



## QUESTION BANK

Name of the Department : Electronics Electrical and electronics Engineering

Subject Code & Name : ME8792 & Power Plant Engineering

Year & Semester : II & III

### UNIT I COAL BASED THERMAL POWER PLANTS

#### PART-A

#### 1. What do you understand by the term boiler draught?

Boiler draught may be defined as the small difference between the pressure of outside air and that of gases within a furnace or chimney at the grate level, which causes flow of air/hot flue gases to take place through boiler.

#### 2. Define steam rate and heat rate?

**Heat rate** is the common measure of system efficiency in a steam power plant. It is defined as "the energy input to a system, typically in Btu/kWh, divided by the electricity generated, in kW." Mathematically:

$$\text{Heat Rate (BTU/kWh)} = \frac{\text{Input Energy (BTU/hr)}}{\text{Output Power (kW)}}$$

**Steam rate:** It is defined as the rate of steam flow (kg/hr) required for producing unit shaft output (1 kW)

#### 3. What are the different sources of energy available for power generation? How long they can last?

1. Steam
2. Gas or air
3. Diesel and petrol
4. Nuclear
5. Renewable energy sources such as solar, wind, geothermal, tidal, wave, MHD etc

#### 4. Why thermal plants are not suitable for supplying fluctuating loads?

Thermal plants are not suitable for supplying fluctuating loads because any change in load demand requires the corresponding change in the output energy. In thermal power plants, the input energy is produced by burning the coal. So, there is always a large time lapse between the change in energy output and input which is not desirable. Therefore, such power stations are used only as base load stations and it supplies the constant power.



## 5. List the four important circuits of the steam power plant.

- Feed water and steam flow circuit
- Coal and ash circuit
- Air and gas circuit
- Cooling water circuit

## 6. Comment on the thermal efficiency of a steam power plant.

Thermal efficiency is a dimensionless performance which is a measure of a device using thermal energy such as internal combustion engine, steam turbine or steam engine, boiler and furnace or refrigerator.

## 7. Define the overall efficiency of a steam power plant.

Overall efficiency is defined as the combined efficiency of boiler, steam turbine, condenser and pump.

## 8. Define air standard cycle efficiency.

It is the ratio of work done during the process to the heat supplied. Air Standard efficiency = Work done / Heat supplied.

Where Work done = Heat supplied - Heat rejected.

## 9. State how the steam boilers are classified.

Steam boilers are classified on the basis of boiler pressure, fuel, boiler material, boiler tube type, circulation, method of combustion, type of support, furnace construction, furnace position, use, erection, mobility, ASME code and heat source.

## 10. Define boiler mountings and accessories.

The devices which are used for functioning with the safe operation of a boiler are called boiler mountings. The devices which are used to increase the efficiency of the boiler are called boiler accessories.

## 11. Why are super heaters used in steam power plants?

The steam produced in the boiler is in the state of saturated condition. The moisture in the steam will affect turbine blades and cause corrosion. To avoid it, the super heater is used. It is used to increase the temperature of steam and improve the efficiency.

## 12. What is the necessity of feed pump in thermal power plant?

Feed pump is a pump which is used to deliver the feed water to the boiler. The quantity of water supplied should be at least equal to the amount of evaporation which is supplied to the engine.

## 13. Mention the two types of feed water heaters in a steam power plant.

- Open feed water heater.
- Closed feed water heater.

## 14. What is the function of deaerator in a thermal power plant?

A deaerator is a device widely used for the removal of air and other dissolved gases from the feed.



## 15. Write the use of water level indicator in boiler.

The water level indicator constantly determines the level of water in the boiler shell.

## 16. What are the accessories used in a boiler?

- (i) Feed water pump
- (ii) Injector
- (iii) Pressure reducing valve
- (iv) Economiser
- (v) Air pre heater
- (vi) Super heater
- (vii) Steam drier or separator
- (viii) Steam trap.

## 17. List out the major advantages of high pressure boilers in modern thermal power plants.

- The tendency of scale formation is eliminated due to high velocity of water through tubes.
- Light weight tubes with better heating surface arrangement can be used. The space required is less. The cost foundation, time of erection and total cost are minimised due to less weight of tubes.
- Due to use of forced circulation, there is more freedom in the arrangement of surface, tubes and boiler components.
- All parts are uniformly heated. So, the danger of overheating is reduced and thermal stress problem is eliminated.

## 18. Distinguish between fouling and slugging.

Slugging is the formation of molten or partially fused deposits on furnace walls or convection surfaces exposed to radiant heat.

Fouling is defined as the formation of deposit on convection heat surfaces such as super heater and reheater.

