

ME6701/ME8792 – POWER PLANT ENGINEERING 2 MARKS - QUESTION BANK

UNIT 1: COAL BASED THERMAL POWR PLANTS

1. Write about out-plant handling?

Out plant handling includes the handling of coalmine to the thermal power plant. These handlings are outside the plant in the following ways. Transportation by sea (or) river, Transportation by rail, Transportation by road, Transportation of coal by pipeline.

2. Write about inplant handling of-coal?

In order to handle large quantity of coal inside the plant, some mechanical handling systems are provided f6r smooth, easy and better controlled operation. The inplant coal handling is divided, into following categories.

3. Why the preparation of coal is necessary?

The coal from coal nines cannot be directly fed into the furnace. Proper preparation of coal should be done before feeding the coal to the furnace. In the coal preparation, the coal passes through the different equipments like

1. Crushers
2. Sizers
3. Driers and Magnetic Separators.

4. Name the different types of coal transforming equipments?

1. Belt conveyors
2. Screw conveyors
3. Bucket elevators
4. Grab bucket elevators
5. Skip hoists
6. Flight conveyors.

The coal transfer starts by carrying of coal from-unloading point to the storage site.

5. Write about screw conveyor and bucket conveyors?

In screw conveyor, an endless helicoid screw is fitted to the 9haft. On one end of the shaft, the driving mechanism is fitted and the other end of the shaft is supported on a ball bearing. While the screw is rotating, the coal is transferred` from one end to the other end.

Bucket conveyors are used as vertical lifts. The coal is loaded at the bottom and unloaded at the top in the bucket conveyors.

6. Define draught, what is the use of draught in thermal power plants?

Draught is defined as a small pressure difference required between the fuel bed (furnace) and outside air to maintain constant flow of air and to discharge the gases through chimney to the

atmosphere. Draught can be obtained by chimney, fan, steam jet (or) -air jet (or) combination of these.

The uses are To supply required quantity of air to the furnace for combustion of fuel., To draw the combustion products through the system. To remove burnt products from the system

7. Write about classification of draught?

Draught is classified as

1. Natural draught
2. Artificial draught .

The artificial draught is further classified as

- (a) Balanced draught
- (b) Induced draught
- (c) Forced draught

8. Define the term Natural draught and what are the advantages of natural draught system?

The tall chimney creates the natural draught by the temperature difference between hot gases in the chimney and cold atmospheric air outside the chimney.

9. Write about artificial draught?

In modern power plants, the draught should be flexible to meet the fluctuating loads and it should be independent of atmospheric conditions. To achieve this, the aid of draft fans becomes must and by employing the draft fans, the height of the chimney would be reduced.

10. Write about forced draught system? (NOV/DEC 2014)

In this system, the blower (forced draft fan) is located at the base of the boiler near the grate. Air is forced to the furnace by forced fan and the flue gases are forced to chimney through economiser and air preheater.

11. State thermodynamic law:

Zeroth law refers to thermodynamic equilibrium and temperature

First law refers to heat, work and energy

Second law refers to entropy

12. State zeroth law of thermodynamics:

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

13. 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.

14. State second and third law of thermodynamics:

The second law of thermodynamics another state variable called entropy. In any closed system, the entropy of the system will either 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.

15. 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.

16. 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

17. What is the purpose of deaeration?

The purpose of deaeration are:

- To remove oxygen, carbon dioxide and other non-condensable gases from feed water.
- To heat the incoming makeup water and return condensate to an optimum temperature
- Minimizing solubility of undesirable gases
- Providing the highest temperature water for injection to the boiler.

18. What are the types of deaerators?

1. Tary- ype 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. What are the advantages and disadvantages of forced draught system (NOV/DEC 2014)

Advantages:

- Since the fan handles cold air, the fan size and the power required are less.
- No need of water cooled bearings because the air being handled is cold air,
- Pressure throughout the system is above atmospheric pressure so the air leakage into the furnace is reduced.

Disadvantages:

- Recirculation due to high air-entry and low air-exit velocities

23. How the induced draught is working?

In an induced draught system, a blower (induced draft fan) is placed near (or) at the base of the chimney. The fan sucks the flue gas from the furnace creating a partial vacuum inside the furnace. Thus atmospheric air is induced to flow through the furnace to aid the combustion of fuel. The flue gases drawn by the fan pass through chimney, to the atmosphere.

24. Why the balanced draught system is preferred than other system?

In the induced draught system, when the furnace is opened for firing, the cold air enters the furnace and dilute the combustion. In the forced draught system, when the furnace is opened for firing, the high pressure air will try to blow out suddenly and furnace may stop. Hence the furnace cannot be opened for firing (q) inspection in both, systems. Balanced draught, which is a combination of induced and forced draught, is used to overcome the above stated difficulties.

25. What is the difference between stocker firing and pulverised fuel firing?

The stocker firing method is used for firing solid coal whereas pulverised firing method is used for firing pulverised coal.

