**COURSE TITLE : POWER PLANT ENGINEERING**
**COURSE CODE : 5017**
**COURSE CATEGORY : E**
**PERIODS/WEEK : 4**
**PERIODS/SEMESTER : 72**
**CREDITS : 4**

## TIME SCHEDULE

| MODULE | TOPICS | PERIODS |
|---|---|---|
| 1 | Introduction<br>Steam Generators<br>Properties of Steam<br>Thermodynamic Vapour Cycle | 17 |
| 2 | Steam Engines<br>Steam Nozzles<br>Steam Turbines<br>Steam Condensors | 17 |
| | TEST I | 2 |
| 3 | Gas Turbines<br>Jet Propulsion<br>Diesel Power plant | 17 |
| 4 | Nuclear Power Engineering<br>Renewable Sources of Energy | 17 |
| | TEST II | 2 |
| | **Total** | **72** |

## OBJECTIVES

**MODULE – I**

1.1.0 Understand the scope and application of power plant engineering

1.2.0 Appreciate the working of modern commercial steam boilers, their mountings and accessories

- 1.2.1 Define a boiler
- 1.2.2 State the function of a boiler
- 1.2.3 Classify the different types of boiler
- 1.2.4 Explain with a line diagram the construction and working of a Nestler boiler
- 1.2.5 Explain with a line diagram the construction of La-Mont boiler
- 1.2.6 Compare fire tube boilers and water tube boiler
- 1.2.7 State the functions and working of boiler mountings such as stop valve, safety valve, water level indicator, pressure gauge and fusible plug using simple diagrams only
- 1.2.8 State the functions and working of boiler accessories such as economizer, feed pump, super heater and air preheater using simple line diagrams only
- 1.2.9 Define boiler draught
- 1.2.10 Explain Natural draught, forced draught, induced draught and balanced draught

1.3.0 Recognize the properties of steam using steam tables and Mollier chart

- 1.3.1 List the uses of steam
- 1.3.2 Explain the formation of steam at constant pressure with a graph indicating the effect of pressure and temperature
- 1.3.3 Distinguish between wet steam, dry steam and superheated steam
- 1.3.4 Compute the enthalpy of wet, dry and super heated steam at the given pressure and state using steam tables

1.3.5 Compute the heat required to produce steam at given pressure and state from feed water at a temperature
1.3.6 Construct T-S and Mollier charts and represent various pressures in them
1.3.7 Determine the condition of steam given the enthalpy and pressure using Mollier chart

1.4.0 Understand the various thermodynamic vapour cycles.
1.4.1 Carnot cycle with steam as working substance
1.4.2 Rankine cycle.

**MODULE – II**

2.1.0 Understand different parts and the working and of Steam Engine
2.1.1 Explain the working of a double acting Steam Engine with simple line sketch

2.2.0 Recognize the use and application of Steam Nozzles
2.2.1 State the functions of a steam Nozzle
2.2.2 Explain convergent nozzles and convergent – divergent nozzles
2.2.3 Derive the expression of velocity of steam leaving a nozzle
2.2.4 Compute the velocity of steam leaving a nozzle with the help of a Mollier chart

2.3.0 Appreciate the working of Steam Turbines
2.3.1 State the function of steam turbines
2.3.2 List the advantages of steam turbines over steam engines
2.3.3 Classify steam turbines
2.3.4 Explain impulse turbines and reaction turbines
2.3.5 Explain the working of a simple De-Laval turbine and Parson's reaction turbine with sketches
2.3.6 State the purpose of compounding in steam turbines
2.3.7 Explain pressure compounding, velocity compounding and pressure-velocity compounding

2.4.0 Recognize the different types of Steam Condensers
2.4.1 State the functions of steam condensers
2.4.2 Classify steam condensers
2.4.3 Explain with simple sketches the working of jet condensers and surface condensers
2.4.4 Define vacuum efficiency
2.4.5 List the factors affecting vacuum efficiency
2.4.6 State the function of cooling towers
2.4.7 Explain different types of cooling towers – Natural draught, forced draught, induced draught and balanced draught

**MODULE – III**

3.1.0 Appreciate the working principle of Gas Turbines
3.1.1 State the application of gas turbine
3.1.2 List the types of gas turbines
3.1.3 Explain with flow diagram and T-S diagram, the working of constant pressure gas turbine (both open type and closed type)
3.1.4 Explain the work done by the constant pressure closed gas turbine(no derivation)
3.1.5 Explain the work done by the constant pressure open type gas turbine(no derivation)
3.1.6 Compute the work done by the above turbines (simple problems only)
3.1.7 Name the fuels used in gas turbines
3.1.8 List the advantages and limitations of gas turbines
3.1.9 Compare gas turbines with steam turbines.

3.2.0 Understand the principle of Jet Propulsion
3.2.1 Explain the principle of Jet propulsion
3.2.2 Explain with sketches the working of turbo jet engine, turbo-prop engine and prop-jet engine

3.2.3 Explain the principles of Rocket propulsion
3.2.4 Explain the working of diesel power plant with a block diagram.

**MODULE – IV**

4.1.0 Understand the theory of Nuclear Power Engineering
- 4.1.1 Explain Nuclear reaction, fission, fusion and chain reaction.
- 4.1.2 Explain the principal parts of a reactor
- 4.1.3 Brief description of reaction control by control rods
- 4.1.4 List the main products of a reactor
- 4.1.5 Brief description of the fuel materials – uranium, thorium, plutonium, and ceramic fuels
- 4.1.6 Brief descriptions of the moderator – graphite, beryllium, beryllium oxide, light and heavy oxide
- 4.1.7 Brief descriptions of coolants – water, liquid metal, gas and organic liquids
- 4.1.8 Explain the working of a Nuclear power plant with the help of a schematic diagram.

