13

Pollution and its Control

13.1. INTRODUCTION

All power production plants, invariably, pollute the atmosphere and the resulting imbalance on Ecology has a bad effect. The pollution is inevitable in some cases and has to be minimised to the extent possible. This is being achieved by effective legislations all over the world.

The power plant pollutants of major concern are :

A. **From fossil power plants**

(*i*) Sulphur oxide (*ii*) Nitrogen oxides

(*iii*) Carbon oxide (*iv*) Thermal pollution

(*v*) Particulate matter.

B. **From nuclear power plants**

(*i*) Radioactivity release (*ii*) Radioactive wastes

(*iii*) Thermal pollution.

Besides this, pollutants such as lead and hydrocarbons are contributed by automobiles.

In this chapter, we shall look at the type of pollutions various power plants cause and the method of minimising these bad effects.

13.2. POLLUTION FROM THERMAL POWER PLANTS

The environment is polluted to a great extent by thermal power plants. The emission from the chimney throws unwanted gases and particles into the atmosphere while the heat is thrown into the atmosphere and rivers. Both these aspects pollute the environment beyond tolerable limits and now are being controlled by appropriate regulations. The types of emissions, effects and methods of minimising these pollutions are discussed below.

The *air pollution* in a large measure is caused by the thermal power plants burning conventional fuels (coal, oil or gas). The combustible elements of the fuel are converted to gaseous products and non-combustible elements to ash. Thus the emission can be classified as follow :

1. Gaseous emission
2. Particulate emission
3. Solid waste emission
4. Thermal pollution (or waste heat).

13.2.1. Gaseous Emission and its Control

The various gaseous pollutants are :

(*i*) Sulphur dioxide (*ii*) Hydrogen sulphide

(*iii*) Oxides of nitrogen (*iv*) Carbon monoxide etc.

The effects of pollutants on environment are as follows :

S. No.	Pollutant	Effects		
		On man	**On vegitation**	**On materials/animals**
1.	SO_2	Suffocation, irritation of throat and eyes, respiration system	Destruction of sensitive crops and reduced yield	Corrosion
2.	NO_2	Irritation, bronchitis, oedema of lungs	—	—
3.	H_2S	Bare disease, respiratory diseases	Destruction of crops	Flourosis in cattle grazing
4.	CO	Poisoning, increased accident-liability	—	—

Removal of sulphur dioxide (SO_2)

SO_2 is removed by wet scrubbers as shown in Fig. 13.1.

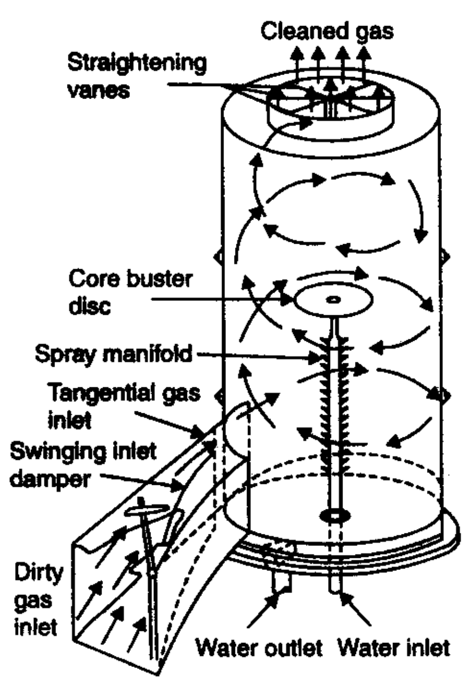

Fig. 13.1. Wet scrubber.

— The gases to be cleaned are admitted tangentially into the *scrubber* which will also help in separating the particulate matters. Water spray absorbs these gases and particulate matters which collect on the surface of the scrubber are washed down by the water and this water is further treated, filtered and reused.

— The wet scrubbers also find application in chemical and grain milling industries.

— The *collection efficiency of scrubber is about 90 per cent.*

The following are *disadvantages* of using wet scrubbers :

1. The gases are cooled to such an extent that they must be reheated before being sent to the stack.

2. The pressure drops are very high.

3. Water used, after dissolving sulphur oxides will contain sulphuric and sulphurous acids which may corrode the pipelines and the scrubber itself. This water cannot be let out into the rivers for obvious reasons.

In power plants where high sulphur content coal is the only source available, it is preferable to remove the sulphur from the coal before it is burnt. This is done by coal washing which reduces the fly-ash as well as some sulphur oxides in the flue gases. But the power plants employ "**Flue-gas desulphurization**" (FGD) system similar to wet scrubber system. FGD can be of the following types :

1. *The recovery or regenerative system*

2. *Throw away or non-regenerative system.* In this system the reactants are not recovered and the final products are *sulphur salts of calcium and magnesium.*

Regenerative System

Some of the regenerative systems are :

1. FW-Bergbau process
2. Wellman-Lord process
3. Wet magnesium oxide process.

— In the Fig. 13.2 is shown the *FW-Bergbau process.* In this process, SO_2 is removed by adsorption and sulphur is collected as molten sulphur.

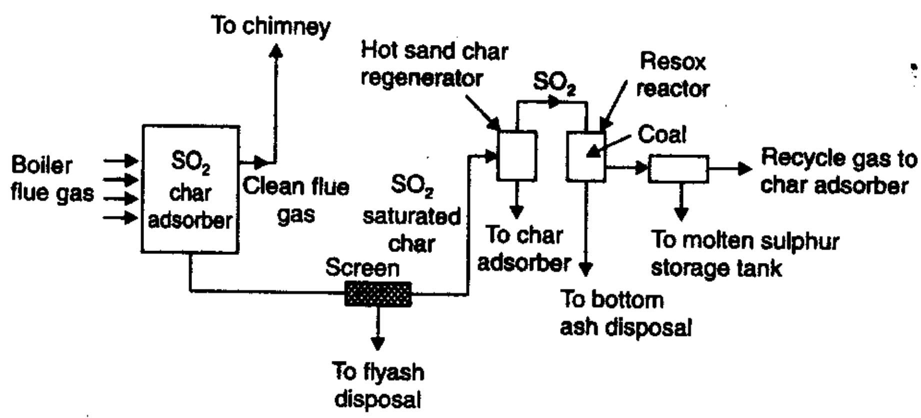

Fig. 13.2. F.W. Bergbau Forshung adsorption FGD regenerative system.

— Fig. 13.3 shows the Wellman-Lord FGD system. This system removes SO_2 by absorption in sodium carbonate and SO_2 is recovered as sulphur or sulphuric acid products.

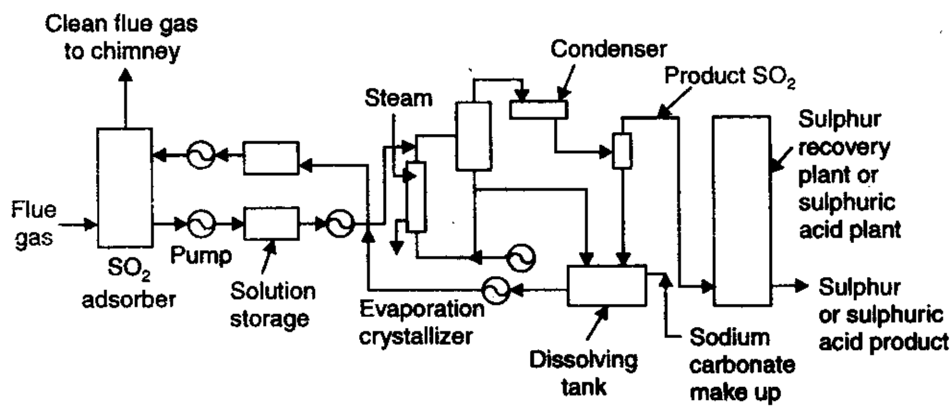

Fig. 13.3. Wellman-Load absorption FGD regenerative system.

In non-regenerative systems the principal reactant is either lime or limestone. The slurry is made into sludge by adding fly-ash and other properietory sludge additives and the sludge is disposed. This method could prove a bit more expensive since no sulphur or sulphur product is recovered and the reactant is not generated as in the case of FW Bergbau process.

Emission of NO_x

Nitrogen oxides are compounds of the elements nitrogen and oxygen, both of which are present in air. The combustion of *fossil fuels* in air is accompanied by the formation of nitric oxide (NO) which is subsequently partly oxidised to nitrogen dioxide (NO_2). The resulting mixture of variable combustion is represented by the symbol NO_x, where x has a value between 1 and 2. Nitrogen oxides are present in stack gases from coal, oil and gas furnaces (and also in the exhaust gases from internal combustion engines and gas turbines).

The following methods are commonly used to reduce the emission of NO_x from thermal (and gas turbine) power plants :

1. Reduction of temperature in combustion zone.
2. Reduction of residence period in combustion zone.
3. Increase in equivalence ratio in the combustion zone.

13.2.2. Particulate Emission and its Control

The particulate emission, in power plants using fossil fuels, is easiest to control. Particulate matter can be either *dust* (particles having a diameter of 1 micron) which do not settle down or *particles* with a diameter of more than 10 microns which settle down to the ground. The particulate emission can be classified as follows :

Smoke. It composes of stable suspension of particles that have a diameter of *less than 10 microns* and are visible only in the aggregate.

Fumes. These are very small particles resulting from chemical reactions and are normally composed of metals and metallic oxides.

Fly-ash. These are ash particles of diameters of *100 microns or less.*

Cinders. These are ash particles of diameters of *100 microns or more.*

The above particulates, in any system of controlling the particulate emission, are to be effectively collected from the flue gases. The performance parameters for any particulate remover is called the *collection efficiency* defined as :

$$\textit{Collector efficiency} = \frac{\text{Mass of dust removed}}{\text{Mass of dust present}} \times 100$$

For different systems the collector efficiency varies from 50 to 99% ; for an *electrostatic precipitator it is move than 90%.*

Some collector systems, their efficiencies and their adaptability, are discussed in the following paragraphs.

13.2.2.1. Cinder catchers

The cinder catchers are shown in Fig. 13.4 to 13.7.

— *Refer Fig. 13.4.* Sudden decreases in gas velocity makes the particulates separate and fall.

— *Refer Fig. 13.5.* A sudden change in the direction of flow of flue gas throws the particulates away and can be collected.

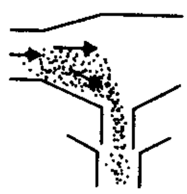

Fig. 13.4. Sudden decrease in gas velocity.

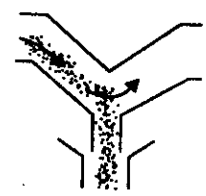

Fig. 13.5. Sudden change in the direction of the flow of flue gas.

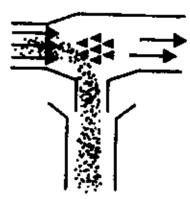

Fig. 13.6. Impingement of flues gases on a series of baffle stops.

Fig. 13.7. Cinder-vane fan.

— *Refer Fig. 13.6.* Impingement of flue gases on a series of baffle stops the particulate matter as shown. These are commonly used in stoker and small cyclone furnaces where crushed coal is burned rather than the very fine pulverised coal. The collection efficiencies of cinder catchers are from 50 to 75%.

— *Refer Fig. 13.7.* **Cinder-vane fan.** The cinder vane fan uses the fan which imparts centrifugal force to the particulates and they are collected as shown. The efficiency is from 50 to 75%.

13.2.2.2. Wet scrubbers

— Wet scrubbers as described for removal of gases can also be used for removal of particulate matters ; but the gases will have to be reheated before they are sent to the stack.

— The wet scrubbers are *not commonly used to remove particulate matters.*

13.2.2.3. Electrostatic precipitator

— An electrostatic precipitator is shown in Fig. 13.8. In this device a very high voltage of 30 kV to 60 kV is applied to the wires suspended in a gas-flow passage between two grounded plates.

The particles in the gas stream acquire a charge from the negatively charged wires and arc then attracted to the ground plates. The grounded plates are periodically rapped by a steel plug which is raised and dropped by an electromagnet and dust is collected in the hoppers below.

— In this type of collector, *care* must be taken to see that *large quantity of unburnt gases do not enter the precipitator*. If such a mixture enters, power should be turned off, otherwise there could be *explosion because of constant sparking between wires and plates.*

— The collection efficiency is about 99 per cent.

— Electrostatic precipitators are suitable for power plants where *fly-ash content is high.* Fly-ash having high electrical resistivity *does not* separate in the electrostatic precipitator. This problem can be solved by injecting *sulphur trioxide* into the exhaust gas which *improves the conductivity of fly-ash*. This again poses a problem of discharging objectionable sulphur trioxide into the atmosphere ; this needs a wet scrubber after the electrostatic precipitator.

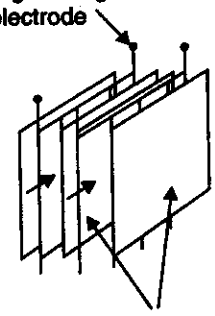

Fig. 13.8. Electrostatic precipitator.