26. What are the different types of stockers?

1. Over feed stockers: Travelling grate stockers, Spread stockers
2. Under feed stockers: Single retort stocker, Multi retort stocker

27. What is the use of pulveriser and name different types of pulverising mills?

The pulveriser is used to pulverise the coal in order to increase the surface exposure. Pulverised coal enables rapid combustion. The different types of pulverising mills are

1. Ball mill
2. Hammer mill
3. Ball and race mill.

28. What are advantages of pulverised fuel coal?(Nov/Dec 2012)

1. The layout is simple and economical

2. It gives direct control of combustion
3. Coal transportation system is simple
4. Maintenance cost is less

29. 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

30. What are the principles of stokers? (Nov/Dec 2012)

A mechanical stoker is a device which feeds coal into the firebox of a boiler. It is standard equipment on large stationary boilers and was also fitted to large steam locomotives to ease the burden of the fireman. The locomotive type has a screw conveyor (driven by an auxiliary steam engine) which feeds the coal into the firebox. The coal is then distributed across the grate by steam jets, controlled by the fireman. Power stations usually use pulverized coal-fired boilers.

31. What is the function of hot primary air? (MAY/JUN 2013)

Coal contains moisture. Hot air from the Primary Air Fans dry the coal in the pulverisers. This makes the burning easy and efficient. This air also carries the dry coal powder from the pulverisers to the burners in the boiler furnace. In the burners the coal powder is mixed with the required amount of Combustion air and burned in the furnace.

32. State important advantages of high-pressure boilers? (Nov/Dec 2012)

The amount of scale formation is less, since the velocity of water through pipes are more. All parts of the system are heated uniformly, so there is no danger of overheating.

33. What is supercritical boiler? Give two advantages. (MAY/JUN 2013)

A supercritical steam generator is a type of boiler that operates at supercritical pressure, frequently used in the production of electric power.

In contrast to a subcritical boiler, a supercritical steam generator operates at pressures above the critical pressure 22 MPa in which bubbles can form. Instead, liquid water immediately becomes steam. Water passes below the critical point as it does work in a high pressure turbine and enters the generator's condenser, resulting in slightly less fuel use and therefore less greenhouse gas production.

Advantages:

- Higher unit cycle efficiency (40 - 42%)
- Lower heat rate and electricity generation cost is lower
- Lower water losses because no continuous blow down
- Reduced auxiliary power consumption

34. Describe the steps to be followed in in-plant coal handling of coal. (MAY/JUN 2014)

- (i) Coal delivery
- (ii) Unloading
- (iii) Preparation

- (iv) Transfer
- (v) Outdoor storage
- (vi) Covered storage
- (vii) In plant handling
- (viii) Weighing and measuring
- (ix) Feeding the coal into furnace

35. Write short notes on cogeneration.

Cogeneration or combined heat and power (CHP) is the use of a heat engine or power station to generate electricity and useful heat at the same time. Cogeneration is a thermodynamically efficient use of fuel. In separate production of electricity, some energy must be discarded as waste heat, but in cogeneration this thermal energy is put to use.

36. Define Binary cycle.

A binary vapour cycle is defined in thermodynamics as a power cycle that is a combination of two cycles, one in a high temperature region and the other in a lower temperature region.

37. 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.

38. 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.

39. 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

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

The hydraulic system carried 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 its 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.

41. 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

42.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

UNIT 2: DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS

1. List the advantages of gas turbine power plant.

1. Low capital cost
2. High reliability
3. Flexibility in operation
4. Capability to quick start
5. High efficiency e.t.c.

2. List the major components of gas turbine.

- 1.Compressor
2. Combustion chamber and
3. Turbine

3. List the types of gas turbine power plants.

- 1.Open cycle gas turbine power plant
2. Closed cycle gas turbine power plant

4. List the disadvantages of gas turbine power plant.

- 1.No load and Partial load efficiency is low
- 2.High sensitive to component efficiency
- 3.The efficiency depends on ambient pressure and ambient temperature
- 4.High air rate is required to limit the maximum inlet air temperature. Hence exhaust losses

are high

5. Air and gas filter is required to prevent dust into the combustion chambers.

5. Define regenerator efficiency.

The regenerator efficiency is defined as: $\frac{\text{Actual temperature rise of air}}{\text{Maximum temperature rise possible}}$

6. List the factors which affect the performance of gas turbine power plants.

1. Part load efficiency
2. Fuel consumption
3. Air mass flow rate
4. Thermal efficiency
5. Regeneration

7. List the methods adopted for circulating the water in a cooling system.

1. Thermosiphon cooling
2. Forced cooling by pump
3. Thermostat cooling
4. Pressurised water cooling
5. Evaporative cooling

8. What are the important functions of a lubricating system?

1. Lubricating
2. Cooling
3. Cleaning
4. Sealing
5. Noise absorption

9. List the various types of lubricating system used in diesel engine.

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

10. What are the starting methods of diesel engine?

1. By an auxiliary engine
2. By an electric motor
3. By compressed air

11. List any four advantages of diesel power plant.

1. It is easy to design and install
2. It is easily available in standard capacities
3. They can respond to load changes
4. They have less stand by losses

12. List any four disadvantages of diesel power plant.

1. High operating cost

- (b) Four stroke diesel engine
- Based on orientation:
- (a) Horizontal diesel engine
 - (b) Vertical diesel engine
- Based on number of cylinders:
- (a) single cylinder
 - (b) Multi cylinder

And other type like naturally aspirated, superheated etc.,

21. List the various functions of fuel injection system.

1. It filters the fuel
2. Monitor the correct quantity of fuel to be injected
3. Timing of the injection process
4. Regulates the fuel supply
5. Fine atomization of fuel oil
6. Distributes the atomized fuel properly inside the combustion chamber

