

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING**UNIT-1 THERMAL POWER PLANTS:****1.State thermodynamic law:**

1. Zeroth law refers to thermodynamic equilibrium and temperature
2. First law refers to heat, work and energy
3. Second law refers to entropy

2.State zeroth law of thermodynamics:

“Two systems in thermal equilibrium with a third system are in thermal equilibrium with each other”

3.State First law of thermodynamics and energy conversion.

The first law of thermodynamics is often called as Law of conservation of energy. This law suggests that energy can be transferred from one system to another in many forms. Also, it cannot be destroyed or created.

4.State second and third law of thermodynamics:

The second law of thermodynamics introduces another state variable called entropy. In any closed system, the entropy of the system will either increase or decrease during a thermodynamic process, the system can never completely return precisely the same state it was in before.

The third law of thermodynamics states that if all the thermal motion of molecules (kinetic energy) could be removed, a state called absolute zero will occur. Absolute zero results in a temperature of 0 kelvin or -273.15 celcius.

5.What is thermodynamic cycle?

A Thermodynamic cycle is a series of thermodynamic processes transferring heat and work, while varying pressure, temperature, and other state variables, eventually returning a system to its initial state.

6.List the various thermodynamic processes:

1. Adiabatic process- a process with no heat transfer into or out of the system
2. Isochoric process- a process with no change in volume, in such case the system does no work
3. Isobaric process- a process with no change in pressure
4. Isothermal process- a process with no change in temperature

7.What is meant by power plant? Power can be defined as the rate of flow of energy and state

that a power plant is a unit built for production and delivery of a flow of mechanical work and electrical energy. A machine or assembling of equipment that produces and delivers a flow of mechanical and electrical energy is a power plant

8. List the factors of power plant performance.

The performance of a power plant can be expressed through some common performance factors as

1. Heat rate
2. Capacity factor
3. Economic efficiency
4. Load factor
5. Operational efficiency

9. What are available energy sources for various power plants?

1. Conventional energy sources or Non-renewable energy sources
2. Non conventional energy sources or Renewable energy sources

10. What are the major power limitations of conventional energy sources?

1. Resources for power generation i.e, coal, gas etc., are limited
2. The hydro power is seasonal and varies depending upon the rainfall in the catchment areas
3. Submersion of land area due to raise in water level
4. Centralized power generation and distribution of the same to long distances will result in high losses.
5. The energy conversion process from thermal power projects results in emission of green house gases

11. List out the various conventional and non conventional power plant:

Types of conventional power plant:

1. Hydro power plant
2. Steam power plant
3. Nuclear power plant
4. Gas turbine power plant

Types of non-conventional power plant:

1. Tidal power plant
2. Wind power plant
3. Geothermal power plant
4. Solar power plant
5. Wave power plant
6. MHD Generation

12.What is hydraulic/ Pneumatic type ash handling system?

The hydraulic system carries the ash with the flow of water high velocity through a channel and finally dumps into a sump. The hydraulic system is divided into a low velocity and high velocity system. The advantages of this system are that it is clean, large ash handling capacity, considerable distance can be traversed, absence of working parts in contact with ash.

In pneumatic type ash handling is the most popular method used in medium level power plants. It uses dense phase conveying system for conveying ash is totally enclosed without any leakage. The system can convey materials up to distance of around 200 -250 mts.

13.List the challenges of ash handling:

1. Indian coal contains high ash content generally which tends to be inconsistent.
2. Design of the system has to adequately cover anticipated variations and be capable of handling the worst scenario
3. System has to be environmentally friendly
4. System has to be energy efficient

14.What is crusher and its crushing method?

A crusher is a machine designed to reduce large solid chunks of raw materials into smaller chunks. Crushers are commonly classified by the degree to which they fragment the starting material.

Crushing Methods:

1. Impact
2. Shear
3. Attrition

4.Compression

15.What are all the types of Mechanical drafts?

There are three types of mechanical drafts: They are:

- 1.Induced draft
- 2.Forced draft
- 3.Balanced draft

16.What is Deaeration?