## 19. Define super critical boilers.

Boilers only with economizer and super heater are called super critical boilers.

## 20. What is super-critical boiler? Give any two advantages.

If boilers incorporate only economizer and super heater, they are called supercritical boilers. The super critical boilers are above 300MW capacity units available.

## 21. What are types of fluidized bed boilers?

Bubbling fluidized bed boilers (BFB).

Circulating fluidized bed boilers (CFB).

## 23. Explain the need of compounding in steam turbines.

In the simple impulse turbine, the expansion of steam from the boiler pressure to condenser pressure takes place in a single stage turbine. The velocity of steam at the exit of turbine is very high. So, there is a considerable loss of kinetic energy. Also, the speed of the rotor is



very high. There are several methods of reducing this speed to a lower value. Compounding is a method of absorbing the jet velocity in stages when the steam flows over moving blades.

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## 24. What is the function of governors in steam turbine?

The governors regulate the supply of steam to the turbine to maintain constant speed of the turbine as far as possible under varying load conditions.

## 25. What are the different methods of governing steam turbines?

- Throttle governing
- Nozzle control governing
- By pass governing
- Combination of throttle and nozzle governing or throttle and by pass governing.

## 26. Enumerate the energy losses in steam turbines.

- Losses in regulating valves
- Losses due to steam friction
- Losses due to Mechanical friction
- Losses due to leakage
- Residual velocity losses
- Carry over losses
- Losses due to wetness of steam
- Losses due to radiation.

## 29. What is a pulverizer and why it is used?

A pulverizer or grinder is a Mechanical device for grinding many different types of materials. Pulverizer mill is used to pulverize the coal for combustion in the steam generating furnaces of fossil fuel power plants.

## 30. What is ESP? State its use.

An electrostatic precipitator (ESP) is a filtration device which is used to remove fine particles such as dust and smoke from a flowing gas using the force of an induced electrostatic charge minimally impeding the flow of gases through the unit.

## 31. Mention the various modern ash handling systems.

- i. Gravitational separator
- ii. Cyclone separator
- iii. Packed type scrubber
- iv. Spray type wet collector
- v. Electrostatic precipitator(ESP)

## 32. What is stoker? Classify it.

Stoker is a feeding device which feeds solid fuels into the furnace in medium and large size power plants.

Types:

- (i) Overfeed stoker, and (ii) Underfeed stoker



## PART-B

1. Draw a general layout of steam power plant with neat diagram and explain the working of different circuits.
2. Explain the following with neat diagram: (i) Benson boiler (ii) Any one type of cogeneration power plant.
3. Draw a general layout of thermal power plant and explain the working of different circuits.
4. Describe the working of a high pressure boiler with super heaters.
5. Draw a neat diagram of Lamont boiler and explain its working.
6. Explain in detail the coal handling system with a suitable block diagram.
7. Describe the different types of over feed stokers and discuss its merits and demerits of each over others.
8. Why is coal pulverized? Explain any one type of pulverized systems used now-a-days.
9. With the help of a neat sketch describe the working of any one type of ash handling system.
10. Differentiate between forced draught and induced draught cooling tower.

## UNIT II DIESEL GAS TURBINE AND COMBINED CYCLE POWER PLANTS

### PART-A

#### 1. What is reheating and regeneration of gas turbine?

**Reheating** is applied in a gas turbine in such a way that it increases the turbine work without increasing the compressor work or melting the turbine materials. When a gas turbine plant has a high pressure and low pressure turbine a reheater can be applied successfully. Reheating can improve the efficiency up to 3 %. A reheater is generally is a combustor which reheat the flow between the high and low pressure turbines.

**Regeneration** process involves the installation of a heat exchanger in the gas turbine cycle. The heat-exchanger is also known as the recuperator. This heat exchanger is used to extract the heat from the exhaust gas. This exhaust gas is used to heat the compressed air. This compressed and pre-heated air then enters the combustors. Regenerated Gas turbines can improve the efficiency more than 5 %.

#### 2. Name the various gas power cycles.

Otto Cycle, Diesel Cycle, Dual Cycle & Brayton Cycle.

#### 3. Why is Carnot cycle not used in real applications?

- i. In a Carnot cycle, all four processes are reversible but there is no process reversible in actual practice.
- ii. There are two processes to be carried out during compression and expansion. During isothermal process, the piston moves very slowly and the piston moves as fast as possible during adiabatic process. This speed variation during the same stroke of the piston is not possible.
- iii) It is not possible to avoid friction between moving parts completely.