22. List the classification of oil injection system.

- (a) Common rail injection system
- (b) Individual pump injection system
- (c) Distributor system

23. List the reason why the cooling system is necessary for a diesel engine.

- To avoid deterioration of lubricating oil
- To avoid damages and overheating of piston
- To avoid uneven expansion which results in cracking
- To avoid pre-ignition and detonation or knocking
- To avoid reduction in volumetric efficiency and power output of the engine

24. What are the methods of cooling system used?

1. Air cooling
2. Water cooling

25. List the methods adopted for circulating the water in a cooling system.

1. Thermosiphon cooling
2. Forced cooling by pump
3. Thermostat cooling
4. Pressurised water cooling
5. Evaporative cooling

26. What are the important functions of a lubricating system?

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29. List any four advantages of diesel power plant.

1. It is easy to design and install
2. It is easily available in standard capacities
3. They can respond to load changes
4. They have less stand by losses

30. List any four disadvantages of diesel power plant.

1. High operating cost
2. High maintenance and lubrication cost
3. Capacity is restricted
4. Noise pollution

31. List any four applications of diesel power plant.

1. Used as peak load plants
2. Suitable for mobile plants
3. Used as standby units
4. Used as emergency plant

32. List the disadvantages of gas turbine power plant.

1. No load and Partial load efficiency is low
2. High sensitive to component efficiency
3. The efficiency depends on ambient pressure and ambient temperature

4. High air rate is required to limit the maximum inlet air temperature. Hence exhaust losses are high
5. Air and gas filter is required to prevent dust into the combustion chambers.

33. Define regenerator efficiency.

The regenerator efficiency is defined as the ratio between actual temperature rise of air to maximum temperature rise possible.

34. List the factors which affect the performance of gas turbine power plants.

1. Part load efficiency
2. Fuel consumption
3. Air mass flow rate
4. Thermal efficiency
5. Regeneration

35. What are the working fluids in gas turbine?

1. Air
2. Helium
3. Argon
4. Carbon dioxide

36. What is the function of draft tube? (MAY/JUN 2013)

The draft tube is a conduit which connects the runner exit to the tail race where the water is being finally discharged from the turbine. The primary function of the draft tube is to reduce the velocity of the discharged water to minimize the loss of kinetic energy at the outlet. This permits the turbine to be set above the tail water without any appreciable drop of available head.

37. How solid injection is classified? (MAY/JUN 2013) Solid Injection Classification:

- Common Rail System
- Unit Injection System
- Individual Pump and Nozzle System
- Distributor System

38. What do you mean by regeneration in gas turbine power plant? (MAY/JUN 2013)

The hot exhaust gases from the turbine are passed through a heat exchanger, or regenerator, to increase the temperature of the air leaving the compressor prior to combustion. This reduces the amount of fuel needed to reach the desired turbine-inlet temperature. The increase in efficiency is, however, tied to a large increase in initial cost and will be economical only for units that are run almost continuously.

39. Write about types of turbines. (NOV/DEC 2013)

Major classifications are,

(1) Impulse turbine

(2) Reaction turbine

Subdivided into,

(a) Kaplan Turbine

(b) Propeller Turbine

(c) Francis Turbine

(d) Pelton Turbine

40. What type of cycle is used in gas turbine? (NOV/DEC 2013)

In an ideal gas turbine, gases undergo three thermodynamic processes: an isentropic

compression, an isobaric (constant pressure) combustion and an isentropic expansion. Together, these make up the Brayton cycle.

UNIT 3: NUCLEAR POWER PLANTS

1. What is meant by radioactivity?

It refers to the German name of Radio-Activitat. Radioactivity is the spontaneous disintegration of atomic nuclei. The nucleus emits particles or electromagnetic rays during this process.

2. What is the unit of Radioactivity?

1. Roentgen
2. RAD (Radiation Absorbed Dose)
3. RBE (Relative Biological Effectiveness)
4. REM (Roentgen Equivalent in Man)
5. Gray (GY) - 100 rads
6. Sievert (SV)

3. What are the types of Radioactive decay?

1. Alpha decay
2. Beta decay
3. Gamma decay
4. Positron emission (Beta positive decay)
5. Electron capture

4. Define-Decay timing.

The number of decay events $-dN$ expected to occur in a small interval of time dt is proportional to the number of atoms present. If N is the number of atoms, then the probability of decay $(-d/N)$ is proportional to dt .

5. What is Uranium enrichment?

In most types of reactor, a higher concentration of uranium is used to make fuel rod. This is produced by a process termed enrichment. The enriched uranium contains more than natural 0.7% U-235.

6. What are the two ways of uranium enrichment?

1. Gas centrifuge process
2. Gas diffusion

7. What is the purpose of reprocessing of nuclear waste?

The used fuel contains 96% uranium, 1% plutonium and 3% radioactive wastes. Reprocessing is used to separate the waste from the uranium and plutonium which can be recycled into new fuel. The reprocessing effectively reduces the volume of waste and limits the need to mine

new supplies of uranium, so that extending the time of resources.

8. Write about atomic number?

The nucleus contains protons and neutrons. The number of protons in a given atom is an atomic number (Z). The atomic number for H is 1 and He -is 2.