13.2.2.4. Baghouse filters

Fig. 13.9 shows a baghouse filter. Baghouse filters are found useful in removing the particulate matters where *low sulphur coal is used.*

— The cloth filters cost about 20 per cent of installation cost and last for $1\frac{1}{2}$ to 3 years.

— The baghouse filter is usually cleaned by forcing air in the reversed direction. They need large filter areas of about 6.5 m^2/MW of power generation. Hence the installation cost could be high.

— Although baghouse filters are expensive, yet they are being widely used in *coal-fired systems.*

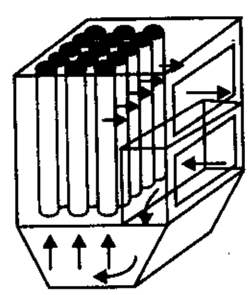
Fig. 13.9. Baghouse filter.

13.2.3. Solid Waste Disposal

From the fossil fuel fired power plants considerable amount of solids in the form of ash is discharged. This ash is removed as bottom ash or slug from the furnace. The fossil fuel fired system also discharges solid wastes such as calcium and magnesium salts generated by absorption of SO_2 and SO_3 by reactant like lime stone.

13.2.4. Thermal Pollution

Discharge of thermal energy into waters is commonly called *'Thermal pollution'*.

Thermal power stations invariably will have to discharge enormous amounts of energy into water since water is one medium largely used to condense steam. If this heated water from condensers is discharged into lakes or rivers, the water temperature goes up. The ability of water to hold dissolved gases goes down when the temperature increases. *At about 35°C, the dissolved oxygen will be so low that the acquatic life will die.* But in very cold regions, letting out hot water into the lakes or rivers helps in increasing the fish growth. But, in our country, such places are not many and hence, it is necessary that we minimise this thermal pollution of water. One of the regulation stipulates that a maximum temperature of water let out can be 1°C above the atmospheric temperature. Thus the thermal power plants or any other industry has to resort to various methods of adhering to this regulation.

13.2.4.1. Thermal discharge index (TDI)

Thermal discharge index (TDI) is the term usually used in connection with the estimation of the *amount of thermal energy released to environment from a thermal power plant*. TDI of any power plant is the *number of thermal energy units discharged to the environment for every unit of electrical energy generated.*

$$\text{TDI} = \frac{\text{Thermal power discharged to environment in } MW_{\text{thermal}}}{\text{Electrical power output in } MW_{\text{electrical}}}$$

This index cannot be zero or else the plant violates the Second law of thermodynamics ; but this index *should be as low as possible to improve the efficiency of the plant as well as to keep the pollution level low.*

The thermal discharge index (TDI) is *strongly dependent on the thermal efficiency of the plant.*

13.2.4.2. How to reduce thermal pollution ?

While considering the efficiency of the thermal plant, it is desirable that the water from a river or lake is pumped through the condenser and fed back to the source. The rise of temperature will be about 10°C which is highly objectionable from the pollution point of view. Hence, this waste heat which is removed from the condenser will have to be thrown into the atmosphere and not into the water source, in this direction following methods can be adopted :

1. Construction of a separate lake.
2. Cooling pond
3. Cooling towers.

1. Construction of a separate lake. A sufficiently large water storage in the form of a lake can be built and once-through cooling the condenser can be adopted. If the natural cooling of water from the lake is not sufficient, floating spray pumps can be employed.

This method *improves the thermal efficiency* of the plant but can prove *expensive*. Also, it may not always be possible to have a large enough lake artificially built.

2. Cooling pond. A cooling pond with continuously operating fountains can be adopted for smaller power plants. This will also serve as a beautifying feature of the power plant site.

3. Cooling towers. In order to throw heat into the atmosphere most power stations adopt the cooling towers. The hyperbolic shape given to the tower automatically induces air from the bottom to flow upwards and the water is cooled by coming in direct contact with the air. This is a natural convection cooling and is also called '*wet-cooling tower*'. The overall efficiency of such plants will be lower than those of the plants adopting once-through cooling system. There will be considerable vapour flumes escaping from the cooling towers. Sometime, make-up cooling water may be scarce. In such cases, *dry cooling tower* can be adopted. Dry cooling towers are much more expensive than wet cooling towers.

All cooling towers, whether dry or wet, are *expensive and add to the initial investment of the plant*. Small plants can adopt mechanical-draft systems using induced or forced draft systems. This helps in avoiding height to the cooling towers. Thus, the initial cost is reduced but the maintenance cost of mechanical-draft systems are high.

13.3. POLLUTION FROM NUCLEAR POWER PLANTS

The various types of pollution from nuclear power plants are :

(*i*) Radioactive pollution
(*ii*) Waste from reactor (solid, liquid, gases)
(*iii*) Thermal pollution.

(*i*) **Radioactive pollution.** This is the most dangerous and serious type of pollution. This is due to radioactive elements and fissionable products in reactor. The best way to abate is the *radio-active shield around the reactor.*

(*ii*) **Waste from reactor.** Due to nuclear reactor reaction nuclear wastes (mixtures of various Beta and Gamma emitting radioactive isotopes with various half lives) are produced which cannot be neutralised by any chemical method. If the waste is discharged in the atmosphere, air and water will be contaminated beyond the tolerable limits. Some methods of storage or disposal of radioactive waste materials are discussed below :

1. **Storage tanks.** The radioactive wastes can be buried underground (very deep below the surface) in corrosion resistance tanks located in isolated areas. With the passage of time these will become stable isotopes.

2. **Dilution.** After storing for a short time, low energy wastes are diluted either in liquid or gaseous materials. After dilution, they are disposed off in sewer without causing hazard.

3. **Sea disposal.** This dilution can be used by adequately diluting the wastes and this method is being used by the British.

4. **Atmospheric dilution.** This method can be used for gaseous radioactive wastes. But solid particles from the gaseous wastes must be filtered out thoroughly since they are the most dangerous with higher half lives.

5. **Absorption by the soil.** Fission products are disposed off by this method. The radioactive particles are absorbed by the soil particles. But this is *expensive.*

6. **Burying is sea.** Solid nuclear wastes can be stored is concrete blocks which are burried in the sea. This method is *expensive but no further care is needed.*

13.4. POLLUTION FROM HYDROELECTRIC POWER PLANTS AND SOLAR POWER GENERATING STATIONS

Hydro-electric and Solar Power Generation plants have no polluting effect on the environment. The hydro-electric project does not pollute the atmosphere at all, but it can be argued that the solar power stations in the long run may upset the balance in nature. To extend the argument to the logical end, imagine a very vast area of land is covered by solar collectors of different forms. Then the minimum required sun's rays may not reach the earth's surface. This will certainly kill the vegetation on the earth and also the bacteria which are destroyed by sun's rays may survive giving rise to new types of health problems. Further, the evaporation of water and consequent rains may change their cycles. Added to these, the average temperatures of the earth and ocean may change. This may result in new balances among the living creatures which cannot be easily predicted. Since we do not envisage such a large scale coverage of earth's surface in the near future, we can safely state that the solar energy power plants do not pollute the atmosphere.

HIGHLIGHTS

1. The power plant pollutants of major concern are :
   (*a*) From fossil power plants :
   (*i*) Sulphur oxide
   (*ii*) Nitrogen oxide
   (*iii*) Carbon oxide
   (*iv*) Thermal pollution
   (*v*) Particulate matter.
   (*b*) From nuclear power plants :
   (*i*) Radioactivity release
   (*ii*) Radioactive wastes
   (*iii*) Thermal pollution.
2. The emission may be classified as follows :
   (*i*) Gaseous emission
   (*ii*) Particulate emission
   (*iii*) Solid waste emission
   (*iv*) Thermal pollution (or waste heat).

3. Thermal discharge index (TDI) of any power plant is the number of thermal energy units discharged to the environment for every unit of electrical energy generated.
4. Thermal pollution can be reduced by :
   (*i*) Constructing a separate lake (*ii*) Cooling pond
   (*iii*) Cooling towers.
5. Some methods of storage or disposal of radioactive waste materials are :
   (*i*) Storage tanks (*ii*) Dilution
   (*iii*) Burial (*iv*) Sea disposal
   (*v*) Atmospheric dilution (*vi*) Absorption by soil
   (*vii*) Burying in sea (*viii*) Projecting into space.

THEORETICAL QUESTIONS

1. Name some power plant pollutants of major concern.
2. How are emissions from thermal power plants classified ?
3. Name important gaseous pollutants discharged by thermal power plants. How are they controlled ?
4. Describe briefly, with the help of a neat diagram, 'wet-scrubber' used for removing SO_2.
5. What is 'Particulate emission' ? How is it controlled ?
6. Define the following :
   Smoke, Fumes, Fly-ash, Cinders.
7. What is an electrostatic precipitator ?
8. Where are 'Baghouse filters' used ?
9. What do you mean by 'Thermal Pollution' ?
10. What is 'Thermal Discharge Index' (TDI) ?
11. Enumerate and explain briefly various methods of reducing the thermal pollution.
12. Write a short note on 'Pollution from Nuclear power plants'.
13. What are the various methods of storage or disposal of radioactive waste materials ?

OBJECTIVE TYPE QUESTIONS BANK

OBJECTIVE TYPE QUESTIONS BANK

A. Choose the Correct Answers :

1. The commercial sources of energy are
   (*a*) solar, wind, biomass
   (*b*) fossil fuels, hydropower and nuclear energy
   (*c*) wood, animal wastes and agriculture wastes
   (*d*) none of the above.
2. Non-commercial sources of energy are
   (*a*) wood, animal wastes and agricultural wastes
   (*b*) solar, wind, biomass
   (*c*) fossil fuels, hydropower and nuclear power
   (*d*) none of the above.
3. The primary sources of the energy are
   (*a*) coal, oil and uranium (*b*) hydrogen, oxygen and water
   (*c*) wind, biomass and geothermal (*d*) none of the above.
4. The secondary sources of energy are
   (*a*) solar, wind and water (*b*) coal, oil and uranium
   (*c*) none of the above.
5. In India largest thermal power station is located at
   (*a*) Kota (*b*) Sarni
   (*c*) Chandrapur (*d*) Neyveli.
6. The percentage O_2 by weight in atmospheric air is
   (*a*) 18% (*b*) 23%
   (*c*) 77% (*d*) 79%.
7. The percentage O_2 by volume in atmospheric air is
   (*a*) 21% (*b*) 23%
   (*c*) 77% (*d*) 79%.
8. The proper indication of incomplete combustion is
   (*a*) high CO content in flue gases at exit (*b*) high CO_2 content in flue gases at exit
   (*c*) high temperature of flue gases (*d*) the smoking exhaust from chimney.
9. The main source of production of biogas is
   (*a*) human waste (*b*) wet cow dung
   (*c*) wet livestock waste (*d*) all above.
10. India first nuclear power plant was installed at
    (*a*) Tarapore (*b*) Kota
    (*c*) Kalpakkam.
11. In fuel cell, the ...... energy is converted into electrical energy
    (*a*) Mechanical (*b*) Chemical
    (*c*) Heat (*d*) Sound.

12. Solar thermal power generation can be achieved by
(a) using focusing collector or heliostates (b) using flat plate collectors
(c) using a solar pond (d) any of the above system.

13. The energy radiated by sun on a bright sunny day is approximately
(a) 700 W/m^2 (b) 800 W/m^2
(c) 1 kW/m^2 (d) 2 kW/m^2.

14. Thorium Breeder Reactors are most suitable for India because
(a) these develop more power
(b) its technology is simple
(c) abundance of thorium deposits are available in India
(d) they can be easily designed.

BASIC STEAM POWER CYCLES

15. Rankine cycle is a
(a) reversible cycle (b) irreversible cycle
(c) constant volume cycle (d) none of the above.

16. The overall efficiency of thermal power plant is equal to
(a) Rankine cycle efficiency
(b) Carnot cycle efficiency
(c) Regenerative cycle efficiency
(d) Boiler efficiency × turbine efficiency × generator efficiency.

17. Rankine cycle efficiency of a good steam power plant may be in the range of
(a) 15 to 20% (b) 35 to 45%
(c) 70 to 80% (d) 90 to 95%.

18. Rankine cycle operating on low pressure limit of p_1 and high pressure limit of p_2
(a) has higher thermal efficiency than the Carnot cycle operating between same pressure limits
(b) has lower thermal efficiency than Carnot cycle operating between same pressure limits
(c) has same thermal efficiency as Carnot cycle operating between same pressure limits
(d) may be more or less depending upon the magnitude of p_1 and p_2.

19. Rankine efficiency of a steam power plant
(a) improves in summer as compared to that in winter
(b) improves in winter as compared to that in summer
(c) is unaffected by climatic conditions
(d) none of the above.

20. Carnot cycle comprises of
(a) two isentropic processes and two constant volume processes
(b) two isentropic processes and two constant pressure processes
(c) two isothermal processes and two constant pressure processes
(d) none of the above.