#### 4. What is and air-standard cycle? Why such cycles are conceived?

Cycle is defined as the series of operations or processes performed on a system so that the system attains its original state. The thermodynamic cycles which use air as the working fluid are known as air standard cycles. Air standard cycles are conceived to simplify the analysis of IC engines.

#### 5. Mention the four thermodynamic processes involved in Diesel cycle.

- iii. One reversible adiabatic compression
- iv. One constant pressure processes
- v. One reversible adiabatic expansion and
- vi. One constant volume.

#### 6. Mention the various processes of dual cycle.

1. Isentropic compression
2. Constant volume heat addition
3. Constant pressure heat addition
4. Isentropic expansion and
5. Constant volume heat rejection.

#### 7. List down the various processes of the Brayton cycle.

1. Isentropic compression
2. Constant pressure heat supplied
3. Isentropic expansion and
4. Constant pressure heat rejection.

#### 8. Define cut-off ratio.

Cut off ratio is defined as the ratio of volume after heat addition to the volume before heat addition.

#### 9. Which cycle is more efficient with respect to the same compression ratio?

For the same compression ratio, Otto cycle is more efficient than Diesel cycle.

#### 10. Name the factors that affect air standard efficiency of Diesel cycle.

Compression ratio and Cut-off ratio.

#### 11. What is the effect of cut-off ratio on the efficiency of Diesel cycle when the compression ratio is kept constant?

When the cut-off ratio of Diesel cycle increases, the efficiency of cycle is decreased when the compression ratio is kept constant and vice versa.

#### 12. Define the terms actual thermal efficiency and relative efficiency. (AU.DEC'12)

Actual efficiency is defined as the ratio of work output by the cycle to the heat input to the cycle.

Relative efficiency is defined as the ratio between actual efficiency and air standard efficiency.



### 13. What is meant by Atkinson cycle?

The cycle with two adiabatic processes for both compression and expansion, one constant volume process for heat addition and one constant pressure process for heat rejection is called Atkinson cycle.

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### 14. Mention a few characteristics of Diesel power plant.

- Diesel power plants are mainly used where high torque is required.
- Fuel and fluid characteristics mean that Diesel power plant could be operated with variety of different fuels depending on configuration.
- Hybrid possibilities are to combine with other power producing devices.

### 15. Under what circumstance will you recommend Diesel power plants?

Diesel power plants are mainly recommended where the fuel prices or reliability of supply favor oil over coal where the water supply is limited and relatively small loads.

### 16. What are the components present in the Diesel electric power plants?

Engine

Air intake system

Engine starting system

Fuel system

Exhaust system

Cooling system

Lubricating system

### 17. Name the various types of Diesel engine used for Diesel power plant.

1. Small size Diesel engine.
2. Medium size Diesel engine
3. Large size
4. Diesel engine.

### 18. What are the different types of engines used in power generation? State their application domain.

1. Diesel engines
2. Dual engines

### 19. How is solid injection system classified?

1. Individual pump and nozzle system
2. Unit injector system
3. Common rail system
4. Distributor system.

### 20. What are the different types of lubrication system in a Diesel power plant?

1. Wet sump lubrication
2. Dry sump lubrication
3. Mist lubrication system.



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## **21. What are equipment's of Diesel engine power plant?**

1. Pneumatic starter
2. Air compressor
3. Air-conditioning and
4. Coolant circulation pump.

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## **22. What are the methods used for starting a Diesel engine?**

1. Starting by an auxiliary engine
2. Use of electric motors or starters
3. Compressed air system

## **23. State the fuels used in the gas turbine power plants.**

Residual liquid fuels, the residue left after the profitable light fractions have been extracted from the crude have been used in gas turbines to some extent.

## **24. What are the main units in a gas turbine power plant?**

1. Compressor
2. Combustion chamber
3. Turbine

## **25. What are the methods by which thermal efficiency of a gas turbine power plant be improved?**

1. Intercooling
2. Reheating
3. Regenerator
4. Combination of intercooling reheating and regenerator.

### **PART-B**

1. Discuss the essential components of the diesel power plant with neat layout.
2. Derive an expression for the work ratio using Brayton cycle. (ii) Discuss the working of any one type of combined cycle power plant.
3. Derive an expression for the air standard efficiency of diesel cycle. Explain why the efficiency of Otto cycle is more than diesel cycle for the same compression ratio.
4. How do you select engine for a diesel power plant? Draw a diesel power plant and explain its major components.
5. Explain the construction and working of gas turbine power plant.
6. Discuss the working of combined cycle power plant.
7. With neat diagram, explain the working principle of the combined MHD and steam open cycle power plant.
8. Discuss the working of combined cycle: power plant.