9. Write about isotopes of an element?

Some elements have the same number of protons in the nucleus but different number- of neutrons. As a result, these elements have the same atomic number but different mass number. Such type of elements which ' have the same atomic number – same number of protons - the -same chemical properties but different mass numbers due to different number of neutrons, are known as I the isotopes of an element.

10. What are the requirements to sustain fission process?

The bombarded neutrons must have sufficient energy to cause fission, The number of neutrons produced must be able to create the rate of fission, The fission process must generate energy, The fission process must be controlled

11. Define multiplication factor of a fission process.

$$k = \frac{\text{Number of neutrons of any one generation}}{\text{number of neutrons of immediately preceding generation.}}$$

12. Define fertile materials and breeding in reactors

There are materials like U^{235} and Th^{232} which are not fissile but can be converted into fissile materials by the bombardment of neutrons. Such materials are known as fertile materials.

The process of converting more fertile material into fissile material in a reaction is known as breeding.

13. What are the desirable properties of a good moderator? (MAY/JUN 2014)

It must be as light as possible It must slowdown the neutron as quick as possible, It must have resistance to corrosion .It must have good machinability, It must have good conductivity and high melting point

14. What are the desirable properties of a coolant?

It should not absorb neutron, Have high chemical and radiation stability, Non-corrosive, Have high boiling point Non-toxic

15. What are the advantages using CO₂ as coolant?

- Gases do not react chemically with the structural materials, Gas can attain any temperature for a particular pressure
- They do not absorb neutron, The leakage of gas will not affect the reactivity, The gas coolant provides best neutron economy

16. What are the advantages of breeder reactors?

It gives high power density than any other reactor, High breeding is possible, High burn-up of fuel is achievable, The operation of the reactor is not limited by Xe poisoning

17. What are the demerits of breeder reactor?

Highly enriched fuel is required, Control is difficult and expensive, Safety must be provided against melt down, Handling of sodium is a major problem

18. What are the advantages of Sodium in fast-breeder reactors?

Sodium has very low absorption cross-sectional area, It possess good heat transfer properties at high temperature and low pressure, It does not react with any of the structural materials used in primary circuits

19. What is the purpose of control rods?

The control rods are used to start the chain reaction, maintain the chain reaction at required level and to shut down the reactor during emergency.

20. What is meant by Nuclear fission? (NOV/DEC 2013)

Uranium exists in different isotopes of U238, P34 and U235. Out of these, EP35 is most unstable. When unstable heavy nucleus is bombarded with high-energy neutrons, it splits up roughly into two equal

21. Define Nuclear Fission.
An atom's nucleus can be split apart. When this is done a tremendous amount of energy is released. The energy is both heat and light energy. This energy ,when let out slowly can be harnessed to generate electricity.

22. Name the different components of nuclear reactor?

1. Nuclear fuel 2. Moderator 3. Control rods 4. Reflectors, 5. Reactor vessel 6. Biological shielding 7. Coolant

23. State some advantages of Pressurized Water reactor?

- The pressurized water reactor is compact
- In this type, water is used as coolant, moderator and reflector water is cheap and available in plenty)
- It requires less number of control rods.

24. What are the advantages of gas cooled reactor nuclear power plant?

1. Fuel processing is simple, 2. The use of CO₂ as coolant completely eliminates the

possibility of explosion in reactor. 3. No corrosion problem

25. Name the coolants commonly used for fast breeder reactors?

Liquid metal (Na (or) Na K), Helium (He), Carbon dioxide.

26. What is the- necessity of Automatic controls for feed water?

The electrical load on power plant varies in an irregular manner. The automatic control provided at a steam power plant successfully meets over the variable load. The automatic control for feed water is necessary sine the supply of feed water depends upon plant load.

27. What is the difference between fission and fusion? (Nov/Dec 2012) (MAY/JUN 2014)

S. NO	Nuclear Fission	Nuclear Fusion
1	In nuclear physics and nuclear chemistry, nuclear fission is a nuclear reaction in which the nucleus of an atom splits into smaller parts (lighter nuclei), often producing free neutrons and photons (in the form of gamma rays).	In nuclear physics, nuclear chemistry and astrophysics nuclear fusion is the process by which two or more atomic nuclei join together, or "fuse", to form a single heavier nucleus.
2	The two nuclei produced are most often of comparable size, typically with a mass ratio around 3:2 for common fissile isotopes.	This is usually accompanied by the release or absorption of large quantities of energy.

28. List the four types of radiation associated with nuclear fission.

- Alpha radiation
- Beta radiation
- Gamma radiation
- Neutron radiation

29. Write few ways of Nuclear Power plant safety.

Radiation doses can be controlled through the following procedures:

- The handling of equipment via remote in the core of the reactor
- Physical shielding
- Limit on the time a worker spends in areas with significant radiation levels
- Monitoring of individual doses and of the working environment

- Safety mechanism of a Nuclear power reactor

30. What is LMFBR? Why liquid metal preferred in fast breeder reactor? (MAY/JUN 2013)

A liquid metal fast breeder reactor (LMFBR) is a nuclear reactor capable of producing more fissile product than it takes in. Breeders exhibit remarkable fuel economy compared to light water reactors. Liquid metal use in fast breeder reactors has long been considered for the improvement of efficiency in their heat transfer systems. Work has been performed around the world on corrosion of sodium- and potassium-cooled fast breeder reactors.