21. In Rankine cycle the work output from the turbine is given by
(a) change of internal energy between inlet and outlet
(b) change of enthalpy between inlet and outlet
(c) change of entropy between inlet and outlet
(d) change of temperature between inlet and outlet.

22. Regenerative heating *i.e.* bleeding steam to reheat feed water to boiler
    (*a*) decreases thermal efficiency of the cycle
    (*b*) increases thermal efficiency of the cycle
    (*c*) does not affect thermal efficiency of the cycle
    (*d*) may increase or decrease thermal efficiency of the cycle depending upon the point of extraction of steam.
23. Regenerative cycle thermal efficiency
    (*a*) is always greater than simple Rankine thermal efficiency
    (*b*) is greater than simple Rankine cycle thermal efficiency only when steam is bled at particular pressure
    (*c*) is same as simple Rankine cycle thermal efficiency
    (*d*) is always less than simple Rankine cycle thermal efficiency.
24. In a regenerative feed heating cycle, the optimum value of the fraction of steam extracted for feed heating
    (*a*) decreases with increase in Rankine cycle efficiency
    (*b*) increases with increase in Rankine cycle efficiency
    (*c*) is unaffected by increase in Rankine cycle efficiency
    (*d*) none of the above.
25. In a regenerative feed heating cycle, the greatest economy is affected
    (*a*) when steam is extracted from only one suitable point of steam turbine
    (*b*) when steam is extracted from several places in different stages of steam turbine
    (*c*) when steam is extracted only from the last stage of steam turbine
    (*d*) when steam is extracted only from the first stage of steam turbine.
26. The maximum percentage gain in regenerative feed heating cycle thermal efficiency
    (*a*) increases with number of feed heaters increasing
    (*b*) decreases with number of feed heaters increasing
    (*c*) remains same unaffected by number of feed heaters
    (*d*) none of the above.
27. In regenerative cycle feed water is heated by
    (*a*) exhaust gases (*b*) heaters
    (*c*) draining steam from the turbine (*d*) all above.
28. Reheat cycle in steam power plant is used to
    (*a*) utilise heat of flue gases (*b*) increase thermal efficiency
    (*c*) improve condenser performance (*d*) reduce loss of heat.
29. Mercury is a choice with steam in binary vapour cycle because it has
    (*a*) higher critical temperature and pressure
    (*b*) higher saturation temperature than other fluids
    (*c*) relatively low vaporisation pressure
    (*d*) all above.
30. Binary vapour cycles are used to
    (*a*) increase the performance of the condenser (*b*) increase the efficiency of the plant
    (*c*) increase efficiency of the turbine.

STEAM POWER PLANT

31. A steam power station requires space
    (*a*) equal to diesel power station
    (*b*) more than diesel power station
    (*c*) less than diesel power station.
32. Economiser is used to heat
    (*a*) air
    (*b*) feed water
    (*c*) flue gases
    (*d*) all above.
33. The modern steam turbines are
    (*a*) impulse turbines
    (*b*) reaction turbines
    (*c*) impulse-reaction turbines
    (*d*) none of the above.
34. The draught which a chimney produces is called
    (*a*) induced draught
    (*b*) natural draught
    (*c*) forced draught
    (*d*) balanced draught.
35. The draught produced by steel chimney as compared to that produced by brick chimney for the same height is
    (*a*) less
    (*b*) more
    (*c*) same
    (*d*) may be more or less.
36. In a boiler installation the natural draught is produced
    (*a*) due to the fact that furnace gases being light go through the chimney giving place to cold air from outside to rush in
    (*b*) due to the fact that pressure at the grate due to cold column is higher than the pressure at chimney base due to hot column
    (*c*) due to the fact that at the chimney top the pressure is more than its environmental pressure
    (*d*) all of the above.
37. The draught produced, for a given height of the chimney and given mean temperature of chimney gases
    (*a*) decreases with increase in outside air temperature
    (*b*) increases with increase in outside air temperature
    (*c*) remains the same irrespective of outside air temperature
    (*d*) may increase or decrease with increase in outside air temperature.
38. The draught produced by chimney of given height at given outside temperature
    (*a*) decreases if the chimney gas temperature increases
    (*b*) increases if the chimney gas temperature increases
    (*c*) remains same irrespective of chimney gas temperature
    (*d*) may increase or decrease.
39. For forced draught systems, the function of chimney is mainly
    (*a*) to produce draught to accelerate the combustion of fuel
    (*b*) to discharge gases high up in the atmosphere to avoid hazard
    (*c*) to reduce the temperature of the hot gases discharged
    (*d*) none of the above.
40. Artificial draught is produced by
    (*a*) induced fan
    (*b*) forced fan
    (*c*) induced and forced fan
    (*d*) all of the above.

41. The draught in locomotive boilers is produced by
(a) forced fan
(b) chimney
(c) steam jet
(d) only motion of locomotive.

42. For the same draught produced the power of induced draught fan as compared to forced draught fan is
(a) less
(b) more
(c) same
(d) not predictable.

43. Artificial draught is produced by
(a) air fans
(b) steam jet
(c) fan or steam jet
(d) all of the above.

44. The artificial draught normally is designed to produce
(a) less smoke
(b) more draught
(c) less chimney gas temperature
(d) all of the above.

45. For the induced draught the fan is located
(a) near bottom of chimney
(b) near bottom of furnace
(c) at the top of the chimney
(d) anywhere permissible.

46. The pressure at the furnace is minimum in case of
(a) forced draught system
(b) induced draught system
(c) balanced draught system
(d) natural draught system.

47. For maximum discharge of hot gases through the chimney, the height of hot-gas column producing draught is
(a) twice the height of chimney
(b) equal to the height of chimney
(c) half the height of chimney
(d) none of the above.

48. The efficiency of chimney is approximately
(a) 80%
(b) 40%
(c) 20%
(d) 0.25%.

49. In balanced draught system the pressure at force fan inlet
(a) is greater than pressure at chimney outlet
(b) is less than pressure at chimney outlet
(c) approximately same as that at chimney outlet.

50. For a steam nozzle, if p_1 = inlet pressure, p_2 = exit pressure and n is the index of isentropic expansion, the mass flow rate per unit area is maximum if
(a) $\frac{p_2}{p_1} \le \left(\frac{2}{n+1}\right)^{\frac{n-1}{n}}$
(b) $\frac{p_2}{p_1} \le \left(\frac{1}{n+1}\right)^{\frac{n}{n+1}}$
(c) $\frac{p_2}{p_1} \le \left(\frac{2}{n+1}\right)^{\frac{n}{n+1}}$
(d) $\frac{p_2}{p_1} \le \left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$.

51. The isentropic expansion of steam through nozzle for the steam initially superheated at inlet is approximated by equation
(a) $pv^{1.3} = C$
(b) $pv^{1.125} = C$
(c) $pv^{1.4} = C$
(d) $pv = C$.

52. The ratio of exit pressure to inlet pressure for maximum mass flow rate per unit area of steam through a nozzle when steam is initially dry saturated is
(a) 0.6
(b) 0.578
(c) 0.555
(d) 0.5457.

53. The ratio of exit pressure to inlet pressure for maximum mass flow rate per unit area of steam through nozzle when steam is initially superheated is

(*a*) 0.555 (*b*) 0.578

(*c*) 0.5457 (*d*) 0.6.

54. The critical pressure ratio of a convergent nozzle is defined as

(*a*) the ratio of outlet pressure to inlet pressure of nozzle

(*b*) the ratio of inlet pressure to outlet pressure of nozzle

(*c*) the ratio of outlet pressure to inlet pressure only when mass flow rate per unit area is minimum

(*d*) the ratio of outlet pressure to inlet pressure only when mass flow rate per unit is maximum.

55. The isentropic expansion of steam through nozzle for the steam initially dry saturated at inlet is approximated by equation

(*a*) $pv = C$ (*b*) $pv^{1.4} = C$

(*c*) $pv^{1.3} = C$ (*d*) $pv^{1.135} = C$.

56. The effect of considering friction losses in steam nozzle for the same pressure ratio leads to

(*a*) increase in exit velocity from the nozzle

(*b*) decrease in exit velocity from nozzle

(*c*) no change in exit velocity from nozzle

(*d*) increase or decrease depending upon the exit quality of steam.

57. The effect of considering friction in steam nozzles for the same pressure ratio leads to

(*a*) increase in dryness fraction of exit steam

(*b*) decrease in dryness fraction of exit steam

(*c*) no change in the quality of exit steam

(*d*) may decrease or increase of dryness fraction of exit steam depending upon inlet quality.

58. In case of impulse steam turbine

(*a*) there is enthalpy drop in fixed and moving blades

(*b*) there is enthalpy drop only in moving blades

(*c*) there is enthalpy drop in nozzles

(*d*) none of the above.

59. De Laval turbine is

(*a*) pressure compounded impulse turbine (*b*) velocity compounded impulse turbine

(*c*) simple single wheel impulse turbine (*d*) simple single wheel reaction turbine.

60. The pressure on the two sides of the impulse wheel of a steam turbine

(*a*) is same (*b*) is different

(*c*) increases from one side to the other side (*d*) decreases from one side to the other side.

61. In De Laval steam turbine

(*a*) the pressure in the turbine rotor is approximately same as in condenser

(*b*) the pressure in the turbine rotor is higher than pressure in the condenser

(*c*) the pressure in the turbine rotor gradually decreases from inlet to exit to condenser

(*d*) none of the above.

62. In case of reaction steam turbine

(*a*) there is enthalpy drop both in fixed and moving blades

(*b*) there is enthalpy drop only in fixed blades

(c) there is enthalpy drop only in moving blades
(d) none of the above.

63. Curtis turbine is
(a) reaction steam turbine
(b) pressure-velocity compounded steam turbine
(c) pressure compounded impulse steam turbine
(d) velocity compounded impulse steam turbine.

64. Rateau steam turbine is
(a) reaction steam turbine
(b) velocity compounded impulse steam turbine
(c) pressure compounded impulse steam turbine
(d) pressure-velocity compounded steam turbine.

65. Parson's turbine is
(a) pressure compounded steam turbine
(b) simple single wheel, impulse steam turbine
(c) simple single wheel reaction steam turbine
(d) multi-wheel reaction steam turbine.

66. Blade or diagram efficiency is given by
(a) $\frac{(C_{w_1} \pm C_{w_0})\, C_{bl}}{C_1}$ (b) $\frac{2C_{bl}\,(C_{w_1} \pm C_{w_0})}{C_1^2}$
(c) $\frac{C_{bl}^2}{C_1^2}$ (d) $\frac{C_1^2 - C_0^2}{C_1^2}$.

67. Axial thrust on rotor of steam turbine is
(a) $\dot{m}_s\,(C_{f_1} - C_{f_0})$ (b) $\dot{m}_s^2\,(C_{f_1} - 2C_{f_0})$
(c) $\dot{m}_s\,(C_{f_1} + C_{f_0})$ (d) $\dot{m}_s\,(2C_{f_1} - C_{f_0})$.

68. Stage efficiency of steam turbine is
(a) $\eta_{blade}/\eta_{nozzle}$ (b) $\eta_{nozzle}/\eta_{blade}$
(c) $\eta_{nozzle} \times \eta_{blade}$ (d) none of the above.

69. For maximum blade efficiency for single stage impulse turbine
(a) $\rho \left(= \frac{C_{bl}}{C_1}\right) = \cos^2 \alpha$ (b) $\rho = \cos \alpha$
(c) $\rho = \frac{\cos \alpha}{2}$ (d) $\rho = \frac{\cos^2 \alpha}{2}$.

70. Degree of reaction as referred to steam turbine is defined as
(a) $\frac{\Delta h_f}{\Delta h_m}$ (b) $\frac{\Delta h_m}{\Delta h_f}$
(c) $\frac{\Delta h_m}{\Delta h_m + \Delta h_f}$ (d) $\frac{\Delta h_f}{\Delta h_f + \Delta h_m}$.

71. For Parson's reaction steam turbine, degree of reaction is
(a) 75% (b) 100%
(c) 50% (d) 60%.

72. The maximum efficiency for Parson's reaction turbine is given by

(a) $\eta_{max} = \frac{\cos\alpha}{1+\cos\alpha}$ (b) $\eta_{max} = \frac{2\cos\alpha}{1+\cos\alpha}$

(c) $\eta_{max} = \frac{2\cos^2\alpha}{1+\cos^2\alpha}$ (d) $\eta_{max} = \frac{1+\cos^2\alpha}{2\cos^2\alpha}$.

73. Reheat factor in steam turbines depends on

(a) exit pressure only (b) stage efficiency only

(c) initial pressure and temperature only (d) all of the above.

74. For multistage steam turbine, reheat factor is defined as

(a) stage efficiency × nozzle efficiency (b) cumulative enthalpy drop × η_{nozzle}

(c) $\frac{\text{cumulative enthalpy drop}}{\text{isentropic enthalpy drop}}$ (d) $\frac{\text{isentropic enthalpy drop}}{\text{cumulative actual enthalpy drop}}$.