## UNIT III NUCLEAR POWER PLANT

### PART-A

#### 1. What is critical mass of nuclear fuel?

A critical mass is the smallest amount of fissile material needed for a sustained nuclear chain reaction.

#### 2. What are isotopes?

Some elements exist in different forms. Mass number of these forms is different but the atomic number is the same. They are known as isotopes of the element.

#### 3. What is known as binding energy?

The energy released at the moment of combination of two nucleons to form nucleus of an atom is called "binding energy".

#### 4. What do you mean by mass defect?

During the interaction two or more particles to combine together, the total mass of the system will Decrease and it will be less than the sum of the masses of the individual particles. The stronger the interaction becomes and more the mass will Decrease. It Decrease the mass of the system called mass defect.

#### 5. What is nuclear fission? or How can nuclear fission be caused?

Nuclear fission is the process of splitting the nucleus into two almost equal fragments accompanied by the release of heat. In other words, it is the process of splitting the unstable heavy nucleus into two fragments of approximately equal mass when bombard with neutrons.

#### 6. What do you understand by moderation?

The process of slowing down the speed of neutrons from high velocity without capturing them is known as moderation.

#### 7. What is known as moderating ratio?

Multiplication ratio or reproduction factor of the system is defined as the number of neutron in any particular generation in total number of neutrons in the preceding generation.

$K = \frac{\text{Number of neutrons in any particular generation}}{\text{Number of neutrons in the preceding generation}}$

#### 8. What is four factor formula?

The four-factor formula is also known as Fermi's four factor formula used in nuclear engineering to determine the multiplication of a nuclear chain reaction in an infinite medium.



## 9. Explain the function of nuclear reactor.

A nuclear reactor is similar to the furnace of a steam power plant or combustion chamber of a gas turbine plant. In the nuclear reactor, heat is produced due to nuclear fission chain reaction.

## 10. What are the essential components of a nuclear reactor?

- Reactor core
- Moderator
- Control rods
- Reflector
- Cooling system
- Reactor vessel
- Biological shielding.

## 11. Explain the function of the moderator.

Moderator is a material which is used to slow down the neutrons from high velocities without capturing them. The fast moving neutrons are far less effective in causing the fission and for the escape from the reactor.

## 12. Name the three moderators commonly used in nuclear power reactor.

Heavy water (D<sub>2</sub>O), water (H<sub>2</sub>O), Beryllium (Be), Graphite (G) and Helium(He) gas are commonly used moderators.

## 13. Why is shielding of a Nuclear reactor necessary?

Shielding is necessary to protect walls of the reactor vessels from radiation damage and it also protect the operating personnel from exposure to radiation. Thick layers of lead concrete or steel are provided all around the reactor. These layers absorb the gamma rays, neutrons etc.

## 14. Define the term "Breeding".

In a fast breeder reactor, the process of producing energy to self-sustain the nuclear fission chain reaction without using moderator is known as breeding. Enriched Uranium (U<sup>235</sup>) or Plutonium is used as fuels which are surrounded by a thick blanket of fertile Uranium(U<sup>238</sup>).

## 15. What is a gas cooled nuclear reactor?

A Gas such as carbon dioxide is used to carry away the heat produced due to nuclear fission in the reactor. For example, the gas cooled reactor is with CO<sub>2</sub> gas as coolant and graphite as moderator.

## 16. What is LMFBR? Why is a liquid metal the preferred coolant in a fast breeder reactor?

LMFBR stands for Liquid Metal Fast Breeder Reactor. The liquid metal is always preferred as the coolant since it is an excellent heat transfer material. Ex: Sodium and Potassium.



## 17. What are the components of pressurized water reactor nuclear power plant?

- Reactor
- Pressuriser
- Heat exchanger
- Coolant pump

## 18. What are the criteria used for evaluation of nuclear plant safety?

- There is no unreasonable risk.
- It has adequate protection of public health and safety.
- Risk is reasonably low.
- Safety is as high as reasonably achievable.
- It limits the risk by use of best technologies at acceptable economic costs.

## 19. List some of the disadvantages of Nuclear power plant.

- Similar to fossil fuels, nuclear fuels are nonrenewable energy resources.
- If the accident occurs, large amount of radioactive material could be released into the environment.
- Nuclear waste also remains radioactive and it is hazardous to health for thousands of years.

## 20. How do you cater for safety of Nuclear power plant?

Nuclear safety and security cover the actions taken to prevent nuclear and radiation accidents or to limit their consequences. The main safety concern is the emission of uncontrolled radiation into the environment which could cause harm to human both at the reactor site and off-site.