4.2.0 Understand the renewable sources of energy
- 4.2.1 Identify the renewable sources of energy
- 4.2.2 Explain with simple sketches the working of solar grain drier and solar cooker
- 4.2.3 Explain solar cells, flat plate collectors and parabolic concentrators
- 4.2.4 Identify the types of wind mills and their uses
- 4.2.5 Explain the principle of working of wind mills
- 4.2.6 Explain the principle of working of Bio gas plant
- 4.2.7 Explain the principle of working of Tidal power station
- 4.2.8 Explain the principle of working of a Geothermal station
- 4.2.9 Explain the working of a Hydro electric power plant

## CONTENT DETAILS

**MODULE – I**

**1. Introduction**

Scope, objectives and applications of Heat Power Engineering

**2. Steam Generators**

a. Introduction
   1. Function
   2. Classification – fire tube and water tube

b. Modern package type industrial boiler – Nestler boiler

c. Modern high pressure boiler – La-Mont boiler

d. Comparison between water tube and fire tube boiler

e. Boiler specifications

f. Boiler mountings – functions with sketches of
   1. Stop valve
   2. Safety valve
   3. Water level indicator
   4. Pressure gauge
   5. Fusible plug

g. Boiler accessories – function with sketches of
   1. Feed pump
   2. Economiser
   3. Super heater
   4. Air preheater

h. Boiler Draught
   1. Natural draught
   2. Forced draught

3. Induced draught
4. Balanced draught

**3. Properties of Steam**

(1) Formation of steam at constant pressure
(2) Properties of steam such as
   a) Total heat of water
   b) Latent heat of steam
   c) Enthalpy of steam
(3) Definition such as
   a) Wet steam
   b) Dry steam
   c) Superheated steam
   d) Dryness fraction
(4) Use of steam tables – calculation of heat required to produce steam at a given pressure and state (simple problem)
(5) Construction of T-S and Mollier diagram
   a) Representation of various thermodynamic pressure in T-S and Mollier diagram
   b) Exercises in finding the conditions of steam using Mollier diagram

**4. Thermodynamic vapour cycle.**

(1) Carnot cycle with steam as working substance.- efficiency of Carnot cycle, (simple problems)
(2) Rankine Cycle - Rankine efficiency. (Simple Problems.)

**MODULE – II**

**1. Steam engine**

Brief explanation (with line sketch) of working of double acting steam engine

**2. Steam Nozzles**

Introduction – functions, types – convergent, convergent -divergent types
Velocity of steam leaving the nozzle (derivation and simple problems using Mollier chart)

**3. Steam Turbines**

Introduction, advantages over steam engine
Classification – impulse, reaction, and simple De-Laval turbine, Parson's reaction turbine.
Compounding of steam turbines – purpose, type of compounding, pressure compounding, velocity compounding, pressure- velocity compounding,

**4. Steam Condensers**

Introduction – functions of condensers
Types – a) Jet condensers – counter flow and parallel flow type
b) Surface condensers
Vacuum efficiency - definition
Factors affecting the vacuum efficiency
Quality of cooling water required for a given steam engine or turbine
Cooling tower – function and types

**MODULE – III**

**1. Gas turbines**

(1) Introduction, advantages of gas turbines over I.C. Engines
(2) Types of gas turbines – constant pressure gas turbine – open and closed type – calculate the work done by the turbines (simple problems only) – fuels used in gas turbine – application of gas turbines – advantages and limitations

**2. Jet Propulsion**

(1) Introduction
(2) Turbo – jet engine, Turbo – prop engine, Prop- jet engine
(3) Principles of Rocket propulsion

**3. Diesel Power Plant**

(1) Explain the working principle with the block diagram

**MODULE – IV**

**1. Nuclear Power Engineering**

Introduction

Nuclear reaction, Fission and fusion and chain reaction, Principal parts of a Reactor, Main products of a reactor, Brief description of reaction control by Control rods, Brief description of the fuel materials, Brief descriptions of the moderators ,Brief descriptions of coolants, Nuclear reactors-name different types, Working of a nuclear power plant with the help of a schematic diagram.

## Renewable sources of energy

Identify the renewable sources of energy

**Solar Energy**

1. Solar grain drier
2. Solar cooker
3. Solar cells
4. Flat plate collector for power generators
5. Parabolic concentrators for power generation

Wind Energy

Principles of working of wind mills

Biogas Energy

Principles of working of Biogas plant

Tidal Energy

Principles of working of a Tidal power plant

Geothermal energy

Principle of working of a geothermal station

Hydro electric power plant

Working of hydroelectric power plant with a schematic diagram

**REFERENCE BOOKS**


1. Text Book of Thermal Engg., - R.S. Khurmi & J.K. Gupta
2. Non-Conventional Energy sources – G.D. Rai
3. Heat Power Engineering – N. Rangassamy & E. Sundara moorthy
4. Elements & Heat Engines, Vol. I, II & III – R..C. Patel and C. J Karan chandani
5. Introduction to Non conventional Energy resources - Rajaetal.
6. Power plant Engineering - Ramalingam
7. Power plant Engineering -P.K.Nag.