75. The value of reheat factor normally varies from

(a) 0.5 to 0.6 (b) 0.9 to 0.95

(c) 1.02 to 1.06 (d) 1.2 to 1.6.

76. Steam turbines are governed by which of the following methods ?

(a) Throttle governing (b) Nozzle control governing

(c) By pass governing (d) All of the above.

77. In steam turbines the reheat factor

(a) increases with the increase in number of stages

(b) decreases with the increase in number of stages

(c) remains same irrespective of number of stages

(d) none of the above.

78. The thermal efficiency of the engine with condenser as compared to without condenser, for a given pressure and temperature of steam, is

(a) higher (b) lower

(c) same as long as initial pressure and temperature is unchanged

(d) none of the above.

79. In Jet type condensers

(a) cooling water passes through tubes and steam surrounds them

(b) steam passes through tubes and cooling water surrounds them

(c) steam and cooling water mix

(d) steam and cooling water do not mix.

80. In a shell and tube surface condenser

(a) steam and cooling water mix to give the condensate

(b) cooling water passes through the tubes and steam surrounds them

(c) steam passes through the cooling tubes and cooling water surrounds them

(d) all of the above varying with situation.

81. In a surface condenser if air is removed, there is

(a) fall in absolute pressure maintained in condenser

(b) rise in absolute pressure maintained in condenser

(c) no change in absolute pressure in the condenser

(d) rise in temperature of condensed steam.

82. The cooling section in the surface condenser
(*a*) increases the quantity of vapour extracted along with air
(*b*) reduces the quantity of vapour extracted along with air
(*c*) does not affect vapour quantity extracted but reduces pump capacity of air extraction pump
(*d*) none of the above.

83. Edward's air pump
(*a*) removes air and also vapour from condenser
(*b*) removes only air from condenser
(*c*) removes only un-condensed vapour from condenser
(*d*) removes air alongwith vapour and also the condensed water from condenser.

84. Vacuum efficiency of a condenser is ratio of
(*a*) $\dfrac{\text{actual vacuum in condenser with air present}}{\text{theoretical vacuum in condenser with no air present}}$
(*b*) $\dfrac{\text{theoretical vacuum in condenser with no air present}}{\text{actual vacuum in condenser with air present}}$
(*c*) $\dfrac{\text{partial pressure of vapour + partial pressure of air present}}{\text{partial pressure of vapour only}}$
(*d*) $\dfrac{\text{partial pressure of vapour only}}{\text{partial pressure of vapour + partial pressure of air pressure}}$.

85. In a steam power plant the function of a condenser is
(*a*) to maintain pressure below atmospheric to increase work output from the prime mover
(*b*) to receive large volumes of steam exhausted from steam prime mover
(*c*) to condense large volumes of steam to water which may be used again in boiler
(*d*) all of the above.

86. In a regenerative surface condenser
(*a*) there is one pump to remove air and condensate
(*b*) there are two pumps to remove air and condensate
(*c*) there are three pumps to remove air, vapour and condensate
(*d*) there is no pump, the condensate gets removed by gravity.

87. Evaporative type of condenser has
(*a*) steam in pipes surrounded by water
(*b*) water in pipes surrounded by steam
(*c*) either (*a*) or (*b*)
(*d*) none of the above.

88. Condenser efficiency is defined as
(*a*) $\dfrac{\text{saturation temperature at condenser pressure}}{\text{rise in cooling water temperature}}$
(*b*) $\dfrac{\text{temperature rise of cooling water}}{\text{saturation temperature corresponding to condenser pressure}}$
(*c*) $\dfrac{\text{temperature rise of cooling water}}{\text{saturation temperature corresponding to condenser pressure - cooling water inlet temperature}}$
(*d*) $\dfrac{\text{saturation temperature corresponding to condenser pressure}}{\text{saturation temperature of vapour at its partial pressure in condenser}}$.

89. Pipes carrying steam are generally made up of
(*a*) steel (*b*) cast iron
(*c*) copper (*d*) aluminium.

90. For the safety of a steam boiler the number of safety valves fitted are
(*a*) four (*b*) three
(*c*) two (*d*) one.

91. Steam turbines commonly used in steam power station are
(*a*) condensing type (*b*) non-condensing type
(*c*) none of the above.

92. Belt conveyor can be used to transport coal at inclinations upto
(*a*) 30° (*b*) 60°
(*c*) 80° (*d*) 90°.

93. The maximum length of a screw conveyor is about
(*a*) 30 metres (*b*) 40 metres
(*c*) 60 metres (*d*) 100 metres.

94. The efficiency of a modern boiler using coal and heat recovery equipment is about
(*a*) 25 to 30% (*b*) 40 to 50%
(*c*) 65 to 70% (*d*) 85 to 90%.

95. The average ash content in Indian coals is about
(*a*) 5% (*b*) 10%
(*c*) 15% (*d*) 20%.

96. Load centre in a power station is
(*a*) centre of coal fields (*b*) centre of maximum load of equipments
(*c*) centre of gravity of electrical system.

97. Steam pressure in a steam power station, which is usually kept now-a-days is of the order of
(*a*) 20 kgf/cm^2 (*b*) 50 kgf/cm^2
(*c*) 100 kgf/cm^2 (*d*) 150 kgf/cm^2.

98. Economisers improve boiler efficiency by
(*a*) 1 to 5% (*b*) 4 to 10%
(*c*) 10 to 12% (*d*) 15 to 20%.

99. In steam power station, the choice of high temperature steam is for
(*a*) increasing the efficiency of boiler alone (*b*) increasing the efficiency of turbine alone
(*c*) increasing overall efficiency (*d*) none of the above.

100. Location of centre of gravity (*c.g*) of any electrical distribution system is determined as
(*a*) $c.g = \dfrac{\text{total loading (electrical)}}{\text{sum of moments about two axes}}$ (*b*) $c.g = \dfrac{\text{sum of moments about two axes}}{\text{total loading}}$
(*c*) $c.g$ = sum of moments × total loading (*d*) $c.g$ = sum of moments × (total loading)^2.

101. Capacity of turbine and generator are related as
(*a*) Turbine kW = $\dfrac{\text{generator kW}}{\text{generator efficiency}}$
(*b*) Turbine kW = generator kW × generator efficiency
(*c*) Turbine kW = generator kW (*d*) Turbine kW = (generator kW)^2.

102. The capacity of large turbo-generators varies from
(*a*) 20 to 100 MW (*b*) 50 to 300 MW
(*c*) 70 to 400 MW (*d*) 100 to 650 MW.

103. Caking coals are those which
(*a*) burn completely (*b*) burn freely
(*c*) do not form ash (*d*) form lumps or masses of coke.

104. Primary air is that air which is used to
(*a*) reduce the flame length (*b*) increase the flame length
(*c*) transport and dry the coal
(*d*) provide air around burners for getting optimum combustion.

105. Secondary air is the air used to
(*a*) reduce the flame length (*b*) increase the flame length
(*c*) transport and dry the coal
(*d*) provide air round the burners for getting optimum combustion.

106. Presence of sulphur in coal will result in
(*a*) corroding air heaters
(*b*) spontaneous combustion during coal storage
(*c*) causing clinkering and slagging
(*d*) facilitating ash precipitation
(*e*) all of the above.

107. Pulverised fuel is used for
(*a*) saving fuel (*b*) better burning
(*c*) obtaining more heat.

108. Combustible elements in the fuel are
(*a*) carbon and hydrogen (*b*) carbon, hydrogen and sulphur
(*c*) carbon, hydrogen and nitrogen (*d*) carbon, hydrogen and ash.

109. Heating value of diesel oil is about
(*a*) 5000 kcal/kg (*b*) 7000 kcal/kg
(*c*) 9000 kcal/kg (*d*) 11000 kcal/kg.

110. Higher calorific value (H.C.V.) is the heating value of fuel
(*a*) without water vapour which are formed by combustion
(*b*) with water vapour which are formed by combustion
(*c*) none of the above.

111. Which one is essential for combustion of fuel ?
(*a*) oxygen to support combustion (*b*) correct fuel air ratio
(*c*) proper ignition temperature (*d*) all the three above.

112. Ultimate analysis of fuel is determination of percentage of
(*a*) total carbon by weight
(*b*) total carbon by weight unit weight of H_2, O_2, N_2, sulphur and ash
(*c*) ash, volatile matter and moisture.

113. Which of the following coals has the highest calorific value ?
(*a*) Peat (*b*) Lignite
(*c*) Bituminous (*d*) Anthracite coal.

114. The proximate analysis of coal gives
(*a*) various chemical constituents, carbon, hydrogen, oxygen and ash
(*b*) fuel constituents as percentage by weight, of moisture, volatile, fixed carbon and ash
(*c*) percentage by weight, of moisture, volatile matter, fixed carbon and ash.

115. In coal preparation plant, magnetic separators are used to remove
(*a*) dust (*b*) clinkers
(*c*) iron particles (*d*) sand.

116. Load carrying capacity of belt conveyor is about
(*a*) 20 to 40 tons/hr (*b*) 50 to 100 tons/hr
(*c*) 100 to 150 tons/hr (*d*) 150 to 200 tons/hr.

117. Method which is commonly applied for unloading the coal for small power plant is
(*a*) lift trucks (*b*) coal accelerators
(*c*) tower cranes (*d*) belt conveyor.

118. Bucket elevators are used for
(*a*) carrying coal in horizontal direction (*b*) carrying coal in vertical direction
(*c*) carrying coal in any direction.

119. The amount of air which is supplied for complete combustion is called
(*a*) primary air (*b*) secondary air
(*c*) tertiary air.

120. In .... system fuel from a central pulverizing unit is delivered to a burner and then to the various burners
(*a*) unit (*b*) central
(*c*) none of the above.

121. Underfeed stokers work best for ...... coals high in volatile matter and with caking tendency
(*a*) anthracite (*b*) lignite
(*c*) semi-bituminous and bituminous.

122. Example of overfeed type stoker is
(*a*) chain grate (*b*) spreader
(*c*) travelling grate (*d*) all of the above.

123. Where unpulverised coal has to be used and boiler capacity is large, the stoker which is used is
(*a*) underfeed stoker (*b*) overfeed stoker
(*c*) any.

124. Travelling grate stokers can burn coals at the rates of
(*a*) 50—75 kg/m^2 per hour (*b*) 75—100 kg/m^2 per hour
(*c*) 100—150 kg/m^2 per hour (*d*) 150—200 kg/m^2 per hour.

125. Capacity of the underfeed stoker is of the order of
(*a*) 100 to 200 kg of coal burned per hour (*b*) 100 to 500 kg of coal burned per hour
(*c*) 100 to 2000 kg of coal burned per hour (*d*) 100 to 4000 kg of coal burned per hour.

126. Economisers are usually used in boiler plant working above
(*a*) 30 kgf/cm^2 (*b*) 50 kgf/cm^2
(*c*) 70 kgf/cm^2 (*d*) 90 kgf/cm^2.

127. Superheating of steam is desirable for
(*a*) increasing the efficiency of Rankine cycle
(*b*) reducing initial condensation losses
(*c*) avoiding too high moisture in the last stage of turbine
(*d*) all of the above
(*e*) none of the above.

128. Thermal efficiency of the steam plant is of the order of
(*a*) 30%
(*b*) 50%
(*c*) 60%
(*d*) 80%.

129. In a regenerative air preheater, the heat is transferred
(*a*) by direct mixing
(*b*) by extracting some gas from the furnace
(*c*) from heating an intermediate material and then heating the air from this material.

130. The height of chimney in a steam power plant is governed by
(*a*) flue gases quantity
(*b*) the draught to be produced
(*c*) control of pollution.

131. In boilers, the feed water treatment is done mainly for removing ...... troubles.
(*a*) corrosion
(*b*) scale formation
(*c*) carry over
(*d*) embrittlement
(*e*) all of the above.

132. Blowing down of boiler water is the process to
(*a*) reduce the boiler pressure
(*b*) increase the steam temperature
(*c*) control the solid concentration in the boiler water by removing some of the concentrated saline water.

133. Deaerative heating is done to
(*a*) heat the water
(*b*) heat the air in the water
(*c*) remove dissolved gases in the water.

134. Reheat factor is the ratio of
(*a*) isentropic heat drop to useful heat drop
(*b*) adiabatic heat drop to isentropic heat drop
(*c*) cumulative actual enthalpy drop for all stages to total isentropic enthalpy heat drop.

135. The value of the reheat factor is of the order of
(*a*) 0.8 to 1.0
(*b*) 1.0 to 1.05
(*c*) 1.1 to 1.5
(*d*) above 1.5.

136. Compounding of steam turbine is done for
(*a*) reducing the work done
(*b*) increasing the rotor speed
(*c*) reducing the rotor speed
(*d*) balancing the turbine.