The nuclear power industry has improved the safety and performance of reactors and it has proposed new and safer reactor designs.

## 21. What are the advantages and disadvantages of breeder reactor?

Advantages:

- i. No moderators is required
- ii. High breeding is possible.
- iii. It gives high power density than other reactors.
- iv. High efficiency in the order of 40% can be obtained.
- v. It has better fuel utilization.
- vi. Absorption of neutrons is low.

Disadvantages:

- i. It has to be cooled with liquid sodium.
- ii. It is even more complicated and expensive than a normal reactor.
- iii. It has potential for misuse of plutonium by terrorists.



## 22. What factors control the selection of a particular type of a reactor?

- i. Neutrons energy
- ii. Type of fuel
- iii. Type of coolant.
- iv. SFR: Sodium Fast Reactor
- v. SCWR: Super-Critical Water-Cooled Reactor.
- vi. VHTR: Very High Temperature reactor cooled with helium at 1000°C at the core for efficient production of hydrogen.

## 23. What are the essential components of a nuclear reactor?

- i. Reactor core
- ii. Moderator
- iii. Control rods
- iv. Reflector
- v. Cooling system
- vi. Reactor vessel
- vii. Biological shielding.

## 24. What are the conditions to be satisfied to sustain nuclear fission process? or Give the requirements of chain reaction.

- i. The chain reaction will become self-sustaining or self propagating only.
- ii. At least one fission neutron becomes available for causing fission of another nucleus.
- iii. The neutrons emitted in fission must have adequate energy to cause fission of other nuclei.
- iv. The number of neutrons produced must be able not only to sustain the fission process but also to increase the rate of fission.
- v. The fission process must liberate the energy.
- vi. It must be possible to control the rate of energy liberation.

## 25. How are the nuclear reactors classified?

- (i) According to the neutrons energy.
  - A) fast reactors in which fast fission is caused by high-energy neutrons.
  - B) Intermediate or epithermal.
  - c) Low energy to Thermal reactors in which fission is due to slow moving neutrons.
- (ii) According to the fuel used
  - a) Natural fuel reactor in which natural Uranium is used as fuel.
  - b) Enriched Uranium reactor in which Uranium used in this reactor contains 5 to 10% of  $U^{235}$ .
- (iii) According to the type of coolant used
  - a) water cooled reactors in which ordinary or heavy water is used as coolants.
  - b) Gas cooled reactors in which  $CO_2$ , He,  $N_2$ , air etc. are used as coolants.
  - c) Liquid metal cooled reactors in which liquid metals such as



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sodium, bismuth and lead are used as coolants.

- iv) According to the type of moderators used
  - a. Graphite moderator reactor.
  - b. Beryllium moderator reactor.
  - c. Water moderator reactor.
- v) According to the construction of core
  - a. Cubical core reactor.
  - b. Cylindrical core reactor.
  - c. Spherical core reactor.
  - d. Annulus core reactor.
  - e. Slab core reactor.

### 26. Distinguish between PHWR and LMFBR.

S.No	PHWR	LMFBR
1	A nuclear power reactor commonly uses unenriched natural uranium as its fuel which uses heavy water (deuterium oxide D <sub>2</sub> O) as its coolant and moderator.	A nuclear reactor is capable of generating more fissile material than it consumes.
2	Pressurized heavy water reactors (PHWR) running on natural uranium have a conversion ratio of 0.8.	The conversion ratio is higher than 1.
3	It is costly.	Its cost is comparatively less..

### PART-B

1. Explain CANDU (Canadian-Deuterium-Uranium) reactor with neat diagram also mention its merits and demerits.
2. Discuss about the safety measures adopted in modern nuclear plants.
3. What is meant by uranium enriched? Describe some methods of Uranium enrichment.
4. Explain the Construction and working of nuclear power plant with a layout.
5. Explain the different types of nuclear reactions and initiation of nuclear reactions.
6. Explain with a neat sketch a boiling water reactor.
7. Explain the working of pressurized water reactor.
8. What is chain reaction? How it is maintained? What is the difference between controlled and uncontrolled chain reaction? Explain with neat sketches and with examples.
9. Discuss the various factors to be considered while selecting the site for nuclear power station.



## UNIT IV POWER FROM RENEWABLE ENERGY

### PART-A

#### 1. Define the term “Hydrology”.

Hydrology is the study of science concentrating the properties of the earth's water and the movement of earth with respect to land.

#### 2. List out the important parameters of a turbine.

- i. Power output of the turbine.
- ii. Friction losses based on isentropic efficiency.
- iii. Maximum temperature which can be taken by the turbine.
- iv. Temperature at the exhaust of the turbine.