The metal coolants have much higher density than the water used in most reactor designs, they remove much heat more rapidly and allow much higher power density. This makes them attractive in situations where size and weight are at a premium, like on ships and submarines

31. What is Neutron life time?

The prompt neutron lifetime, is the average time between the emission of neutrons and either their absorption in the system or their escape from the system. The term lifetime is used because the emission of a neutron is often considered its birth, and the subsequent absorption is considered its death.

32. What is Uranium-235 chain Reactor?

In a chain reaction, particles released by the splitting of the atom go off and strike other uranium atoms splitting those. Those particles given off split still other atoms in a chain reaction. If at least one neutron from U-235 fission strikes another nucleus and causes it to fission, then the chain reaction will continue.

33. What is four factor formula?

The four factor formula is used in nuclear engineering to determine the multiplication of a nuclear chain reaction in an infinite medium. The formula is:

9. Reproduction Factor - The thermal utilization factor
10. The resonance escape probability - The fast fission factor

34. List the four types of radiation associated with nuclear fission.

1. Alpha radiation
2. Beta radiation
3. Gamma radiation
4. Neutron radiation

35. Define Alpha radiation.

This is basically the atomic nucleus of the element (He) consisting of two protons and two neutrons. It is not very penetrative and the danger to man arises if an alpha emitting

element, such as plutonium, then the alpha radiation be very damaging. **36. Define Beta radiation.**

Beta radiation consists of electrons or their positively charged counterparts. This can penetrate the skin, but not very far. **37. Define Gamma radiation.**

Gamma radiation is penetrative in a manner similar to X-rays and has similar physical properties. It can be stopped only by thick shields of lead or concrete. **38. Define Neutron radiation.**

Neutron radiation consists of the neutrons emitted during the fission process. Neutrons are also very penetrative, but less so than gamma-radiation.

39. Define water as moderator.

Neutrons from fission have very high speeds and must be slowed greatly by water moderation to maintain the chain reaction. The Uranium-235 is enriched to 2.5-3.5% to allow ordinary water to be the moderator. Enough spontaneous events occur to initiate a chain reaction if the proper moderation and fuel density is provided.

40. List the types of Nuclear reactors.

The reactors are classified based on the following:

1. Type of fuel used
2. Neutron flux spectrum
3. The coolant

41. List the various widespread power plant reactor types.

1. Pressurized water reactor (PWR)
2. Boiling water reactor (BWR)
21. Pressurized Heavy water reactor (PHWR)
22. Liquid metal fast Breeder Reactors (LMFBR)
23. High temperature Gas cooled reactors (HTGCR)

42. What is a pressurized water reactor (PWR)?

The PWR belongs to the light water type. The moderator and the coolant are both light water (H₂O). The cooling water circulates in two loops, which are fully separated from one another. PWR keeps water under pressure, so the water heats but does not boil even at the high operating temperature.

43. What is a boiling water reactor (BWR)?

In a boiling water reactor, light water plays the role of moderator and coolant as well. Part of the water boils away in the reactor pressure vessel, thus a mixture of water and

steam leaves the reactor core. **44. What is Molten Salt Reactor (MSR)?**

A molten salt reactor is a type of nuclear reactor where the primary coolant is a molten salt. Molten salt refers to a salt that is in the liquid phase that is normally a solid at standard temperature ionic liquid, although technically molten salts are a class of ionic liquids.

45. Nuclear Power plant safety.

Radiation doses can be controlled through the following procedures: 1. The handling of equipment via remote in the core of the reactor

2. Physical shielding
3. Limit on the time a worker spends in areas with significant radiation levels
4. Monitoring of individual doses and of the working environment
5. Safety mechanism of a Nuclear power reactor

46. List the Nuclear power plants in India.

1. Kaiga (3*22MWPWR), Karnataka
2. Kakrapar (2*22MWPWR), Gujarat
3. Kudankulam (2*100MWPWR), Tamilnadu
4. Madras (2*17MWPWR), Tamilnadu

47. Define mean generation time.

It is the average time from a neutron emission to a capture results in fission. The mean generation time is different from prompt neutron lifetime because the mean generation time only includes neutron absorption that leads to fission reaction.

UNIT 4: POWER FROM RENEWABLE ENERGY

1. What are the components of solar energy?

- Collector
- Storage unit

4. What is concentration ratio?

Concentration ratio is defined as the ratio between the aperture area and the receiver absorber area of the collector.

3. List the various types of solar energy collectors. (NOV/DEC 2013)

1. Stationary collectors (or) Non-concentrating
 - (a) Flat plate collectors
 - (b) Compound parabolic collectors

(c) Evacuated tube collectors

2. Sun tracking concentrating collector

(a) single axis tracking

(b) Two-axis tracking

4. List any four applications of solar collectors.

- Solar water heating
- Solar space heating systems
- Solar refrigeration
- Industrial process heat systems

5. List the four important solar systems.

- Low temperature cycles using flat plate collector or solar pond
- Power tower or central receiver system
- Distributed collector system
- Concentrating collectors for medium and high temperature cycle

6. List the advantages of solar Energy.

- Solar energy is free from pollution
- They collect solar energy optically and transfer it to a single receiver, thus minimizing thermal-energy transport requirements
- They typically achieve concentration ratios of 300 to 1500 and so are highly efficient both in collecting energy and converting it to electricity
- The plant requires little maintenance or help after setup
- It is economical

7. List any four disadvantages of solar energy.

- Available in day time only
- Need storage facilities
- It needs a backup power plant