137. Topping turbines are
(*a*) low pressure condensing units
(*b*) high pressure non-condensing units
(*c*) low pressure non-condensing units
(*d*) high pressure condensing units.

138. In throttle governing
(*a*) larger heat drop is available
(*b*) lesser heat drop is available
(*c*) there no effect on heat drop.

139. The commonly used material of condenser tubes is
(*a*) aluminium
(*b*) cast iron
(*c*) admiralty brass
(*d*) mild steel.

140. The blades of impulse turbine are
(*a*) symmetrically shaped around the centre line
(*b*) asymmetrically shaped around the centre line
(*c*) none of the above.

141. For medium and large size turbines the ...... governing is used.
(*a*) throttle (*b*) nozzle control
(*c*) by pass (*d*) combination of (*a*), (*b*), (*c*).

142. Function of air pump in condenser is to
(*a*) remove water (*b*) maintain vacuum
(*c*) maintain atmospheric pressure.

143. Wet air pump removes
(*a*) air only (*b*) only condensate
(*c*) both air and condensate.

DIESEL POWER STATION

144. In diesel cycle
(*a*) compression ratio and expansion ratio are equal
(*b*) compression ratio is greater than expansion ratio
(*c*) compression ratio is less than expansion ratio
(*d*) compression ratio = (expansion ratio)^2.

145. Compression ratio of an I.C. engine is the ratio of
(*a*) $\frac{\text{total volume}}{\text{swept volume}}$ (*b*) $\frac{\text{total volume}}{\text{clearance volume}}$
(*c*) either of the above (*d*) none of the above.

146. In a diesel engine the heat lost to the cooling water is
(*a*) 10% (*b*) 20%
(*c*) 30% (*d*) 70%.

147. The mechanical efficiency of a diesel engine is defined as
(*a*) $\frac{\text{B.H.P.}}{\text{I.H.P.}}$ (*b*) $\frac{\text{I.H.P.}}{\text{B.H.P.}}$
(*c*) B.H.P. × I.H.P. (*d*) $\frac{(\text{B.H.P.})^2}{\text{I.H.P.}}$.

148. The temperature of cooling water leaving the diesel engine should not be more than
(*a*) 30°C (*b*) 40°C
(*c*) 60°C (*d*) 80°C.

149. Total cost of a diesel power plant per kW of installed capacity is less than that of steam power plant by
(*a*) 5 to 10% (*b*) 20 to 30%
(*c*) 40 to 50% (*d*) 70 to 80%.

150. The ratio of piston stroke to bore of cylinder for internal combustion engines varies between
(*a*) 0.9 to 1.9 (*b*) 0.5 to 0.8
(*c*) 0.3 to 0.6 (*d*) 0.1 to 0.2.

151. Air fuel rate required for the combustion in diesel engine is about
(*a*) 5 : 1 (*b*) 10 : 1
(*c*) 15 : 1 (*d*) none of the above.

152. In multicylinder engines a particular sequence in the firing order is necessary
(*a*) to provide the best engine performance (*b*) to obtain uniform turning moment
(*c*) to operate the ignition system smoothly (*d*) to obtain non-uniform turning moment.

153. Most high speed diesel engines work on
(*a*) Diesel cycle (*b*) Carnot cycle
(*c*) Dual combustion cycle (*d*) Otto cycle.

154. In case of diesel engine, the pressure at the end of compression is in the range of
(*a*) 7—8 kgf/cm^2 (*b*) 20—25 kgf/cm^2
(*c*) 35—40 kgf/cm^2 (*d*) 50—60 kgf/cm^2.

155. Reciprocating motion of the piston is converted into a rotary one by
(*a*) connecting rod (*b*) crank shaft
(*c*) crank web (*d*) gudgeon pin.

156. Maximum temperature which is developed in the cylinder of a diesel engine is of the order of
(*a*) 1000—1500°C (*b*) 1500—2000°C
(*c*) 2000—2500°C (*d*) 2500—3000°C.

157. In a four stroke cycle engine, the four operations namely suction, compression, expansion and exhaust are completed in the number of revolutions of crank shaft equal to
(*a*) four (*b*) three
(*c*) two (*d*) one.

158. In a two stroke cycle engine, the operations namely suction, compression, expansion and exhaust are completed in the number of revolutions of crank shaft equal to
(*a*) four (*b*) three
(*c*) two (*d*) one.

159. In a four stroke cycle S.I. engine the cam shaft runs
(*a*) at the same speed as crank shaft (*b*) at half the speed of crank shaft
(*c*) at twice the speed of crank shaft
(*d*) at any speed irrespective of crank shaft speed.

160. The following is an S.I. engine.
(*a*) Diesel engine (*b*) Petrol engine
(*c*) Gas engine (*d*) None of the above.

161. The following is C.I. engine.
(*a*) Diesel engine (*b*) Petrol engine
(*c*) Gas engine (*d*) None of the above.

162. In a four stroke cycle petrol engine, during suction stroke
(*a*) only air is sucked in (*b*) only petrol is sucked in
(*c*) mixture of petrol and air is sucked in (*d*) none of the above.

163. In a four stroke cycle diesel engine, during suction stroke
(*a*) only air is sucked in (*b*) only fuel is sucked in
(*c*) mixture of fuel and air is sucked in (*d*) none of the above.

164. The two stroke cycle engine has
(*a*) one suction valve and one exhaust valve operated by one cam
(*b*) one suction valve and one exhaust valve operated by two cams
(*c*) only ports covered and uncovered by piston to effect charging and exhausting
(*d*) none of the above.

165. For same output, same speed and same compression ratio the thermal efficiency of a two stroke cycle petrol engine as compared to that for four stroke cycle petrol engine is
(*a*) more (*b*) less

(c) same as long as compression ratio is same
(d) same as long as output is same.

166. The ratio of brake power to indicated power of an I.C. engine is called
(a) mechanical efficiency (b) thermal efficiency
(c) volumetric efficiency (d) relative efficiency.

167. The specific fuel consumption of a diesel engine as compared to that for petrol engine is
(a) lower (b) higher
(c) same for same output (d) none of the above.

168. The thermal efficiency of petrol engine as compared to diesel engine is
(a) lower (b) higher
(c) same for same power output (d) same for same speed.

169. Compression ratio of petrol engines is in the range of
(a) 2 to 3 (b) 7 to 10
(c) 16 to 20 (d) none of the above.

170. Compression ratio of diesel engines may have a range
(a) 8 to 10 (b) 10 to 15
(c) 16 to 20 (d) none of the above.

171. The thermal efficiency of good I.C. engine at the rated load is in the range of
(a) 80 to 90% (b) 60 to 70%
(c) 30 to 35% (d) 10 to 20%.

172. In case of S.I. engine, to have best thermal efficiency the fuel-air mixture ratio should be
(a) lean (b) rich
(c) may be lean or rich (d) chemically correct.

173. The fuel-air ratio, for maximum power of S.I. engines, should be
(a) lean (b) rich
(c) may be lean or rich (d) chemically correct.

174. In case of petrol engine, at starting
(a) rich fuel-air ratio is needed (b) weak fuel-air ratio is needed
(c) chemically correct fuel-air ratio is needed
(d) any fuel-air ratio will do.

175. Carburettor is used for
(a) S.I. engines (b) gas engines
(c) C.I. engines (d) none of the above.

176. Fuel injector is used in
(a) S.I. engines (b) gas engines
(c) C.I. engines (d) none of the above.

177. Very high speed engines are generally
(a) gas engines (b) S.I. engines
(c) C.I. engines (d) steam engines.

178. In S.I. engine, to develop high voltage for spark plug
(a) battery is installed (b) distributor is installed
(c) carburettor is installed (d) ignition coil is installed.

179. In S.I. engine, to obtain required firing order
(a) battery is installed (b) distributor is installed
(c) carburettor is installed (d) ignition coil is installed.

180. For petrol engines the method of governing employed is
(*a*) quantity governing (*b*) quality governing
(*c*) hit and miss governing (*d*) none of the above.

181. For diesel engines the method of governing employed is
(*a*) quantity governing (*b*) quality governing
(*c*) hit and miss governing (*d*) none of the above.

182. Voltage developed to strike spark in the spark plug is in the range
(*a*) 6 to 12 volts (*b*) 1000 to 2000 volts
(*c*) 20000 to 25000 volts (*d*) none of the above.

183. In a 4-cylinder petrol engine the standard firing order is
(*a*) 1-2-3-4 (*b*) 1-4-3-2
(*c*) 1-3-2-4 (*d*) 1-3-4-2.

184. The torque developed by the engine is maximum
(*a*) at minimum speed of engine (*b*) at maximum speed of engine
(*c*) at maximum volumetric efficiency speed of engine
(*d*) at maximum power speed of engine.

185. Iso-octane content in a fuel for S.I. engines
(*a*) retards auto-ignition (*b*) accelerates auto-ignition
(*c*) does not affect auto-ignition (*d*) none of the above.

186. Normal heptane content in fuel for S.I. engines
(*a*) retards auto-ignition (*b*) accelerates auto-ignition
(*c*) does not affect auto-ignition (*d*) none of the above.

187. The knocking in S.I. engines increases with
(*a*) increase in inlet air temperature (*b*) increase in compression ratio
(*c*) increase in cooling water temperature (*d*) all of the above.

188. The knocking in S.I. engines gets reduced
(*a*) by increasing the compression ratio
(*b*) by retarding the spark advance
(*c*) by increasing inlet air temperature
(*d*) by increasing the cooling water temperature.

189. Increasing the compression ratio in S.I. engines
(*a*) increases the tendency for knocking (*b*) decreases tendency for knocking
(*c*) does not affect knocking (*d*) none of the above.

190. The knocking tendency in petrol engines will increase when
(*a*) speed is decreased (*b*) speed is increased
(*c*) fuel-air ratio is made rich (*d*) fuel-air ratio is made lean.

191. The ignition quality of fuels for S.I. engines is determined by
(*a*) cetane number rating (*b*) octane number rating
(*c*) calorific value rating (*d*) volatility of the fuel.

192. Petrol commercially available in India for Indian passenger cars has octane number in the range
(*a*) 40 to 50 (*b*) 60 to 70
(*c*) 80 to 85 (*d*) 95 to 100.

193. Octane number of the fuel used commercially for diesel engine in India is in the range
(*a*) 80 to 90 (*b*) 60 to 80
(*c*) 60 to 70 (*d*) 40 to 45.

194. The knocking tendency in C.I. engines increases with
(*a*) decrease of compression ratio (*b*) increase of compression ratio
(*c*) increasing the temperature of inlet air
(*d*) increasing cooling water temperature.

195. If petrol is used in a diesel engine, then
(*a*) low power will be produced (*b*) efficiency will be low
(*c*) black smoke will be produced (*d*) higher knocking will occur.

GAS TURBINE POWER PLANT

196. Thermal efficiency of a gas turbine plant as compared to diesel engine plant is
(*a*) higher (*b*) lower
(*c*) same (*d*) may be higher or lower.

197. Mechanical efficiency of a gas turbine as compared to internal combustion reciprocating engine is
(*a*) higher (*b*) lower
(*c*) same (*d*) un-predictable.

198. For a gas turbine the pressure ratio may be in the range
(*a*) 2 to 3 (*b*) 3 to 5
(*c*) 16 to 18 (*d*) 18 to 22.

199. The air standard efficiency of closed gas turbine cycle is given by (r_p = pressure ratio for the compressor and turbine)
(*a*) $\eta = 1 - \dfrac{1}{(r_p)^{\gamma-1}}$ (*b*) $\eta = 1 - (r_p)^{\gamma-1}$
(*c*) $\eta = 1 - \left(\dfrac{1}{r_p}\right)^{\frac{\gamma-1}{\gamma}}$ (*d*) $\eta = (r_p)^{\frac{\gamma-1}{\gamma}} - 1$.

200. A closed cycle gas turbine works on
(*a*) Carnot cycle (*b*) Rankine cycle
(*c*) Joule cycle (*d*) Atkinson cycle.

201. Thermal efficiency of closed cycle gas turbine plant increases by
(*a*) reheating (*b*) intercooling
(*c*) regenerator (*d*) all of the above.

202. With the increase in pressure ratio thermal efficiency of a simple gas turbine plant with fixed turbine inlet temperature
(*a*) decreases (*b*) increases
(*c*) first increases and then decreases (*d*) first decreases and then increases.

203. The thermal efficiency of a gas turbine cycle with ideal regenerative heat exchanger is
(*a*) equal to work ratio (*b*) less than work ratio
(*c*) more than work ratio (*d*) unpredictable.

204. In a two stage gas turbine plant reheating after first stage
(*a*) decreases thermal efficiency (*b*) increases thermal efficiency
(*c*) does not affect thermal efficiency (*d*) none of the above.

205. In a two stage gas turbine plant reheating after first stage
(*a*) increases work ratio (*b*) decreases work ratio
(*c*) does not affect work ratio (*d*) none of the above.