Mechanical and chemical deaeration is an integral part of modern boiler water protection and control. Deaeration coupled with other aspects of external treatment, provides the best and highest quality feed water for boiler use.

17.What is the purpose of deaeration?

The purpose of deaeration are:

1. To remove oxygen, carbon dioxide and other noncondensable gases from feedwater.
2. To heat the incoming makeup water and return condensate to an optimum temperature
3. Minimizing solubility of undesirable gases
4. Providing the highest temperature water for injection to the boiler.

18.What are the types of deaerators?

1. Tray-Type Deaerating heaters
2. Spray-Type Deaerating heaters

19.What is meant by cooling Towers?

It is a tower or building like device in which atmospheric air circulates in direct or indirect contact with warmer water and water is thereby cooled. Cooling towers may either use the evaporation of water to remove process heat and cool the working fluid.

20.List the types of cooling towers:

- 1.Evaporative or wet cooling tower
- 2.Nonevaporative or dry cooling tower
 - (a) Air cooled condensers
 - (b) Air cooled exchangers

21. List the types of cooling functions to condense the steam:

1. Once-through wet cooling
2. Recirculating wet cooling
3. Dry cooling

22. List the factors to be considered while choosing a site for steam power station:

1. Supply of fuel
2. Availability of water
3. Transportation facilities
4. Cost and type of land
5. Nearness to load centres
6. Distance from populated area

23. List the thermal power plant in Tamilnadu.

Alathiur(2*18MW), Tamilnadu, Madras cements

Ennore(2*60MW,3*110MW) Tamilnadu Electricity Board

Neyveli(6*50MW,2*100MW) Tamilnadu Neyveli lignite corp Ltd.

24. Define super heater:

A Super heater is a device used to convert saturated steam into a dry steam used for power generation or processes steam which has been super heated is known as superheated steam.

25. List the types of super heaters:

1. Radiant super heater- absorb heat by radiation
2. Convection super heater-absorb heat via a fluid
3. Separately fixed super heaters- it is totally separated from the boiler

REVIEW QUESTIONS:

1.What is thermodynamic cycle? Explain the various thermodynamic cycle with relevant diagram:

2.State the thermodynamic laws with relevant examples.

3.Explain in detail about Rankine cycle.

4.Explain the functioning of thermal power plant with its layout

5.Explain in detail about Pulverised coal system

6.What is meant by Fluidized bed combustion? Explain in detail about various FBC systems.

7.Write short notes on material handling in thermal power plant.

8.Explain the function and various types of crushers.

9.Explain the various types of boilers.

10.Explain the condenser and cooling system of the thermal power plant.

11.What is meant by Deaeration and Deaerators? Explain in details.

12.Explain the purpose of cooling tower in thermal power plant.

MIE 6701 - Power Plant Engineering.

16 Mark

1. Draw the lay out of modern Steam Power Plant and explain its working.

Main components of Thermal Power plant (Diagram)

Function: - one of coal, oil or natural gas is used to heat boiler to convert water in to steam.

Process: -

- 1) water intake: - water taken in to boiler
- 2) Boiler heating: - Boiler is heated with the help of coal or natural gas.
- 3) steam turbine: - steam generated in boiler sent through steam turbine.
- 4) generator: - connect to steam turbine.
- 5) special machines - Economizer, air pre heater.
- 6) Ash collection system - Residue & Ash collection system is place to collect all waste.

main parts: -

- 1) coal conveyor
- 2) Stoker
- 3) Pulverizer
- 4) Boiler
- 5) coal ash
- 6) Air Preheater
7. Electrostatic Precipitator
- 8) smoke stack
- 9) Turbine
10. Condenser
11. Transformer
12. cooling Tower.
13. Generator
14. high voltage Power lines.

2) what is Fluidised Bed Combustion system?

