NATIONAL UNIVERSITY OF ENGINEERING
COLLEGE OF MECHANICAL ENGINEERING
MECHANICAL ENGINEERING PROGRAM

MN153 – THERMAL DRIVING FORCE

I. GENERAL INFORMATION

CODE	**:**	MN153 Thermal Driving Force
SEMESTER	**:**	10
CREDITS	**:**	4
HOURS PER WEEK	**:**	4 (Theory, Practice)
PREREQUISITES	**:**	MN314 Heat and Mass Transfer, MN464 Laboratory of Mechanical Engineering III
CONDITION	**:**	Compulsory
DEPARTMENT	**:**	Mechanical Engineering

II. COURSE DESCRIPTION

The course prepares students for the analysis and design of thermo-electric power plants focusing on their mechanical and thermal components. Students project the market size and requirements, compare different types of thermoelectric power (steam, gas, fuel, cogeneration, etc.) plants and select the most appropriate satisfying requirements. Students size, select and integrate the plant components, as well as their mounting, installation and commissioning. Operation and environment issues are taken into account for designing.

III. COURSE OUTCOMES

At the end of the course, students:

1. Manage and plan the operation of electric power plant to satisfy requirements with lower costs.
2. Design, calculate and select the components of power plants.
3. Design, calculate and integrate different types of electrical power plants towards the achievement of a better level of thermal efficiency.
4. Formulate strategies for recovery and utilization of remaining heat in plant production processes.
5. Design evacuation systems of used fluids, reducing pollution and without affecting the environment.
6. Design and size power plants projecting future demand.

IV. LEARNING UNITS

1. **OPERATION AND CONTROL OF ELECTRIC POWER PLANTS**
   Revision of thermodynamic cycles of thermal power plants / Power balance / Metallurgical limit / Interconnected systems / Variable load / Regulation criteria / Diagram of loads / Rates of plant operation: load factor, diversity factor, plant capacity factor, plant use factor / Problems.
2. **THERMOELECTRIC GAS POWER PLANTS**
   Components / Types of plants / Mechanical arrangements / Turbine / Combustion chamber / Compressor / Auxiliary systems / Starting / Regulation / Lubrication system / Refrigeration system / Performance / Power diagrams / Calculations for determining required power / Problems.
3. **THERMOELECTRIC STEAM POWER PLANTS**
   Basic considerations of selection / Preliminary design and technical features / Type of plants / Power plant / Refrigeration system / Operation with variable loads / Main and auxiliary elements: boiler, turbine, condenser, cooling tower and pre heaters / Compressed air / Installation reliability / Economic performance / Start and stop / Problems.

4. **FUEL GENERATOR SETS POWER PLANTS**
   Characteristics for the generator set selection / Size units / In-place power / Number of units / Costs / Lubrication system / Refrigeration system / Fuel system / Electrical power equipment / Problems.
5. **COMBINED CYCLE POWER PLANTS AND COGENERATION**
   Introduction / Definition / Benefits / General scheme / Classification: steam turbine, gas turbine / Advantages and disadvantages / Alternative internal combustion engines: advantages and disadvantages / Selection and analysis of cogeneration systems / Rate Q/E: low, medium, high / Types of arrays of thermal plants with gas turbines, steam turbines, internal combustion engines / Sizing / Heat recovery / Exploitation of available heat in industrial process plants / Problems.
6. **ENERGY FLOW IN A THERMOELECTRICAL POWER PLANT**
   Heat / Conduction / Convection surface / Heat transfer by convection between steam and water / Recovering boiler calculation / Transfer area / Examples of calculation of convection, radiation and distribution of heated surfaces / Coal gasification.
7. **GAS CIRCUITS**
   Function of gas circuits / Storage of carbon / Conveyors / Systems of pulverized coal / Oil storage and supply system / Natural gas and PLG / Ash handling / Duct of gas / Mechanical shooting / Natural shooting / Gas flow control / Combustion control equipment / Biofuels.
8. **STEAM APPLICATIONS**
   Plants / Functional relationship of equipment / Wet steam / Source / Steam distribution / Sizing of pipes / Condensation speed / Traps of steam / Steam distribution at production plant / Superheated steam.
9. **WATER TREATMENT PLANTS**
   Function of water / Water pollution and effects / Analysis and testing of water / Concentration / Water treatment / Types of water treatment plants / Sizing of water treatment plants / Selection of the type of treatment.
10. **PIPELINES SYSTEMS**
    Classification of pipelines systems / Commercial pipelines / Connections of pipes / Different types of valves / Thermal expansion / Thermal insulation / Determination of the size of pipelines / Stands of pipelines / Design of pipelines systems.
11. **NEW TECHNOLOGIES**
    New technologies and alternatives applied to cogeneration plants.

V. METHODOLOGY

The course takes place in theory and practice sessions. In theory sessions faculty presents the theory, concepts and design methods. In practice sessions, students apply theory to complete the design of a steam or gas power plant considering market size, selection and sizing of required components and their integration, as well as mounting and installation. At the end of the course, students submit and defend a final report. Student active participation is promoted throughout the course.

VI. GRADING FORMULA

The Final Grade PF is calculated as follow:

PF = (EP + 2*EF + TM) / 4

EP: Mid-term Exam EF: Final Exam
TM: Final report

VII. BIBLIOGRAPHY

1. F. MORSE
   Power Plant Engineering, Van Nostrand Ed.
2. BOARD PEGAMON PRESS
   Modern Power Station Practice, 2nd Edition, London, UK.
3. ARTHUR P
   Heat Exchanger Design, John Wiley Ed., 2005.