206. In a two stage gas turbine plant, with intercooling and reheating
(*a*) both work ratio and thermal efficiency improve
(*b*) work ratio improves but thermal efficiency decreases
(*c*) thermal efficiency improves but work ratio decreases
(*d*) both work ratio and thermal efficiency decrease.

207. For a jet propulsion unit, ideally the compressor work and turbine work are
(*a*) equal (*b*) unequal
(*c*) not related to each other (*d*) unpredictable.

208. Greater the difference between jet velocity and aeroplane velocity
(*a*) greater the propulsive efficiency (*b*) less the propulsive efficiency
(*c*) unaffected is the propulsive efficiency (*d*) none of the above.

209. For starting gas turbine, the turbine rotor is usually motored upto 'coming in' speed which is equal to
(*a*) rated speed of the gas turbine (*b*) half of the rated speed of the gas turbine
(*c*) no relation with speed of the turbine.

210. The blades of the gas turbine rotor are made of
(*a*) carbon steel (*b*) stainless steel
(*c*) high alloy steel (*d*) high nickel alloy (Nimic 80).

211. Maximum temperature in a gas turbine is of the order of
(*a*) 700°C (*b*) 900°C
(*c*) 1600°C (*d*) 2100°C.

212. In gas turbines, high thermal efficiency is obtained in
(*a*) closed cycle (*b*) open cycle
(*c*) in both the cycles.

213. In a gas turbine plant, a regenerator increases
(*a*) work output (*b*) pressure ratio
(*c*) thermal efficiency (*d*) none of the above.

214. Maximum combustion pressure in a gas turbine is ...... as compared to diesel engine.
(*a*) same (*b*) less
(*c*) more.

215. Capital cost of a gas turbine plant is ...... than that of a steam power plant of same capacity
(*a*) same (*b*) lower
(*c*) higher.

HYDRO-ELECTRIC POWER PLANTS

216. Pelton turbines are mostly
(*a*) horizontal (*b*) vertical
(*c*) inclined.

217. The annual depreciation of a hydropower plant is about
(*a*) 0.5 to 1.5% (*b*) 10 to 15%
(*c*) 15 to 20% (*d*) 20 to 25%.

218. The power output from a hydro-electric power plants depends on three parameters
(*a*) head, type of dam and discharge
(*b*) head, discharge and efficiency of the system
(*c*) efficiency of the system, type of draft tube and type of turbine used
(*d*) type of dam, discharge and type of catchment area.

219. Water hammer is developed in
(*a*) penstock (*b*) draft tube
(*c*) turbine (*d*) surge tank.

220. The function of a surge tank is
(*a*) to supply water at constant pressure
(*b*) to produce surges in the pipe line
(*c*) to relieve water hammer pressures in the penstock pipe.

221. Gross head of a hydropower station is
(*a*) the difference of water level between the level in the storage and tail race
(*b*) the height of the water level in the river where the storage is provided
(*c*) the height of the water level in the river where tail race is provided.

222. Operating charges are minimum in the case of ...... for same power output.
(*a*) gas turbine plant (*b*) hydel plant
(*c*) thermal plant (*d*) nuclear plant.

223. Location of the surge tank in a hydro-electric station is near to the
(*a*) tailrace (*b*) turbine
(*c*) reservoir.

224. Pelton wheel turbine is used for minimum of the following heads
(*a*) 40 m (*b*) 120 m
(*c*) 180 m or above.

225. Running cost of a hydro-electric power plant is
(*a*) equal to running cost of a steam power plant
(*b*) less than running cost of a steam power plant
(*c*) more than running cost of a steam power plant.

226. The empirical relation for determination of number of buckets (Z) for Pelton turbine in terms of jet ratio (m) is given by
(*a*) $Z = 15\text{ m} + 0.5$ (*b*) $Z = 0.5\text{ m} + 15$
(*c*) $Z = \frac{m}{0.5} + 15$.

227. Francis turbine is usually used for
(*a*) high heads (*b*) medium heads
(*c*) low heads.

228. In high head hydro-power plant the velocity of water is pen stock is about
(*a*) 1 m/s (*b*) 4 m/s
(*c*) 7 m/s (*d*) 12 m/s.

229. Pelton turbine is suitable for high head and
(*a*) high discharge (*b*) low discharge
(*c*) both low and high discharge.

230. In reaction turbine, function of the draft tube is
(a) to increase the flow rate
(b) to reduce water hammer effect
(c) to convert kinetic energy of water to potential energy by a gradual expansion in divergent part.

231. Francis turbine is usually used for
(a) low head installation upto 30 m
(b) medium head installation from 30 to 180 m
(c) high head installation above 180 m
(d) for all heads.

232. In Francis turbine runner, the number of blades is generally of the order of
(a) 1-2
(b) 4-6
(c) 6-8
(d) 12-16.

233. Francis, Kaplan and propeller turbines fall under the category of
(a) impulse turbine
(b) reaction turbine
(c) impulse reaction combined
(d) axial flow.

234. The specific speed (N_S) of the turbine is given by
(a) $N_S = \frac{N\sqrt{P}}{H^{5/4}}$
(b) $N_S = \frac{N\sqrt{P}}{H^{3/4}}$
(c) $N_S = \frac{N\sqrt{P}}{H^{3/2}}$
(d) $N_S = \frac{N\sqrt{P}}{H^{2/3}}$.

235. The expression for power output (P) in kW, of a hydro-electric station is
(a) $\frac{Qw H \eta_0}{0.736 \times 75}$
(b) $\frac{0.736\, QwH}{75 \times \eta_0}$
(c) $\frac{75\, QwH\, \eta_0}{0.736}$
(d) $\frac{0.736\, QwH\, \eta_0}{75}$.

NUCLEAR POWER STATIONS

236. The average thermal efficiency of a modern nuclear power plant is about
(a) 30%
(b) 40%
(c) 60%
(d) 80%.

237. Reflectors of a nuclear reactor are made up of
(a) boron
(b) cast iron
(c) beryllium
(d) steel.

238. The function of a moderator in a nuclear reactor is
(a) to slow down the fast moving electrons
(b) to speed up the slow moving electrons
(c) to start the chain reaction
(d) to transfer heat produced inside the reactor to a heat exchanger.

239. When a nuclear reactor is operating at constant power the multiplication factor is
(a) less than unity
(b) greater than unity
(c) equal to unity
(d) none of the above.

240. The conversion ratio of a breeder reactor is
(a) equal to unity
(b) more than unity
(c) less than unity
(d) none of the above.

241. In the nuclear fission reactions ...... isotope of uranium is used.
(a) U^{233}
(b) U^{234}
(c) U^{238}.

242. Tarapur nuclear power plant has
(*a*) pressurised water reactors (*b*) boiling water reactors
(*c*) CANDU type reactors.

243. Critical mass of fuel is the amount required to make the multiplication factor ...... unity.
(*a*) equal to (*b*) less than
(*c*) more than.

244. The nuclear energy is measured as
(*a*) MeV (*b*) MW
(*c*) Curie.

245. Fission chain reaction is possible when
(*a*) fission produces the same number of neutrons which are absorbed
(*b*) fission produces more neutrons than are absorbed
(*c*) fission produces less neutrons than are absorbed
(*d*) none of the above.

246. In nuclear chain fission reaction, each neutron which causes fission produces
(*a*) no new neutron (*b*) one new neutron
(*c*) more than one new neutron.

247. ...... is the most commonly used moderator.
(*a*) Graphite (*b*) Sodium
(*c*) Deuterium (*d*) Any of the above.

248. Which of the following are fertile materials
(*a*) U^{238} and Th^{239} (*b*) U^{238} and Th^{232}
(*c*) U^{233} and Pu^{239} (*d*) U^{238} and Pu^{239}.

249. In a nuclear reactor the function of a reflector is to
(*a*) reduce the speed of the neutrons (*b*) stop the chain reaction
(*c*) reflect the escaping neutrons back into the core.

250. In gas cooled reactor (GCR) ...... are used as moderator and coolant respectively.
(*a*) heavy water and CO_2 (*b*) graphite and air
(*c*) graphite and CO_2 (*d*) none of the above.

251. In a pressurised water reactor (PWR)
(*a*) the coolant water is pressurised to work as moderator
(*b*) the coolant water boils in the core of the reactor
(*c*) the coolant water is pressurised to prevent boiling of water in the core
(*d*) no moderator is used.

252. The function of the moderator in a nuclear reactor is to
(*a*) stop chain reaction (*b*) absorb neutrons
(*c*) reduce the speed of neutrons (*d*) reduce temperature.

253. Thermal shielding is provided to
(*a*) protect the walls of the reactor from radiation damage
(*b*) absorb the fast neutrons
(*c*) protect the operating personnel from exposure to radiation
(*d*) (*a*), (*b*) and (*c*) above (*e*) (*b*) and (*c*) both
(*f*) none of the above.

254. A CANDU reactor uses
(*a*) only fertile material (*b*) highly enriched uranium (85% U^{235})
(*c*) natural uranium as fuel and heavy water as moderator and coolant.

255. Fission of U^{235} releases ...... energy.
(*a*) 200 MeV (*b*) 238 MeV
(*c*) 431 MeV.

256. Fast breed reactors are best suited for India because
(*a*) of large thorium deposits (*b*) of large uranium deposits
(*c*) of large plutonium deposits.

257. India's first nuclear power plant was started at
(*a*) Narora (U.P.) (*b*) Tarapur (Mumbai)
(*c*) Kota (Rajasthan) (*d*) Kalpakkam (Chennai).

POWER PLANT ECONOMICS

258. Load factor of a power station is defined as
(*a*) maximum demand/average load (*b*) average load × maximum demand
(*c*) average load/maximum demand (*d*) none of the above.

259. Load factor of a power station is generally
(*a*) equal to unity (*b*) less than unity
(*c*) more than unity (*d*) none of the above.

260. Diversity factor is always
(*a*) equal to unity (*b*) less than unity
(*c*) more than unity (*d*) more than twenty.

261. The load factor for heavy industries may be taken as
(*a*) 10 to 20% (*b*) 25 to 40%
(*c*) 50 to 70% (*d*) 70 to 80%.

262. The load factor of domestic load is usually
(*a*) 10 to 15% (*b*) 30 to 40%
(*c*) 50 to 60% (*d*) 60 to 70%.

263. Annual depreciation cost is calculated by
(*a*) sinking fund method (*b*) straight line method
(*c*) both (*a*) and (*b*) (*d*) estimate value.

264. Depreciation charges are high in case of
(*a*) thermal plant (*b*) diesel plant
(*c*) hydro-electric plant (*d*) any of the above.

265. Demand factor is defined as
(*a*) average load/maximum demand (*b*) maximum demand/connected load
(*c*) connected load/maximum demand (*d*) maximum demand × connected load.

266. High load factor indicates that
(*a*) cost of generation per unit power is increased
(*b*) total plant capacity is utilised for most of the time
(*c*) total plant capacity is not properly utilised for most of the time.

267. A load curve indicates
(*a*) average power used during the period

(*b*) average kWh (kW) energy consumption during the period
(*c*) neither (*a*) nor (*b*).

268. Approximate estimation of power demand can be made by the method/methods
(*a*) load survey method (*b*) statistical methods
(*c*) mathematical method (*d*) economic parameters
(*e*) all of the above.

269. Annual depreciation as per straight line method, is calculated by
(*a*) the capital cost divided by number of years of life
(*b*) the capital cost minus the salvage value, is divided by the number of years of life
(*c*) investing a uniform sum of money per annum at stipulated rate of interest.

270. A consumer has to pay lesser fixed charges in
(*a*) flat rate tariff (*b*) two part tariff
(*c*) maximum demand tariff.

271. In two part tariff, variation in load factor will affect
(*a*) fixed charges (*b*) operating or running charges
(*c*) both (*a*) and (*b*).

272. In India the tariff for charging the consumers for the consumption of electricity is based on
(*a*) straight meter rate (*b*) block meter rate
(*c*) reverse form of block meter rate (*d*) two part tariff.

273. In Hopkinson demand rate or two part tariff the demand rate or fixed charges are
(*a*) dependent upon the energy consumed
(*b*) dependent upon the maximum demand of the consumer
(*c*) both (*a*) and (*b*) (*d*) none of the above.

NON-CONVENTIONAL POWER GENERATION

274. The function of a solar collector is to convert
(*a*) solar energy into electricity (*b*) solar energy into radiation
(*c*) solar energy into thermal energy.

275. Most of the solar radiation received on earth surface lies within the range of
(*a*) 0.2 to 0.4 microns (*b*) 0.38—0.78 microns
(*c*) 0—0.38 microns.

276. Flat plate collector absorbs
(*a*) direct radiation only (*b*) diffuse radiation only
(*c*) direct and diffuse both.

277. Main applications of solar energy may be considered in the following categories
(*a*) solar electric applications (*b*) fuel from biomass
(*c*) direct thermal applications (*d*) both (*a*) and (*b*)
(*e*) (*a*), (*b*) and (*c*).

