional Analysis in Energy Engineering,
- Energy flow Problems Particularized by Dimensional Analysis,
- Common Dimensionless Groups and Their Relationships,
- Physical Significance of Dimensionless Groups,
- Particularization of the Relationship of Dimensionless Groups Using Experimental Data, Physical Models and Similitude.

Mode of Assessment

The method of assessment is by written examination and evaluation from case studies.

Mode of Delivery

Include formal lectures (including those from Visiting Lecturers), case studies, tutorial exercises, practical demonstrations, directed learning and individual work

References

- Tanase G. Dobre, Jos G. Sanchez Marcan (2007) *Modelling, Simulation and Similitude*, Chemical Engineering, Wiley ISBN-13: 978-3527306077
- Josef Kallrath et al (2009) *Optimization in the Energy Industry (Energy Systems)* Springer; 1 edition ISBN 13 978-3540889649
- Adrian Bejan, Eden Mamut (1999) *Thermodynamic Optimization of Complex Energy Systems* Springer ISBN-13: 978-0792357254
- Stanislaw Sieniutycz ,Jacek Jezowski (2009) *Energy Optimization in Process Systems* Elsevier Science ISBN-13: 978-0080451411