8. List the various components of wind energy system.

1. Rotor 2. Gearbox 3. Enclosure 4. Tailvane

9. What are the two basic design of turbines?

1. Vertical axis (or) Egg beater style 2. Horizontal axis (propeller style) machines

10. Write down the various types of wind power plants.

- 1.Remote 2.Hybrid 3.Grid connected

11. List any four advantages of wind turbine.

- 1.Inexhaustible fuel source 2.No pollution
3.Excellent supplement to other renewable source 4.Its free

12. List the disadvantages of wind power generation.

- 1.Low energy production 2.Expensive maintenance

13. What are the various ways of creating tidal energy?

- 1.Tidal Barrager 2.Tidal fences 3.Tidal turbines

List the various types of turbines used in tidal power

14.station.

- 1.Buld turbine 2.Rim turbine 3.Tubular turbines

15.What are the components of tidal power station?

- 1.Barrage 2.Turbines 3.Sluices 4.Embankments

16. List four advantages of hydro electric power plant. (MAY/JUN 2013)

- It is a clean and safe source of energy
- They are self sustaining
- They create habitat for more types of fish
- They can act as a flood controller
- They are the most efficient energy source running from 90-95% efficiency

17. What is pondage and storage? (MAY/JUN 2014)

STORAGE

In a conventional hydropower plant, the water from the reservoir flows through the plant, exits and is carried down stream. A pumped-storage plant has two reservoirs:**Upper reservoir** - Like a conventional hydropower plant, a dam creates a reservoir. The water in this reservoir flows through the hydropower plant to create electricity.**Lower reservoir** - Water exiting the hydropower plant flows into a lower reservoir rather than re-entering the river and flowing downstream.

PONDAGE

It usually refers to the comparably small water storage behind the weir of a run-of-the-river

hydroelectric power plant. Such a power plant has considerably less storage than the reservoirs of large dams and conventional hydroelectric stations which can store water for long periods such as a dry season or year. With pondage, water is usually stored during periods of low electricity demand and days when the power plant is inactive, enabling its use as a peaking power plant in dry seasons and a base load power plant during wet seasons.

18. What is water hammer? ((MAY/JUN 2014)

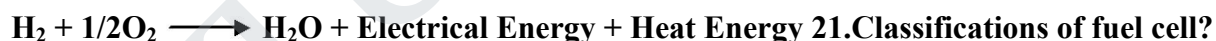
Water hammer (fluid hammer) is a pressure surge or wave caused when a fluid in motion is forced to stop or change direction suddenly (momentum change). A water hammer commonly occurs when a valve closes suddenly at an end of a pipeline system, and a pressure wave propagates in the pipe. It is also called hydraulic shock.

19.What is the source of geothermal energy? (NOV/DEC 2013)

Geothermal energy is clean and renewable source of energy that refers to heat found in Earth's core. The geothermal energy is basically a form of thermal energy that has its origin in radioactive decay of various minerals inside the Earth's core.

20.What is fuel cell?

A fuel cell is an energy conversion device that reacts a fuel and oxygen to produce electricity. The most common fuel is hydrogen. Produces electricity, water, and heat by the combination of hydrogen and oxygen.



(d) **Temperature**

(a)Low temperature (< 300°C) (b)High Temperature (> 300°C)

(e) **Electrolyte**

(a)PEMFC (low Temperature, *proton- conducting polymer*) (b)PAFC (200°C *,phosphoric acid in a matrix*)

(c)AFC (KOH, 80°C *aqueous potassium hydroxide in a matrix*) (d)MCFC (650°C, *molten carbonate salt in a ceramic matrix*) (e)SOFC (> 900°C, *oxide ion-conducting ceramic*)

(f)BFC - *Biological Fuel Cell (Sugar)*

- **Write the functions of platinum catalyst.**

(a) Dissociate the C-H bond.

(b) Facilitate the reaction of the resulting residue with some oxygen containing species to form CO_2

• **Write the advantages of fuel cell?**

- Water is the only discharge (pure H_2)
- High efficiency
- Low weight and volume
- Portable
- No hazardous emissions

24. Write short notes on Biological fuel cell?

Biological fuel cell converts the chemical energy of carbohydrates, such as sugars and alcohol directly into electrical energy.

First time Rohrbach et al. designed the biological fuel cell in which clostridium butyricum was used as a biological material to generate hydrogen from glucose fermentation.

25. What are sources of Biogas?

Biogas can be produced by anaerobic digestion of organic matter. Potential raw materials available on a large scale are cow dung, municipal waste and plants specially grown for this purpose like water hyacinth, algae, certain types of grasses.

26. Write the formula to calculate the hydraulic power produced by a hydroturbine:

The hydraulic power is given by the formula:

$$P = \rho g Q H$$

Where P is the hydraulic energy in watts

G is acceleration due to gravity (9.81 M/s^2)

P is water density

Q is the flow or discharge

H is the height of fall of water or head in meter.

27. List any four advantages of hydro power:

1. Water source is perennially available
2. Running cost is very low
3. Non-polluting
4. Power generation can be switched on and off in a very short period.