278. Temperature attained by a flat-plate collector is of the
(*a*) order of about 90°C (*b*) range of 100°C to 150°C
(*c*) above 150°C (*d*) none of the above.

279. A pyranometer is used for measurement of
(*a*) direct radiation only (*b*) diffuse radiation only
(*c*) direct as well as diffuse radiation.

280. Sun tracking is needed in the case of ...... collector.
(*a*) flat plate (*b*) cylindrical parabolic and paraboloid.
(*c*) both (*a*) and (*b*).

281. In a solar collector the function of the transparent cover is to
(*a*) transmit solar radiation only (*b*) protect the collector from dust
(*c*) decrease the heat loss from collector beneath to atmosphere.

282. Temperature attained by cylindrical parabolic collector is of the range of
(*a*) 50 to 100°C (*b*) 100 to 150°C
(*c*) 150 to 300°C (*d*) 300 to 500°C.

283. Most widely used material of a solar cell is
(*a*) arsenic (*b*) cadmium
(*c*) silicon (*d*) steel.

284. Photovoltaic cell or solar cell converts
(*a*) thermal energy into electricity
(*b*) electromagnetic radiation directly into electricity
(*c*) solar radiation into thermal energy.

285. Maximum wind energy available is proportional to
(*a*) square of the diameter of rotor (*b*) air density
(*c*) cube of the wind velocity (*d*) (*a*), (*b*) and (*c*).

286. ...... type of wind mill is of simple design.
(*a*) Horizontal axis wind mill (*b*) Vertical axis wind mill
(*c*) None.

287. Cost of wind energy generator compared to conventional power plants for the same power output is
(*a*) equal (*b*) lower
(*c*) higher.

288. The turbine which is used in a tidal power plant for getting continuous power is
(*a*) simple impulse type (*b*) reversible type
(*c*) propeller type.

289. Largest geothermal plant in operation is in
(*a*) Maxico (*b*) Italy
(*c*) Russia (*d*) California.

290. Geothermal plant is suitable for
(*a*) base load power (*b*) peak load power
(*c*) none.

291. A geothermal field may yield
(*a*) hot water (*b*) wet steam
(*c*) dry steam (*d*) (*a*, (*b*) and (*c*).

292. Geothermal power plants as compared to fossil fuel plants have ...... load factor.
(*a*) equal (*b*) lower
(*c*) higher.

293. Geothermal steam and hot water may contain
(*a*) NH_3 (*b*) Na_2S
(*c*) H_2S, NH_3 and radon gas.

294. Fuel cells have conversion efficiencies of the order of
(*a*) 20% (*b*) 30%
(*c*) 50% (*d*) 70%.

295. Fuel cell is a device in which
(*a*) chemical energy is converted into electricity
(*b*) heat energy is first converted into chemical energy
(*c*) heat energy is converted into electricity.

296. The nature of the current developed by *MHD* generator is
(*a*) direct current (*b*) alternating current
(*c*) either direct or alternating.

297. In *MHD* generators the conductor employed is
(*a*) gas (*b*) liquid metal
(*c*) liquid metal or gas (*d*) none of the above.

298. Seeding material which is added with the working fluid in *MHD* generator is used for
(*a*) decreasing the conductivity of the gas
(*b*) increasing the conductivity of the gas
(*c*) creating no effect on conductivity.

299. Power output per unit volume of an *MHD* generator is proportional to
(*a*) square of the magnetic flux density (*b*) electrical conductivity of the gas
(*c*) square of the fluid velocity (*d*) (*a*), (*b*) and (*c*).

300. Biogas consists of
(*a*) only methane (*b*) methane and CO_2 with some impurities
(*c*) a special organic gas (*d*) none of the above.

301. The main byproduct of the biogas plant is
(*a*) biogas (*b*) bio-mass
(*c*) organic manure.

302. Thermo-electric energy conversion is due to
(*a*) radiation (*b*) emission effect
(*c*) thermal energy.

303. The working principle of thermo-electric generator is based on the principle of
(*a*) Hall (*b*) Seebeck
(*c*) Faraday.

304. Materials which are employed for electrodes in thermo-electric generators are of
(*a*) insulators (*b*) semiconductors
(*c*) metals (*d*) conductors.

305. Thermionic converter utilizes
(*a*) Thermionic emission effect (*b*) Pettier effect
(*c*) Seebeck effect.

ANSWERS

1. (*b*)	**2.** (*a*)	**3.** (*a*)	**4.** (*a*)	**5.** (*c*)	**6.** (*b*)	**7.** (*a*)
8. (*a*)	**9.** (*d*)	**10.** (*a*)	**11.** (*b*)	**12.** (*d*)	**13.** (*c*)	**14.** (*c*)
15. (*a*)	**16.** (*d*)	**17.** (*b*)	**18.** (*a*)	**19.** (*b*)	**20.** (*b*)	**21.** (*b*)

22. (*b*)	**23.** (*a*)	**24.** (*b*)	**25.** (*b*)	**26.** (*a*)	**27.** (*c*)	**28.** (*b*)
29. (*d*)	**30.** (*b*)	**31.** (*b*)	**32.** (*b*)	**33.** (*c*)	**34.** (*b*)	**35.** (*b*)
36. (*b*)	**37.** (*a*)	**38.** (*b*)	**39.** (*b*)	**40.** (*d*)	**41.** (*c*)	**42.** (*b*)
43. (*d*)	**44.** (*d*)	**45.** (*a*)	**46.** (*c*)	**47.** (*b*)	**48.** (*d*)	**49.** (*c*)
50. (*d*)	**51.** (*a*)	**52.** (*b*)	**53.** (*c*)	**54.** (*d*)	**55.** (*d*)	**56.** (*b*)
57. (*a*)	**58.** (*c*)	**59.** (*c*)	**60.** (*a*)	**61.** (*a*)	**62.** (*a*)	**63.** (*b*)
64. (*c*)	**65.** (*d*)	**66.** (*b*)	**67.** (*a*)	**68.** (*c*)	**69.** (*c*)	**70.** (*c*)
71. (*c*)	**72.** (*c*)	**73.** (*d*)	**74.** (*c*)	**75.** (*c*)	**76.** (*d*)	**77.** (*a*)
78. (*a*)	**79.** (*c*)	**80.** (*b*)	**81.** (*a*)	**82.** (*b*)	**83.** (*d*)	**84.** (*a*)
85. (*d*)	**86.** (*b*)	**87.** (*a*)	**88.** (*c*)	**89.** (*a*)	**90.** (*c*)	**91.** (*a*)
92. (*a*)	**93.** (*a*)	**94.** (*d*)	**95.** (*d*)	**96.** (*c*)	**97.** (*d*)	**98.** (*b*)
99. (*c*)	**100.** (*b*)	**101.** (*a*)	**102.** (*b*)	**103.** (*d*)	**104.** (*c*)	**105.** (*d*)
106. (*e*)	**107.** (*b*)	**108.** (*b*)	**109.** (*d*)	**110.** (*b*)	**111.** (*d*)	**112.** (*b*)
113. (*d*)	**114.** (*c*)	**115.** (*c*)	**116.** (*b*)	**117.** (*b*)	**118.** (*b*)	**119.** (*b*)
120. (*b*)	**121.** (*c*)	**122.** (*d*)	**123.** (*b*)	**124.** (*d*)	**125.** (*c*)	**126.** (*c*)
127. (*d*)	**128.** (*a*)	**129.** (*b*)	**130.** (*b*)	**131.** (*e*)	**132.** (*c*)	**133.** (*c*)
134. (*c*)	**135.** (*c*)	**136.** (*c*)	**137.** (*b*)	**138.** (*b*)	**139.** (*c*)	**140.** (*a*)
141. (*b*)	**142.** (*b*)	**143.** (*c*)	**144.** (*b*)	**145.** (*b*)	**146.** (*c*)	**147.** (*a*)
148. (*c*)	**149.** (*b*)	**150.** (*a*)	**151.** (*c*)	**152.** (*a*)	**153.** (*c*)	**154.** (*c*)
155. (*a*)	**156.** (*c*)	**157.** (*c*)	**158.** (*d*)	**159.** (*b*)	**160.** (*b*)	**161.** (*a*)
162. (*c*)	**163.** (*a*)	**164.** (*c*)	**165.** (*b*)	**166.** (*a*)	**167.** (*a*)	**168.** (*a*)
169. (*b*)	**170.** (*c*)	**171.** (*c*)	**172.** (*a*)	**173.** (*b*)	**174.** (*a*)	**175.** (*a*)
176. (*c*)	**177.** (*b*)	**178.** (*d*)	**179.** (*b*)	**180.** (*a*)	**181.** (*b*)	**182.** (*c*)
183. (*d*)	**184.** (*c*)	**185.** (*a*)	**186.** (*b*)	**187.** (*d*)	**188.** (*b*)	**189.** (*a*)
190. (*a*)	**191.** (*b*)	**192.** (*c*)	**193.** (*d*)	**194.** (*a*)	**195.** (*d*)	**196.** (*b*)
197. (*a*)	**198.** (*b*)	**199.** (*c*)	**200.** (*c*)	**201.** (*d*)	**202.** (*c*)	**203.** (*a*)
204. (*a*)	**205.** (*a*)	**206.** (*b*)	**207.** (*a*)	**208.** (*b*)	**209.** (*b*)	**210.** (*d*)
211. (*a*)	**212.** (*a*)	**213.** (*c*)	**214.** (*b*)	**215.** (*b*)	**216.** (*a*)	**217.** (*a*)
218. (*b*)	**219.** (*a*)	**220.** (*c*)	**221.** (*a*)	**222.** (*b*)	**223.** (*b*)	**224.** (*c*)
225. (*b*)	**226.** (*b*)	**227.** (*b*)	**228.** (*c*)	**229.** (*b*)	**230.** (*c*)	**231.** (*b*)
232. (*d*)	**233.** (*b*)	**234.** (*a*)	**235.** (*d*)	**236.** (*a*)	**237.** (*c*)	**238.** (*a*)
239. (*c*)	**240.** (*b*)	**241.** (*a*)	**242.** (*b*)	**243.** (*a*)	**244.** (*a*)	**245.** (*b*)
246. (*c*)	**247.** (*a*)	**248.** (*b*)	**249.** (*c*)	**250.** (*c*)	**251.** (*c*)	**252.** (*c*)
253. (*e*)	**254.** (*c*)	**255.** (*a*)	**256.** (*a*)	**257.** (*b*)	**258.** (*c*)	**259.** (*b*)
260. (*c*)	**261.** (*d*)	**262.** (*a*)	**263.** (*c*)	**264.** (*a*)	**265.** (*b*)	**266.** (*b*)
267. (*b*)	**268.** (*e*)	**269.** (*b*)	**270.** (*c*)	**271.** (*b*)	**272.** (*c*)	**273.** (*b*)
274. (*c*)	**275.** (*a*)	**276.** (*c*)	**277.** (*e*)	**278.** (*a*)	**279.** (*c*)	**280.** (*b*)
281. (*c*)	**282.** (*c*)	**283.** (*c*)	**284.** (*b*)	**285.** (*d*)	**286.** (*b*)	**287.** (*c*)
288. (*b*)	**289.** (*b*)	**290.** (*a*)	**291.** (*d*)	**292.** (*c*)	**293.** (*c*)	**294.** (*d*)
295. (*a*)	**296.** (*a*)	**297.** (*c*)	**298.** (*b*)	**299.** (*d*)	**300.** (*b*)	**301.** (*c*)
302. (*b*)	**303.** (*b*)	**304.** (*b*)	**305.** (*a*).			

