
Fluid machinery & power plants

Finalità

The course completes the knowledge yielded during Macchine AB, as for fluid machinery and primary energy converters. The discipline is dealt with according to the Italian engineering tradition: a unique theory for hydraulic/steam/gas as well as for open/closed cycle processes is developed. Models are updated in view of engineering methods utilised in the 21st century. Applications are practice oriented.

Programma

Energy systems and economics: history of prime movers, hydropower fundamentals; thermal power plants, the laws of thermodynamics, figure of merit for direct cycles, fuels and their properties, nuclear energy.

Analysis of fluid machinery: compression and expansion processes, efficiencies, Stodola's plot, internal and mechanical turbine characteristics; matching pumps to loads; perfect and semi-perfect gas, polynomial models; energy balance across chemical reactions, high temperature dissociation, adiabatic combustion temperature; regeneration in power plants; similarity applied to fluid machinery; 2D aerodynamics, lift & drag.

Power plants: design criteria for hydropower (storage & run of river) plants; feed water heating, humidity, reheating in steam power plants; nuclear reactors (BWR, PWR, LMFBR), nuclear steam cycles; cycles and open processes for gas turbine power plants, component matching, off design and control methods; power sharing, afterburning, multiple pressures in combined cycle power plants, STIG; internal combustion engine fundamentals, fuel-air cycles, gas exchange process, combustion development, energy balance.

Fluid machinery and power plant components: stage efficiencies, power breakdown in Curtis stages, 3D effects in axial turbomachines, capacity limits of steam turbines, heat exchangers for steam plants, condensers & subcooling, air condensers, cooling towers, air pre-heaters; axial thrust balancing and seals in turbomachines; vanes and velocity triangles, diffusers, suction head and cavitation in hydraulic turbines; dynamic compressors, stall, surge, multistage compressors, choking, rotating stall; gas turbine combustion chambers, heat recovery steam generators; positive displacement compressors, reciprocating and rotary, reciprocating pumps, flow ripples, dampers, rotary pumps for fluid power systems.

Attività d'esercitazione

Gas & water steam models.

Applications on pump-piping matching procedures, combined cycle power plants.

Preliminary design of: Pelton & Banki turbines, water tube steam generator, condensing system, centrifugal pump, steam turbine, reciprocating compressor.

Modalità d'esame

oral

Testi consigliati

C. Caputo – Gli impianti convertitori di energia – Masson, Milan

C. Caputo – Le macchine volumetriche – Masson, Milano

C. Caputo – Le turbomacchine – Masson, Milan