Devi Ahilya University, Indore, India Institute of Engineering & Technology				**III Year B.E. (Mechanical Engg.) (Full Time)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
6MERE1: ENERGY CONVERSION SYSTEMS	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
Duration of Theory Paper: 3 Hrs	3	1	2	3	1	1	5

Course Objective:
The course is designed
1. To make students to understand principal and operation of vapour power cycles.
2. To develop the understanding of the combustion of fuel in boiler furnace.
3. To make students to understand principal construction and working of different types of power boilers used in steam power plants
4. To make them able to perform the testing to find boiler efficiency and heat balance sheet.
5. To understand the operation and design of steam turbines, Nozzles, condensers and cooling towers.

Prerequisite(s): Applied Thermodynamics, Elements of Mechanical Engineering.

COURSE CONTENT

UNIT-I
Vapour Power Cycles: Simple Rankine Cycles, Binary Vapour Cycles, Regenerative Cycles, Reheating Cycles, Combined Reheating-Regenerative Cycle, Water Extraction Cycle, Back Pressure, Pass-out and Mixed Pressure Turbine Cycles.
Power Station Economics**:** Elements of fixed and operating costs, power and various tariffs, definitions and applications of load curves, load factor, Capacity factor, plant-utilization factor, diversity factor and demand factor.

UNIT-II
Steam Generators: Fuels and Combustion for Steam Generators. High-pressure steam boilers-Advantages of high pressure boilers, Lamont Boiler, Benson Boiler, Monotube Boiler, Loeffler Boiler, Velox Boiler, Revolving Boilers, Radiant Type boiler for power plants, Heat recovery steam generators(HRSG), Fluidised Bed Boiler, Super Critical Boilers, Draughts, Chimney calculations, Performance of Boiler- Equivalent Evaporation, Boiler Trial Boiler Efficiency, Heat balance sheet, Overview of Boiler Codes.

UNIT-III
Nozzles: Introduction, General flow analysis, Nozzle equation, , Types and Construction of Nozzles and Diffusers, Design Parameters, Theory of steam injectors, Flow through Nozzles and Diffusers, Nozzle Efficiency, Diffuser Efficiency, Critical Pressure Ratio, effect of friction on performance. Effect of Variation of Back Pressure.

UNIT-IV
Steam Turbines: Steam Turbine types, Flow of Steam through Impulse Turbine Blades, Flow of Steam through Impulse-Reaction Turbine Blades, Energy Losses in Steam Turbines, State Point Locus, Reheat Factor, and Design procedure, Governing and Performance of Steam Turbines,

Steam Turbine Auxiliary Systems, Construction, Stress Analysis, Operation and Maintenance of Steam Turbines.

UNIT-V

Condensers and Cooling Towers: Functions of Condensers, Cooling Systems, Elements of Water Cooled Condensing unit, Types of Condensers- Jet Condensers, Surface Condensers, Condenser Vacuum and Measurement, Dalton's law of partial pressure, Mass of circulating water required, Air leakage, its effects and removal, Air cooling system, Design of condensers, Air Pumps, Vacuum Efficiency, Condenser Efficiency, Cooling Ponds and
Cooling Towers, Analysis of Cooling Tower (Cooling efficiency, Range, Approach)

LIST OF PRACTICAL ASSIGNMENTS

1. To study the working of High Pressure Boilers.
2. To Study the Induced Draught, Forced Draught and Balanced Draught.
3. To find the boiler efficiency using Orsat's Apparatus.
4. To study the Steam Nozzles and determine the Nozzle Efficiency.
5. To study the Steam Turbines in any Thermal power plant.
6. To study of Condensers and Cooling Towers and determine the Condenser Efficiencies.
7. To study and determine the thermal efficiency of any thermal power plant in an Industrial Visit.
8. To study and determine the thermal efficiency of cogeneration power plant in a Process Industry Visit.

Course Outcome:

Students earned credits will develop ability to

CO1. Determine the overall efficiency of steam power plant through various arrangements of vapour power cycles.

CO2. Determine the thermo chemistry of fuels and Actual air and Coal required in Furnace of boilers

CO3. Understand the working of actual power boilers used in steam power plants, its chimney calculation and to perform the boiler trial for efficiency and input / output of heat

CO4. Understand the working of steam nozzles and diffusers and determine the performance parameters and efficiency of steam nozzles

CO5. Determine the Diagram Power, Gross Stage Efficiency, Specific steam consumption and Design parameters of steam turbines.

CO6. Understand the construction, operation and Maintenance of Steam Turbines and its auxiliaries.

CO7. Determine the performance parameters of Condensers, air pumps, cooling Towers.

Books Recommended:

[1]. Skrotzki & Vopat, *Power Station Engg. & Economy,* Mc Graw & Kagakush, 1960.
[2]. Dr. R. Yadav, *Applied Thermodynamics*, Central Publishing House, 2012.
[3]. Dr. R. Yadav, Steam & Gas Turbines and Power Plant Engineering, 2015.
[4].Yahya, S.M., *Turbine, Compressors & Fans.* TMH 1996.
[5] Arora S.C. & Domkundwar S. *Power Plant Engineering* Dhanpat Rai Sons, 2005.
[6] P.K. Nag, *Power Plant Engineering*, TMH, 2008.

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5. To understand the operation and design of steam turbines, Nozzles, condensers and cooling towers.

Course Outcome:

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Determine the overall efficiency of steam power plant through various arrangements of vapour power cycles.	PO1, PO2
CO2	Determine the thermo chemistry of fuels and Actual air and Coal required in Furnace of boilers.	PO1, PO3, PO4
CO3	Understand the working of actual power boilers used in steam power plants, its chimney calculation and to perform the boiler trial for efficiency and input / output of heat.	PO1, PO3, PO4, PO7
CO4	Understand the working of steam nozzles and diffusers and determine the performance parameters and efficiency of steam nozzles.	PO1, PO3, PO4
CO5	Determine the Diagram Power, Gross Stage Efficiency, Specific steam consumption and Design parameters of steam turbines.	PO1, PO3, PO4, PO7
CO6	Understand the construction, operation and Maintenance of Steam Turbines and its auxiliaries.	PO1, PO3, PO4
CO7	Determine the performance parameters of Condensers, air pumps, cooling Towers.	PO1, PO3, PO4, PO7

CO-PO Relationship

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	3	3										
CO2	3		3	3								
CO3	3		3	3			3					
CO4	3		3	3								
CO5	3		3	3			3					
CO6	3		3	3								
CO7	3		3	3			2					

* CO (rows) mention nil/very small/insignificant contribution to the PO(column)

1→ relevant and small significance 2 → medium or moderate and 3 →strong