28. List any four disadvantages of hydropower:

1. High capital investment and low rate of return
2. Gestation period is very large
3. Power generation depends on availability of water
4. Transmission cost and losses are high

29. List the factors to be considered for the selection of site for hydro power plant:

1. Availability of water and water head
2. Accessibility of site
3. Water storage capacity
4. Distance from the load center
5. Type of land

30. List the classification of dams:

1. Based on their functions:
 - (a) storage dams
 - (b) Diversion dams
 - (c) Detention dams
2. Based on their shape:
 - (a) Trapezoidal dams
 - (b) Arch dams
3. Based on the materials of construction:
 - (a) Earth dams (b) Rock pieces dams
 - (c) Stone masonry dams (d) concrete dams
 - (e) RCC dams (f) Timber and Rubber dams
4. Based on hydraulic design:
 - (a) Overflow type dam
 - (b) Non-overflow type dam
5. Based on structural Design:
 - (a) Gravity dam

- (b) Arch dam
- (c) Buttresses dam

31.What is a surge tank?

A surge tank is a small reservoir in which the water level rises or falls to reduce the pressure swings during opening and closing of inlet valve. The surge tank is not required for run off plants and medium head plants.

32.What is a Draft tube?

The draft tube allows the turbine to be set above the tail race to facilitate inspection and maintenance. It also regains the major portion of the kinetic energy at the runner outlet by diffuser action. The draft tube can be a straight conical tube or an allow tube.

33.List the equipments present in a power house:

1. Hydraulic turbines
2. Electric generators
3. Governors
4. Gate valves and rehet valves
5. Water circulating pumps
6. Air duct
7. Switch board and instruments
8. Storage batteries and cranes

34.List the types of hydro power plants based on availability of head;

1. High head power plant(head>100m)
2. Medium head power plant(30m-100m)
3. Low head power plants(head<30m)

35.List the advantages of pumped storage power plants:

1. Increases the peak load capacity at low cost
2. High operating efficiency
3. Better load factor
4. Independence of steam flow conditions

36.List the advantages of impulse turbine:

1. Greater tolerance of sand and other particles in the water
2. Better access to working parts
3. No pressure seals around the shaft
4. Easier to fabricate and maintain
5. Better part-flow

efficiency

37. List any four pumped storage hydro power plants in India:

1. Bihar, Maharashtra, 150 MW
2. Kadamparai, Coimbatore, Tamilnadu, 400MW
3. Nagarjuna Sagar PH, Andhra Pradesh, 810MW
4. Purulia pumped storage project, Avodhva hills, West Bengal, 900MW
5. Srisaillam Left Bank PH, Andhra Pradesh, 900 MW
6. Tehri Dam, Uttaranchal, 1000 MW

38. What are the essential elements of hydro power plant?

1. Catchment area
2. Reservoir
3. Dam
4. Surge tanks
5. Draft tubes
6. Power house
7. Switched for transmission of power

39. What is meant by catchment area and explain its function:

The whole area behind the dam is called the catchment area. The rain water in the area will be drained into the dam through a dam or river.

40. Explain Reservoir:

A reservoir may be natural, like a lake on a mountain or artificially built by erecting a dam across a river.

41. Define surge tank:

A Surge tank is a small reservoir in which the water level rises and swings during opening and closing of inlet valve.

42. What is power house?

A power house is a stable structure which houses the equipment in the power plant

43. What is meant by pumped storage power plant?

The pumped storage plants are used for load balancing. During peak load water is used to work on turbines to produce electricity. Water after working in turbines is stored in the tail race reservoir.

45. What are mini Hydro plants?

The mini power plants operate with 5m-20m head and produce about 1 MW

to 5 MW of power.

46. What is micro hydro plants?

The micro power plants require a head less than 5m and produce 0.1 MW to 1 MW.

47. Define turbines:

A turbine converts energy in the form of falling water into rotating shaft power.

The selection of best turbine for any particular site depends on the site characteristics.

48. What are the disadvantages of impulse turbine?

They are unsuitable for low-head sites because of their low specific speeds.

49. What is pelton turbine?

A pelton turbine consists of a set of specially spread buckets mounted on a periphery of a circular disc. It is turned by jets of water which are discharged from one or more nozzles.

50. What is meant by reaction turbines?

Francis turbine and propeller turbines are the reaction turbines. The reaction turbines rotate faster than impulse turbine.

51. What is meant by propeller turbine?

The basic propeller turbine consists of a propeller. Inside it consist of a continuation of the penstock tube.

52. What is meant by Kaplan turbine?

The pitch of the propeller blades together with wicket gate adjustment, enables reasonable efficiency to be maintained under part flow conditions. Such turbines are called as Kaplan turbines.

53. Define twin runners:

Two runners can be placed on the same shaft either side by side or on opposite sides of the generator. This configuration is unusual and would only be used if the number of jets per runner had maximized.

54. State the advantages of impulse turbine over reaction turbine:

Impulse turbine are usually cheaper than reaction turbine because there is no need for a specialist pressure casing.

55. Explain impulse turbine in terms of heads?

High head- pelton Turgo

Medium head- Multi jet pelton turgo

Low head- cross flow

56.Explain reaction turbine in terms of head:

High head- Francis

Medium head- Propeller

Low head- Kaplan

UNIT 5: ENERGY ECONOMIC AND ENVIRONMENTAL ISSUES OF POWERPLANTS

1. Define demand factor?

Demand factor is defined as the ratio of maximum demand to connected load. Connected load is the sum of ratings in kW of equipment installed in the consumer's premises. Maximum demand is the maximum load, which a consumer uses at any time.