#### 3. What is a draft turbine?

After passing through the runner, the water is discharged to the tailrace through a gradually expanding tube called draft tube.

The pressure at the exit of the runner of a reaction turbine is generally less than atmospheric pressure. By passing through reduced size draft tube, the outer velocity of water is reduced and gain in useful pressure head is achieved to increase the output of turbine.

#### 4. What is the function of draft tube?

1. It allows the turbine to be set above tail. Water level is without loss of head for doing inspection and maintenance.
2. It regains the major portion of the kinetic energy delivered from the runner by the diffuse action.

#### 5. What are the different types of spill ways?

- Chute spillway
- Stepped spillway
- Bell-mouth spillway.

#### 6. Define unit speed of turbine.

Unit speed is defined as the speed of turbine when working under a unit head. Unit speed  $N_s = N/\sqrt{H}$

#### 7. What is the significance of specific speed of hydraulic turbines?

1. To predict the behaviour of a turbine working under different conditions.
2. To make the comparison between the performances of turbine of same types with different sizes.
3. To compare the performance.

#### 8. What is a surge tank?

A surge tank is a small reservoir or tank in which the water level rises or falls to reduce.



## 9. What is draft tube? In which type of turbine it is mostly used?

The tube which increases the outlet velocity of turbines is known as draft tube. So, the head is saved by fitting a draft tube.

## 10. What is the necessity of draft tubes? List the types.

1. To Decreases the pressure at the runner exit less than the atmospheric pressure in order to increase the working head.
2. To recover some of kinetic energy going to tail race as waste. Types of draft tube:

Draft tubes are classified into two types.

- (i) Straight conical or concentric tube.
- (ii) Elbow type
- (iii) Moody spreading type

## 11. Write the function of draft tube in turbine outlet.

1. It allows the turbine to be set above tail-water level without loss of head for doing the inspection and maintenance.
2. It regains the major portion of the kinetic energy delivered from the runner by the diffusion action.

## 12. What are the factors to be considered in selecting turbines?

1. Rotational speed of the turbine
2. Specific speed
3. Maximum efficiency
4. Part load efficiency
5. Head
6. Types of water
7. Runaway speed
8. Cavitation
9. Number of turbine units
10. Overall cost.

## 13. On what basis hydraulic turbines are selected?

1. Water availability
2. Water storage
3. Water head
4. Various geological investigations
5. Environmental aspects
6. Consideration of water pollution effects.

## 14. What do you understand by zero energy houses?

A zero energy building is also known as a zero net energy (ZNE) or net-zero energy building (NZEB). It refers to a building with zero net energy consumption and zero carbon emissions annually.



## 15. List any four advantages of wind turbine.

- v. Wind industry developers and manufacturers make lots of money by investing them due to government subsidies and cash incentives.
- vi. They make the environmentalists happy because man is finally punished against the earth.

## 16. What are the advantages of pumped storage plant?

- a. It is free from effects of environment pollution.
- b. Such plants are readily adoptable to automation as well as remote control.

## 17. What is the purpose of flywheel which is used in an IC engine?

A flywheel is a heavy rotating mass which is placed between power source and driven member to act as a reservoir of energy. The primary function of flywheel is to act as an “energy accumulator”. It will absorb the energy when the demand is less than the supply of energy and will release it when the demand is more than the energy being supplied.

## 18. What is the function of flywheel?

A flywheel used in machine serves as a reservoir which stores energy during the period when the supply of energy is more than the requirement and releases it during period when the requirement of energy is more than supply.

## 19. What are the components of tidal power plants?

1. The dam or dyke
2. Sluice ways
3. The power house.

## 20. What are the different methods of producing electricity with tides?

1. Single basin arrangement
  - a) Single ebb-cycle system
  - b) Single tide-cycle system
  - c) Double cycle system
2. Double basic arrangement

## 21. What is a solar cell?

A solar cell is a device which directly converts the energy of light into electrical energy through the process of photovoltaic effect.

## 22. What are the classifications of geothermal energy?

- Hydrothermal convective systems
- Geopressured resources
- Petro-thermal or hot dry rocks
- Magma resources
- Volcanoes.

## 23. What are the types of geothermal power plants?

1. According to geothermal energy resources



- a. Geothermal steams
  - b. Geothermal brine
  - c. Geothermal hot water
  - d. Hot rock
2. According to thermodynamic cycle
    - a. Steam turbine cycle
    - b. Binary cycle
    - c. Total flow concept.

