MET 401: Power Plant Engineering

(Required)

Course Description:

MET 401: Power Plant Engineering LT: 3 LB: 3 CR: 4

This course deals with application of thermal engineering and fluid mechanics to different thermo-fluid systems. It is concerned with the types, construction, working principles and performance of : boilers, heat exchangers, turbines, power plants, internal combustion engines, overall plant performance, load curves and economics of power plants. This course is supported by tutorials, laboratory experiments and field visits.

Prerequisite: MET 303 - Applied Thermodynamics and Heat Transfer
MET 306- Applied Fluid Mechanics

Textbook: Power Plant Engineering. by P.K.. Nag, Tata-McGraw Hill. Higher Education, 3rd ed 2008

References:

1. Powerplant Technology, by M.M. EL-Wakil, McGraw Hill, 1st Edition, 1984
2. Modem Power Plant Engineering, by Weisman, J., Eckert, L., Prentice Hall, 1st edition. 1985

Course Learning Objectives:

To enable the students to:

1. Describe sources of energy and types of power plants
2. Analyze different types of steam cycles and estimate efficiencies in a steam power plant
3. Describe basic working principles of gas turbine and diesel engine power plants. Define the performance characteristics and components of such power plants
4. List the principal components and types of nuclear reactors.
5. Evaluate cycle efficiency and performance of a gas cooled reactor power plant
6. Classify different types of coupled vapor cycles and list the advantages of combined cycles power plant
7. List different types of fuels used in power plants and estimate their heating values
8. List types, principles of operations, components and applications of steam turbines, steam generators, condensers, feed water and circulating water systems. Estimate different efficiencies associated with such systems
9. Define terms and factors associated with power plant economics. Calculate present worth depreciation and cost of different types of power plants. Estimate the cost of producing power per kW.

Course Outline:

[I] Modules:

Module	Topic	Duration
1.	Introduction	1 week
2.	Analysis of Steam Cycles	2 weeks
3.	Fuels and Combustion	1 week
4.	Steam Generators	1 week
5.	Steam Turbines	2 weeks
6.	Diesel Engine and Gas Turbine Power Plants	2 weeks
7.	Combined Cycle power plant	1 week
8.	Nuclear Power Plants	1 weeks
9.	Condensers, Feedwater and Circulating Water Systems	2 weeks
10	Economics of Power Generation	2 weeks

[II] Laboratory Work/Projects:

Exercise	Topic	Duration
1.	Tutorial 1-First and Second Law of Thermodynamics Calculations	1 week
2.	Tutorial 2 - Calculations of Simple Rankine and Reheating Cycles	1 week
3.	Field Visit to a Steam Power Plant	1 week
4.	Trial and Operation of Boilers	2 weeks
5.	Tutorial 3 - Boiler Efficiency Calculations	1 week
6.	Tutorial 4 - Diesel Engine and a Gas Turbine Power Plants Cycle's Calculations	1 week
7.	Operating and Testing the Performance of Diesel Engines	1 week
8	Operating and Testing the Performance of Gas Turbine Power Plants	1 week
9	Field Visit to a Diesel Engine and Gas Turbine Power Plants	2 weeks
10.	Tutorial 5 - Combined Cycle Power Plant Calculations	1 week
11.	Performance Test of Cooling Towers	1 week

Evaluation Methods:

1. Major exams and a final exam.
2. Assignments, quizzes and teamwork
3. Lab work, mid, visit report and final lab exams.

Course Learning Outcomes:

The expected learning outcome is that the students will be able to:

1. Define basic terms and properties used in thermodynamics and state first and law of thermodynamics and apply it to different thermodynamics systems
2. Represent different types of steam cycles on pressure-volume and temperature diagram
3. List the methods and advantages of reheating of steam and explain the advantages of regeneration
4. Discuss different types of Feed water heaters and their applications and calculate different type of efficiencies in a steam power plant

5. List types, applications and describe working principles of most commonly boilers and describe types, advantages and operating principles of auxiliary systems use steam generators
6. Evaluate the operation performance of a steam boiler
7. Describe the construction and working principles of impulse and reaction turbine: and construct velocity diagram in impulse and reaction turbines
8. List the advantages and disadvantages of diesel plants and recognize and evaluate the performance characteristics of diesel plants
9. Describe construction, working principles and advantages of a combined gas turbine steam turbine power plant
10. Describe the construction and working principles of gas turbine power plants and evaluate the performance of a gas turbine power plant.
11. List different types of nuclear reactors and explain the construction and working principles of a gas cooled reactor power plant
12. List the functions and types of feed water heaters and list the functions, types and working principles of cooling towers
13. Calculate make-up water in cooling towers
14. Define load factor, demand factor and methods of plant selection
15. Make a load-duration curve analysis of a power plant
16. Estimate fixed and running cost of a plant and its depreciation

Prepared by:

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