2. Define load curve?

Load curve is a graphical representation between load in kW and time in hours. It shows variation of load at the power station. The area under the load curve represents the energy generated in a particular period.

3. Define load factor?

Load factor is defined as the ratio of average load to the peak load (or) maximum demand.

4. What includes fixed cost?

Fixed cost includes the following cost.

1. Cost of land
2. Cost of building
3. Cost of equipment
4. Cost of installation
5. Interest,
6. Depreciation cost
7. Insurance,
8. Management cost

5. What includes operating cost?

Operating cost includes the following cost.

1. Cost of fuel
2. Cost of operating labour
3. Cost of maintenance labours and materials

4. Cost of supplier like

Water for feeding boilers, for condenser and for general use.

Lubrication oil and, grease. Water treatment chemicals.

6. What is the need of depreciation cost?

Depreciation cost is the amount to be set aside per year from the income of the plant to meet the depreciation caused by the age of service, wear and tear of the machinery and equipments. Depreciation amount collected every year helps in replacing and repairing the equipment.

7. Site selection criteria for hydroelectric power plant?

1. Availability of water
2. Water storage
2. Water head
3. Accessibility of site
4. Distance from the load centre
5. Type of the land of the site

8. Site selection criteria for thermal power plant?

1. Transportation network
2. Geology and soil type
3. Topography
4. Water resources
5. Population centre
6. Area size

9. Site selection criteria for nuclear power plant?

1. Availability of water
2. Disposal of Waste
3. Away from populated area
4. Nearest to the load centre
5. Other Factors – Accessibility to the road and rail are general considerations.

10. Write the types of pollution control methods adopted in thermal power plants?

1. Air pollution control
 - (a) Electrostatic precipitators
 - (b) Low NOX burners
 - (c) Flue gas stack
 - (d) Dry ash extraction
2. Water pollution control
 - (a) Coal/oil setting pits
 - (b) Ash dykes & disposal systems
 - (c) Ash water recycling system
 - (d) Effluent treatment plant
3. Thermal pollution control
4. Noise pollution control

11. What are the pollutants come out of the coal fired power plant?

Coal combustion releases nitrogen oxides, sulfur dioxide, particulate matter (PM), mercury, and dozens of other substances known to be hazardous to human health

12. Write advantages and disadvantages of nuclear power plant?

Advantages

- Economic

- Environmental
- Portability & Productivity

Disadvantages

- Waste storage
- Accidents
- National Security
- Ease of peaceful usage to weapons program

13. What is the purpose of electrostatic precipitator?

An electrostatic precipitator (ESP) is a filtration device that removes fine particles, like dust and smoke, from a flowing gas using the force of an induced electrostatic charge minimally impeding the flow of gases through the unit.

14. Write nuclear waste disposal methods.

(a) Utilizing underground facility (b) Injecting into deep aquifers (c) Deep bore holes (d) Rock melting

15. Flyash Disposal in Ash Ponds

Primarily, the flyash is disposed off using either dry or wet disposal scheme. In dry disposal, the flyash is transported by truck, chute or conveyor at the site and disposed off by constructing a dry embankment (dyke). In wet disposal, the flyash is transported as slurry through pipe and disposed off in impoundment called "ash pond". Most of the power plants in India use wet disposal system

16. What are the pollutants from nuclear power plants?

Nuclear power plants do not emit carbon dioxide, sulfur dioxide, or nitrogen oxides as part of the power generation process. However, fossil fuel emissions are associated with the uranium mining and uranium enrichment process as well as the transport of the uranium fuel to and from the nuclear plant.

17. What do you mean by spent fuel? How it is disposed?

Every 18 to 24 months, nuclear power plants must shut down to remove and replace the "spent" uranium fuel. This spent fuel has released most of its energy as a result of the fission process and has become radioactive waste.

Currently, the spent fuel is stored at the nuclear plants at which it is generated, either in steel-lined,

concrete vaults filled with water or in above-ground steel or steel-reinforced concrete containers with steel inner canisters.

18. What are the effects on aquatic life and water by nuclear wastes?

- Heavy metals and salts build up in the water used in all power plant systems, including nuclear ones. These water pollutants, as well as the higher temperature of the water discharged from the power plant, can negatively affect water quality and aquatic life. Nuclear power plants sometimes discharge small amounts of tritium and other radioactive elements as allowed by their individual wastewater permits.
- Waste generated from uranium mining operations and rainwater runoff can contaminate groundwater and surface water resources with heavy metals and traces of radioactive uranium.

19. Radioactive Waste Generation and disposal methods?

- Enrichment of uranium ore into fuel and the operation of nuclear power plants generate wastes that contain low-levels of radioactivity. These wastes are shipped to a few specially designed and licensed disposal sites.
- When a nuclear power plant is closed, some equipment and structural materials become radioactive wastes. This type of radioactive waste is currently being stored at the closed plants until an appropriate disposal site is opened.
- Management, packaging, transport, and disposal of waste are strictly regulated and carefully controlled by the U.S. Nuclear Regulatory Commission and the U.S. Department of Transportation.

20. Write the nuclear waste streams that may harm the environment?

1. Spent nuclear fuel at the reactor site (including fission products and plutonium waste)
2. Tailings and waste rock at uranium during reactor operation
3. Releases of large quantities of dangerous radioactive materials during accidents