## 24. What is bio gas? Give the advantages.

Biogas is a type of gas that is formed by the biological breakdown of organic matter in an oxygen deficient environment. It is counted as an ecofriendly biofuel. Biogas contains 60% methane and carbon dioxide. It can be employed for generating electricity and also as automotive fuel. Biogas can be used as a substitute for compressed natural gas (CNG).

### Advantages

- Provides a non-polluting and renewable source of energy.
- Efficient way of energy conversion (saves fuelwood).
- Leads to improvement in the environment, and sanitation and hygiene.
- Provides a source for decentralized power generation.
- Leads to employment generation in the rural areas.
- Household wastes and bio-wastes can be disposed of usefully and in a healthy manner.

## 25. List the difference between Francis and Kaplan turbine.

Difference between Francis turbine and Kaplan turbine		
	Francis turbine	Kaplan turbine
1.	It needs one servomotor for regulation of direct vanes.	It requires servomotors for regulation of vanes with turning runner blades.
2.	Shaft might be placed horizontally and vertically.	Shaft of runner is for all time vertical.
3.	Precise speed range as of 50 to 250.	Precise speed ranges as of 250 to 850.
4.	Servomotor is located outside rotor shaft.	Servomotors are located inside hollow shaft of turbine runner.
5.	Flow of water is radially and mixed flow type.	It is simply axial flow turbine.
6.	Number of vanes is big (16 to 24 blades).	Number of vanes is little (3 to 8 blades).
7.	Runner vanes is not regulating.	Runner vanes are regulating.
8.	Turbine works by middle discharge at average head.	It works by high discharge by low heads.



## PART-B

1. What are the essential elements of hydro power plant? Explain with a neat sketch.
2. Explain the working of Pelton turbine with a neat diagram. What is the function of a draft tube?
3. Describe the working of a low head hydro plant with a neat diagram.
4. Compare and contrast Kaplan turbine and Francis turbine.
5. Discuss various components of wind energy system.
6. Explain with a neat sketch a pumped storage power plant
7. Explain the spring tides and neap tides. Discuss the different tidal power schemes and configurations with neat sketches.
8. Draw a schematic diagram of a solar power plant and explain the operation of it. Also mention its merits and demerits.
9. Explain the construction and working of geo thermal power plant and tidal power plants.
10. Define the terms anaerobic digestion, Fermentation and What are the advantages and disadvantages of floating drum plant Give the list of the materials used for biogas generation.
11. Describe the principle of a fuel cell and discuss the choice of fuels required.
12. (i) Explain the construction and working of fuel cell also mention its merits and demerits.  
(ii) List the advantages and disadvantages of wind energy system.
13. Explain with a neat sketch working of a distributed (Parabolic) trough Solar Power Plant.

## UNIT V ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS

### PART-A

#### 1. What is main objective of tariff?

- Recovery of cost of producing electrical energy at the power station.
- Recovery of cost on the capital investment in transmission and distribution systems.
- Recovery of cost of operation and maintenance of supply of electrical energy *e.g.*, metering equipment, billing etc.
- A suitable profit on the capital investment.

#### 2. Define law of conservation of Energy.

Energy may be neither create nor destroyed but it can be transferred from one form to another form.



### 3. What is the significance of incremental rate for a power plant?

Boiler efficiency is defined as the ratio of heat energy used in system formation to the heat energy supplied by burning of fuel in the same period but the incremental heat rate is the reciprocal of boiler efficiency.

### 4. What are the various operating costs of fired steam power plant?

- a) Cost of fuel
- b) Lubricating oil, grease water cost
- c) Cost of maintenance and repairs
- d) Cost of operating labour
- e) Cost of supervision
- f) Taste.

### 5. Define demand for electricity.

It is defined as the electricity requirement during the period of time of high price or more stress.

### 6. Define "Diversity factor.

Diversity factor is defined as the ratio of sum of the individual maximum demand to the actual peak load of the system.

Diversity factor =  $\frac{\text{Sum of individual maximum demand}}{\text{Actual peak load of the system}}$

### 7. Define plant use factor.

The ratio of the average power load of a **plant** to its rated capacity.

### 8. What are the major factors that decide the economics of power plants?

- i. Connected load
- ii. Demand
- iii. Maximum demand
- iv. Demand factor
- v. Load factor
- vi. Capacity factor or plant capacity factor
- vii. Utilization factor
- viii. Reserve factor
- ix. Diversity factor
- x. Plant use factor

### 9. State the importance of load curves.

- a. To obtain the average load on the power station and the maximum demand of the power station.
- b. To know the incoming load thereby helping to decide the installed capacity of the power station.
- c. To decide the economical sizes of various generating units.



