



ENERGY CONSERVATION AND WASTE HEAT RECOVERY

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INTENDED AUDIENCE : Energy Science and Engineering, Mechanical Engineering, Electrical Engineering students

PRE-REQUISITES : Basic Thermodynamics

INDUSTRIES APPLICABLE TO : BHEL, NTPC, CESC, WBSEB, DVC and other power companies, GE, Siemens, Alstom

COURSE OUTLINE :

Estimates from analyses and audits from various industries suggest that 20 to 50% of industrial energy input is lost as waste heat. This waste heat can be in the form of hot exhaust gases, water/fluid streams (from condensers in power plants) or heat lost from hot equipment and surfaces. As the world strives for higher energy efficiencies, it is imperative that along with better equipment we focus on recovering the energy stored in this “waste heat” and utilize it for useful purposes. The proposed course introduces us to various methods of Waste Heat Recovery that has been employed by the industry to harness the energy stored in waste heat and use it for generation of additional electric power.

ABOUT INSTRUCTOR :

Prof. Prasanta Kumar Das is a Professor of Mechanical Engineering and presently the Dean Post Graduate Studies and Research at IIT Kharagpur. He possesses a vast experience in teaching and research. His research interests lie in the broad area of thermal engineering with a special emphasis on two phase flow. Apart from teaching many fundamental subjects he offered applied courses like Power Plant Engineering, Thermal System Design, Waste Heat Recovery etc. He has also conducted tailor-made courses for industries. He contributed actively in sponsored research and offered consultancy to different Government and private industries. He contributed more than 190 publications in international journals, a vast number of publications in national and international conferences and 10 patents. He has supervised more than 20 scholars for their doctoral degree. He is fellows of Indian National Academy of Engineering and National Academy of Sciences India.

Prof. Anandaroop Bhattacharya is an Associate Professor of Mechanical Engineering at IIT Kharagpur. His research interests lie in the areas of electronics cooling, transport in porous media and gas turbine heat transfer. Prior to joining IIT, Anandaroop spent 12 years in the industry in USA and India working at Intel, General Motors and General Electric Research Centers.

COURSE PLAN :

Week 1 : Introduction to Waste Heat, Importance of Waste Heat Recovery, Review of Thermodynamics – Introduction to First and Second Laws

Week 2 : Review of Thermodynamics – Entropy, Entropy Generation, First and Second Law efficiency

Week 3 : Power Plant Cycles - Energy Cascading, Rankine Cycle, modification of Rankine cycle, examples

Week 4 : Gas Turbine Cycle, Combined Cycle, Combined Gas Turbine-Steam Turbine Power Plant, Heat Recovery Steam Generators

Week 5 : Thermodynamic cycles for low temperature application, Cogenerations, Introduction to Heat Exchangers, Analysis – LMTD and ϵ -NTU method

Week 6 : Analysis of Heat Exchanger – continued, Problem solving, Special Heat Exchangers for Waste Heat Recovery, Synthesis of Heat Exchanger Network

Week 7 : Heat pipes & Vapor Chambers, Direct conversion technologies –Thermoelectric Generators.

Week 8 : Direct conversion technologies – Thermoelectric Generators (contd.), Thermoionic conversion, Thermo-PV, MHD

Week 9 : Heat Pump; Heat Recovery from Incinerators, Energy Storage – Introduction.

Week 10 : Energy Storage Techniques – Pumped hydro, Compressed Air, Flywheel, Superconducting Magnetic storage

Week 11 : Energy Storage Techniques – Thermal storage (Sensible & Latent), Battery, Chemical Energy Storage, Fuel cells.

Week 12 : Energy Economics