Sketch & describe: -

Fluidized beds solid fuels in upward blowing jet of air during combustion process

Types:-

PFBC (Pressurized Fluidized bed combustion)
 CFB (Circulating Fluidized bed)

PFBC

→ Diagram of PFBC

Fluidized bed combustion technology. The first generation PFBC system also uses a sorbent & jets of air to suspend mixture of sorbent & atmospheric FBC is crossing over the commercial threshold.

Circulating Fluidized Bed (CFB)

CFB is a new & evolving technology, that has become a very efficient method of generating low cost electricity.

Features of CFB

- (i) wide range of fuel adaptability.
- (ii) low pollution.
- (iii) combustion efficiency
- (iv) space saving.

Process Flow of CFB.

Advantages of Pulverised coal:-

- large capacity plant.
- Easy to adapt
- higher ash percentage
- Increase thermal efficiency.

2.
 2) Enumerate various Ash handling Systems:-
 Ash handling Plant consist of two Segregate systems

- (i) bottom ash handling system
- (ii) Fly ash handling system

Ash handling system [Diagram]

widely used Ash handling system are

- (i) Mechanical Handling system
- (ii) use of screw/Belt conveyor
Bucket Elevator.

(ii) Hydraulic Ash Handling System:
 Carried the ash with flow of water with high velocity through a channel & finally dumps in to Sump

(iii) Pneumatic Type:-

Most Popular method used in medium level. Power plant

Principal operation:-

- (i) conveying material is collected in hopper & is sensed by permissive level probe provide in hopper & initiate conveying cycle.
- (ii) The inlet valve on top of vessel open & allow material to gravitate in to vessel.

(ii) Pneumatic Ash Extraction system [Diagram]

Ash vacuum system [Diagram]

Ash pressure system [Diag]

4) Explain the operation of Air Preheater:-

* Block diagram of Air Preheater.

* Remaining heat of flue gas is utilized by air preheater device used in steam boiler to transfer heat from flue gas to combustion air before air enter the furnace. Also known as air heater.

TYPES OF Air Heaters:-

- (i) Tubular Air heater
- (ii) Plate type Air heater
- (iii) Regenerative Air heater

Tubular Air heater:-

Flue gas flow outside the tube in which air flows heating it.

Plate type Air heater:-

Rectangular flat plates spaced 1.5 to 2cm apart leaving alternate air & gas passages.

Regenerative Air Heater:-

The transfer of heat from hot gas to cold air is done in 2 stages. In 1st stage hot heat from hot gas passed to packing of air heater.

3.
5) write short notes on different draft systems.

There are 3 types of mechanical draft

- (i) Induced draft
- (ii) Forced draft
- (iii) Balanced draft

Induced draft:-

to obtain one of three ways, first being "stack effect" of a heated chimney. Second method through steam jet. This method was common on steam driven locomotives which could not have tall chimneys.

Forced draft:-

Draft is obtained by forcing air in to furnace by means of FD fan & ductwork. Forced draft furnaces usually have a positive pressure.

Balanced draft.

use of both induced & forced draft. More common with larger boilers where the flue gases have to travel a long distance through many boiler passes. The induced

draft fan works in conjunction with forced draft fan allowing furnace pressure to be

maintain b/s atmosphere pressure

Diagram of Induced, Forced, Balanced draft.

6) Enumerate the selection of steam power plants.

To get an overall economy we should take care of following factors:-

(i) Supply of fuel:-
plant should be located in place near coal mines hence transport cost could be reduced.

(ii) Availability of water:-
Large amount of water required for the condenser for proper cooling process so there should be natural resource near by plant to get continuous supply of water.

(iii) Transportation facilities:-
modern steam plant requires transport of coal as well as machineries needed for station.

(iv) Cost & type of land:-
requires large area the cost of land that we buy should be cheap else it will increase initial cost to a large amount & the bearing capacity of soil.

(v) Nearness to load centres:-
The plant should be located near to load center since it could reduce the transmission cost to a very large amount.

(vi) Distance from populated area:-
It is located at a favourable distance from populated area because daily tonnes of coal.