## 10. What is the use of load curves in power plant?

Load curve is a graphical representation which shows the power demands for every instant during certain time period. By drawing these load curves, the peak load can be identified. Therefore, the capacity of power plant can be judged.

These curves give full information about the incoming load and they help to decide the installed capacity of the power station. It is also useful to decide the economical sizes of various generating units.

## 11. How does the fuel cost related to the load and the cost of power generation?

The cost of power generation is directly proportional to the fuel cost because the operating cost is directly linked with the fuel cost.

## 12. What are fixed cost?

Fixed costs are the cost required for the installation of complete power plant. This cost includes the cost of land, buildings, equipment, transmission and distribution lines, cost of planning and designing the plant and many others. It also consists of interest, taxes, depreciation, insurance etc.

## 13. Define flat rate tariff.

The charging of amount depending only on the connected load and fixed number of hours of use per month or year is called flat rate tariff.

## 14. List the types of tariffs to calculate energy rate.

- Flat demand rate
- Straight line meter rate
- Block meter rate
- Hopkinson demand rate of two-part tariff
- Doherty rate or three part tariff.

## 15. How the tariff for electrical energy is arrived?

Tariff is calculated by the following equation.  $E = Ax + By + C$

Where

$E$  = Total amount of bill for the period considered  
 $A$  = Rate per kW of maximum demand

$X$  = Maximum demand in kW

$B$  = Energy rate per kWh

$Y$  = energy consumed in kWh during the period considered

$C$  = Constant amount charged to the consumer during each bill period. This charge is independent of demand or total energy.

## 16. Define depreciation.

It is the amount to be set aside per year from income to meet the depreciation caused by the age of service, wear and tear of machinery.



**17. Mention any four methods for calculating depreciation.**

- Straight line method
- Sinking fund method
- Diminishing value method
- Net percent value method
- Double sinking fund method.

**18. What are the factors that contribute for energy cost?**

- Cost of fuel.
- Cost of operating labour.
- Cost of maintenance labour and materials.
- Cost of supplies

**19.A. List out four important factors to be considered for the selection of site for power plants,**

- Cost of land as well as taxes on land.
- It should be near load centers.
- It should be accessible by road, rail etc.,
- Sufficient quantity of cooling water should be available.
- The selected site should be away from the populated area
- Enough space should be available for future expansion of plants.
- The selected site should satisfy geological factors.

**20. What are the different pollutions in the flue gas?**

- Oxides of nitrogen
- Oxides of sulphur
- Carbon monoxide
- Particulates.

**21. What are the methods used for reduction of SO<sub>2</sub> pollutant?**

- Adding lime stone (CaCO) to the coal
- Using wet scrubbers
- Using electro static precipitator.

**22. What is the equipment used to control the particulates?**

- Scrubbers
- Cyclone separator
- Fabric filters
- Electro static precipitators.

**23. List down the nuclear waste disposal methods.**

- Disposal in sea.
- Disposal in land.
- Disposal by reduction process through chemical reaction.
- Disposal by solidification process.



## 24. What are the various methods followed to transport solid waste?

- (i) Wet slurry method: This method uses water slurry to transport the material to the disposal area.
- (ii) Pneumatic method: This method uses the air to transport solid wastes to the disposal area.
- (iii) Trucking.
- (iv) Rail transport.
- (v) Conveyor usually fixed or movable belt conveyor systems is used, and
- (vi) Barge uses waterways to transport waste materials.

## 25. What are the costs involved in fired steam power plant?

- Maintenance and repairs cost
- Operating labour cost
- Supervision cost

## PART-B

1. Explain the methods to control pollution in thermal and nuclear power plants.
2. Write an explanatory note on the economics of power generation.
3. What is meant by load factor and diversity factor?
4. Elucidate the objectives and requirements to tariff and general form of tariff.
5. What are the elements which contribute to the cost of, the electricity? And how can the cost power generation be reduced?
6. Explain briefly the various methods used to, calculate the depreciation cost.
7. What are the fixed and operating costs of steam power plant? How are they accounted for fixing cost of electricity?
8. Explain the analysis of pollution from thermal power plants. What is methods used for control the pollutants?
9. Write short notes on nuclear waste disposal.
10. (i) Explain the site selection criterion of hydro power plant.  
(ii) A peak load on the thermal power plant is 75 MW. The loads having maximum demands of 35 kW, 20 MW, 15 MW and 18 MW are connected to the power plant. The capacity of the plant is 90 MW and annual load factor is 0.53. Calculate the average load on power plant, energy supplied per year, demand factor and diversity factor.