POSMEC | UFSC
Programa de Pós-Graduação em Engenharia Mecânica
Universidade Federal de Santa Catarina

Disciplina: Concentrated Solar Power: Fundamentals, Technology and Economics	Código: EMC 410160
Área de Concentração: Engenharia e Ciências Térmicas	
Carga Horária Total: 30h	N° de Créditos: 2
Teórica: 25h	Classificação: Normal
Prática: 5h	Bimestre (s): 4º
Prof. Júlio César Passos, Dr.	

Pré-requisitos:

Código	**Disciplina**
EMC 410159	Fundamentos para Sistemas de Concentração Heliotérmica

Ementa/ Topics

Introduction. Basics of Solar Irradiation. Measuring Solar Irradiation. Principles of CSP Technology. Parabolic Trough Plants. Solar Tower Plants. Solar Dish Plants. Condenser Cooling. Site Evaluation. Calculation of Electricity Generation Cost.

Programa/Program

1. Reasons for Using Solar Energy, Greenhouse Effect;
2. Basics of Solar Irradiation, Radiative Transfer in the Atmosphere, Different Scattering Mechanisms, Direct and Diffuse Irradiation, Global Horizontal Irradiation (GHI), Solar Time vs. Local Time, the Sun's Position, Solar Resource Maps,Solar Resource Maps;
3. Measuring Solar Irradiation, High Precision Measuring Station, Measuring the Solar Resource: The TMY (Typical Meteorological Year),Measuring the Solar Resource: Describing the uncertainty;
4. Principles of CSP Technology, The Principles of CSP Technology and Overview of different CSP Technologies on the Market,Classification of Solar Energy Technologies, Principle of Concentrated Solar Power (CSP), Types of CSP Power Plants and Status of Application, Systematic of Describing the Different CSP Technologies;
5. Scheme of Parabolic Trough Solar Power Plant, Possible Heat Engines, The Rankine Process and the Process the Process used in Steam Turbine Power Plants, The Rankine Process in h,s-Diagram, Depiction of the Expansion in the h,s-Diagram of Water and Steam, The Problem of Low Super Heating at Parabolic Trough Solar Power Plants, The necessity of Reheating at Parabolic Trough Solar Power Plants, Multi Stage Feed Water Pre-Heating, Efficiency of Rankine Process, h,s-Diagram for Water and Steam,The Three Main Components of a Parabolic Trough Collector, Parabolic Trough Solar Collectors, The Absorber Pipe, Schematic of Parabolic Trough Collector Field, Parabolic Trough Solar Collectors: Tracking and Efficiency, Performance Calculation of Total Plant System, The Difference between Direct Normal Irradiation (DNI) and Direct Incident Irradiation (DII), Description of "End Losses", Incident Angle Modifyer (IAM), Performance of a Collector (SCA) as Function of Sun's Position and DNI, A Case Study: Parabolic Trough Solar Collector (PTSC) at MadinatZayed, PTSC: Power of the entire Collector Field without Shading and Thermal Inertia, PTSC: Shading by Neighbor Collectors,PTSC: Power of the entire Collector Field with Shading and Thermal Inertia, Power Generation Profile, CSP Simulation Tools, PTSC:Plants, Status of Application, PTSC: Plants in Operation, PTSC: Plants under Construction (in 2015), PTSC: Picture Gallery, PTSC:Developments, PTSC: Integrated Solar Combined Cycle System (ISCCS), PTSC: Direct Steam Generation (DSG), PTSC: Thermal Energy Storage (TES), Cost of Thermal Storage at CSP, PTSC: Thermal Energy Storage (TES), Linear Fresnel Collector CSP Plants;
6. Solar Tower Power Plants (STPP), STPP: Possible Heat Engines, Heliostat Fields, Tracking, Receiver Types: Open or Cavity, STPP: Direct Steam Generation in Receiver, STPP: Performance Calculation, STPP: Status of Application, Picture Gallery and Current Developments;
7. Solar Dish Plants and Micellaneous Technologies, SDP: Possible Heat Engines, Stirling Engine, Receiver of Stirling Motor, SD: Concentrator Types, SD: Performance Calculation, SDP: Status of Application, SDP: Current Developments and Summary;
8. Condenser Cooling, Cooling of the Condenser at Steam Power Plants;
9. Site Evaluation for CSP Plants, Site and Infrastructure;
10. Calculation of Electricity Generation Cost; Comparison with the price of Electricity of Fossil Fired Plants.

Critério de Avaliação:

Exam and List of Exercises.

Bibliografia:

1. Duffie, J.A., Beckman, W.A., Solar Engineering of Thermal Processes, John Wiley & Sons, 3rd ed., 2006.
2. Goebel, O., Prof. Dr. Ing. Olaf Goebel's Lectures, 2014.
3. Sá, A. B. ; **Passos, J.C.**, Numerical Analysis of a power plant using parabolic trough collectors. In: CONEM 2014 - VIII Congresso Nacional de Engenharia Mecânica, 2014, Uberlândia. Anais dos CONEM 2014. Rio de Janeiro: ABCM, pp. 1-10, 2014.
4. Solé, A.C., EnergíaTermosolar, Cano Pina, S.L.-EdicionesCeysa, 1ª edición, 2010.

Master of Science Dissertations defended at LEPTEN:

Sá, A. B. de, Procedimento para Modelagem de uma Planta Termossolar Utilizando a Tecnologia de Coletores Cilindro Parabólicos, Programa de Pós-Graduação em Engenharia Mecânica, Universidade Federal de Santa Catarina, Florianópolis-SC, 181 págs., 2013.

Pigozzo Filho, V.C., Análise Experimental de um Sistema Solar com Concentrador CilindricoParabólico, Programa de Pós-Graduação em Engenharia Mecânica, Universidade Federal de Santa Catarina, Florianópolis-SC, 2013.