B. Say 'Yes' or 'No'

1. 1 kg of uranium is equivalent to energy obtained by 4500 tonnes of high grade coal.
2. Presence of sulphur in the fuel is considered to be desirable.
3. Hydrogen is the main constituent of coal.
4. Peat is the first stage in the formation of coal from wood.
5. Bituminous coal has low percentage of volatile matter.
6. Anthracite is very hard coal.
7. Wood charcoal is obtained by destructive distillation of wood.
8. Liquid fuels require large space for storage.
9. The main constituents of natural gas are methane and ethane.
10. Water gas is produced by blowing steam into white hot coke or coal.
11. Capital cost of hydro-plants is less than diesel power station.
12. A normal working life of 100 years is estimated for wind mills.
13. The amount of excess air supplied varies with the type of fuel and the firing conditions.
14. Total weight of carbon in one kg of flue gas is = (2/5 CO_2 + 3/7 CO).
15. Electrical energy cannot be easily transported from one place to another.
16. Power is primarily associated with mechanical work and electrical energy.
17. A chemical fuel does not release heat energy on combustion.
18. Liquid fuels are less advantageous in comparison to solid fuels.
19. The operating cost of an hydro-electric plant is very high.
20. When methane burns in the pressure of oxygen the combustion products are carbondioxide and water vapours ?
21. Carnot cycle efficiency = $\frac{T_1 - T_2}{T_2}$.
22. Carnot cycle gives the highest thermal efficiency.
23. Industrial power plants are normally non-condensing.
24. The cooling water supply to the condenser helps in maintaining a low pressure in it.
25. The power plant capacity can be determined by studying the load duration curve and anticipated future demands.
26. A generator must operate economically at full load.
27. The consumption of steam per kWh decreases with the increased pressure.
28. A belt conveyor is very suitable means of transporting small quantities of coal over small distances.
29. Belt conveyor is not suitable for greater heights and short distances.
30. Flight conveyer requires little operational care.
31. A '*stoker*' is a power operated fuel feeding mechanism and grate.
32. In stoker firing cheap grade of fuel cannot be used.
33. In case of overfeed stokers, the coal is fed into the grate above the point of air admission.
34. Spreader stokers can burn any type of coal.
35. The *underfeed* principle is suitable for burning the semi-bituminous and bituminous coals.
36. The amount of air which is used to carry the coal and to dry it before entering into the combustion chamber is known as secondary air.
37. Coal is pulverised in order to increase its surface exposure, thus promoting rapid combustion without using large quantities of excess air.
38. In burners, too much secondary air can cool the mixture and prevent its heating to ignition temperature.

39. A turbulent burner is also called a long flame burner.
40. A wick burner is suitable for models or domestic appliances.
41. A fluidised bed may be defined as the bed of solid particles behaving as a fluid.
42. The 'collection efficiency' of a dust collector is the amount of dust removed per unit weight of dust.
43. The small pressure difference which causes a flow of gas to take place is termed as draught.
44. Forced draught is a negative pressure drop.
45. Steam jet draught is a simple and easy method of producing artificial draught.
46. The boilers which produce steam at pressures of 20 bar and above called high pressure boilers.
47. The removal of the mud and other impurities of water from the lowest part of the boiler is termed as 'blowing off'.
48. Shell diameter of the Cochran boiler is about 15 m.
49. Stirling water tube boiler is an example of bent tube boiler.
50. LaMont boiler works on a forced circulation and the circulation is maintained by a centrifugal pump, driven by a steam turbine using steam from the boiler.
51. Velox boiler makes use of pressurised combustion.
52. The feed pump is used to heat the feed water.
53. The function of an injector is to feed water into the boiler.
54. An economiser is a device in which the waste heat of the flue gases it utilised for heating the feed water.
55. The function of the air preheater is to decrease the temperature of air before it enters the furnace.
56. The function of a superheater is to increase the temperature of the steam above saturation temperature.
57. The function of a steam separator is to remove the entrained water particles from the steam conveyed to the steam engine or turbine.
58. Feed water heating with steam at a lower pressure than boiler pressure usually decreases overall plant efficiency.
59. Jet type open heaters do not work well at low pressures, specially at sub-atmospheric pressure.
60. For good performance feed water heaters must be drained and vented.
61. Factor of evaporation is defined as the ratio of heat received by 1 kg of water under working conditions to that received by 1 kg of water evaporated from and at 0°C.
62. If the boiler, economiser and superheater are considered as a single unit, then the boiler efficiency is termed as overall efficiency of the boiler plant.
63. Heat recovery equipment does not include economiser and superheater.
64. A *steam nozzle* may be defined as a passage of varying cross-section, through which heat energy of steam is converted to pressure energy.
65. In a convergent-divergent nozzle, because of the higher expansion ratio, addition of divergent portion produces steam at higher velocities as compared to convergent nozzle.
66. The steam turbine is a prime mover in which kinetic energy of steam is transformed into potential energy.
67. In an impulse turbine there is a gradual pressure drop and takes place continuously over the fixed and moving blades.
68. Velocity compounding method is used in Rateau and Zoelly turbines.

69. In general, optimum blade speed ratio (ρ) for maximum blade efficiency or maximum work done is given by

$$\rho = \frac{\cos \alpha}{2n}$$

where α = nozzle angle

n = number of moving/rotating blade rows in series.

70. Velocity-compounded impulse turbine has high steam consumption and low efficiency.

71. The degree of reaction turbine stage is defined as the ratio of heat drop over fixed blades to the total heat drop in the stage.

72. It is the overall or net efficiency that is meant when the efficiency of a turbine is spoken of without qualification.

73. The efficiency of a steam turbine is considerably reduced if throttle governing is carried out at low loads.

74. Nozzle control can only be applied to reaction turbines.

75. A steam condenser is a device or an appliance in which steam condenses and heat released by steam is absorbed by water.

76. In jet condensers the exhaust steam and water do not come in direct contact with each other.

77. In counter-flow type jet condenser the steam and cooling water enter the condenser from opposite directions.

78. Low level counter flow jet condenser is also called barometric condenser.

79. In an ejector condenser the exhaust steam and cooling water mix in hollow truncated cones.

80. A jet condenser entails high manufacturing cost.

81. The vacuum efficiency is defined as the ratio of maximum obtainable vacuum to actual vacuum.

82. An air pump which removes the moist air alone is called a dry air pump.

83. In a cooling pond some spray or cooling devices are employed.

84. In a cooling tower water is made to trickle down drop by drop so that it comes in contact with the air moving in the opposite direction.

85. In induced draught cooling towers the fans are placed at the top of the tower and they draw the air in through towers extending all around the tower at its base.

86. The formation of scale reduces heat transfer and simultaneously raises the temperature of the metal wall.

87. Sodium carbonate is essentially responsible for the scale formation.

88. The carbondioxide is next to oxygen which is responsible for corrosion.

89. Water solids carried over in the steam leaving a boiler drum are called "carry over".

90. Deposits on turbine blade increase the efficiency.

91. 'Foaming' is the weakening of boiler steel as a result of inner crystalline cracks.

92. Coagulation is the process in which water is allowed to stand at stand-still in big tanks so that solid matter settles down.

93. The process of removing dissolved oxygen is known as deaeration.

94. Zeolites almost completely remove hardness but do not reduce alkalinity or total solids.

95. Demineralisation is often the most costly method of producing make up water for high pressure boilers.

96. pH value of water is the logarithm of the reciprocal of hydrogen ion concentration.

97. The steam pipes for high temperature application are manufactured from mild steel.

98. Chromium improves corrosion and oxidation resistance.

99. The standby losses in diesel power plants are less.

100. A diesel power plant can respond to varying load without any difficulty.

101. The cost of building and civil engineering works in case of diesel power plant is high.
102. Any type of engine or machine which derives heat energy from the combustion of fuel or any other source and converts this energy into mechanical work is termed as a heat engine.
103. In an I.C. engine the combustion of fuel takes place outside the engine cylinder.
104. The inside diameter of the cylinder is called bore.
105. The top most position of the piston towards cover end side of the cylinder is called bottom dead centre.
106. The compression ratio is the ratio of total cylinder volume to clearance volume.
107. The average speed of the piston is called the piston speed.
108. Spark plug is used in a diesel engine.
109. Petrol engine is used in cars and motorcycles.
110. In a petrol engine the power is produced by compression ignition.
111. Engines driving electrical generators have lower speeds and simple combustion chambers.
112. In an I.C. engine the temperature of the gases inside the engine cylinder may vary from 35°C or less to as high as 2750°C during the cycle.
113. The major short coming of thermo-syphon cooling is that cooling depends only on the temperature and is independent of the engine speed.
114. Lubrication is the admittance of oil between two surfaces having no relative motion.
115. Splash system is used on some small 4-stroke stationary engines.
116. Semi-pressure system of lubrication is a combination of splash and pressure systems.
117. Dry sump lubrication is generally adopted for high capacity engine.
118. Mist lubrication system is used for 4-stroke cycle engines.
119. The compressed air system is commonly used for starting large diesel engine employed for stationary power plant service.
120. In general, lower the cetane number higher are the hydrocarbon emissions and noise level.
121. Higher cetane rating of the fuel higher is the propensity for diesel knock.
122. Gas turbines are self-starting.
123. In almost all the fields open cycle gas turbine plants are used.
124. A heat exchanger is usually used in large gas turbine unit for marine propulsion or industrial power.
125. The specific heat of helium at constant pressure is about two times that of air.
126. The main demerit associated with constant volume combustion turbines is that the pressure difference and velocities of hot gases are not constant ; so the turbine speed fluctuates.
127. Natural gas is the ideal fuel for gas turbines, but this is not available everywhere.
128. Blast furnace and producer gases cannot be used for gas turbine power plant.
129. Liquid fuels of petroleum origin such as distillate oils or residual oils are most commonly used for gas turbine plant.
130. Minerals like sodium, vanadium and calcium prove very harmful for turbine blading.
131. There exists an optimum pressure ratio producing maximum thermal efficiency for a given turbine inlet temperature.
132. In a centrifugal compressor the capacity varies inversely as the speed ratio.
133. The centrifugal compressor is superior to the axial flow machine in that a high pressure ratio can be obtained in a short rugged single stage machine, though at the cost of lower efficiency and increased frontal area.
134. The primary function of the combustor is to provide for the chemical reaction of the fuel and air being supplied by the compressor.
135. Free-piston engine plants are the conventional gas turbine plants with the difference that the air compressor and combustion chamber are replaced by a free piston engine.

136. In an interconnected system the peak load is supplied by hydropower when the maximum flow demand is less than the stream flow while steam plant supplies the base.
137. The power plant should be set up near the load centre.
138. The whole area behind the dam draining into a stream or river across which the dam has been built at a suitable placed is called 'catchment area'.
139. Water held in upstream reservoir is called pondage.
140. The water behind the dam at the plant is called storage.
141. A weir is a low overflow dam across a stream for measuring flow or mountain water level, as at a lake outlet.
142. A dike is an embankment to confine water.
143. A levee is a dike near the bank of a river to keep low land from overflowing.
144. A buttress dam has a vertical upstream face.
145. An emergency spillway comes into action when the occurring flood discharge exceeds the designed flood discharge.
146. A siphon spillway is designed on the principle of a siphon.
147. A head race is a channel which conducts water from the wheels.
148. A canal is an open waterway evacuated in natural ground.
149. A flume is a closed channel erected on the surface or supported above ground on a trestle.
150. A tunnel is an open channel excavated through a natural obstruction.
151. A pipeline is a closed conduit usually supported on or above the surface of the land.
152. A penstock is a closed conduit for supplying water under pressure to turbine.
153. Open channels are generally very expensive.
154. Tunnels are generally the most costly type of conduits for a given length.
155. Penstocks are used where the slope is too great for a canal.
156. Reinforced concrete penstocks are suitable upto 5 m head.
157. Steel penstocks can be designed for any head, with the thickness varying with the pressure and diameter.
158. Exposed penstocks last longer and are more accessible for inspection and maintenance.
159. Overflow surge tank is very satisfactory and economical.
160. Inclined surge tank is more costlier than ordinary type.
161. Restricted orifice surge tank is also called throttled surge tank.
162. In a reaction turbine the pressure energy of water is converted into kinetic energy.
163. The plants which cater for the base load of the system are called base load plants.
164. Microhydel plants make use of standardised bulb sets with unit output ranging from 100 to 1000 kW working under heads between 1.5 to 10 metres.
165. A hydraulic turbine converts the potential energy of water into mechanical energy.
166. The specific speed of a turbine is defined as the speed of a geometrically similar turbine that would develop one brake horsepower under a head of 2 metres.
167. Specific speed, $N_s = \dfrac{N\sqrt{P_t}}{H^{3/4}}$

where N = The normal working speed (r.p.m.)

P_t = Power output of the turbine

H = The net or effective head (m).

168. Turbines with low specific speeds work under a high head and low discharge condition.
169. The Pelton wheel is a tangential flow impulse turbine.
170. The hydraulic efficiency of a Pelton wheel is maximum when the velocity of the wheel is $\frac{3}{4}$th the velocity of the jet of water at inlet.

171. In a Pelton wheel the angle of deflection of the jet through the buckets is taken as 120° if no angle of deflection is given.
172. In reaction turbines the runner utilizes both potential and kinetic energies.
173. In Francis turbine the ratio of width of the wheel to its diameter varies from 0.10 to 0.20.
174. In Francis turbine the flow ratio varies from 0.4 to 0.6.
175. In the Kaplan turbine the blades are adjustable.
176. The runner of too low specific speed with low available head increases the cost of generator due to the low turbine speed.
177. An increase in specific speed of turbine is accompanied by lower maximum efficiency and greater depth of excavation of the draft tube.
178. The ratio of the volume of the water actually striking the runner to the volume of water supplied to the turbine is called volumetric efficiency.
179. The cavitation effect cannot be reduced by polishing the surfaces.
180. Spear regulation is satisfactory when a relatively large penstock feeds a small turbine and the fluctuation of load is small.
181. Hydrology is a science which deals with the depletion and replenishment of water resources.
182. Precipitation includes all the water that falls from atmosphere to earth surface.
183. Transfer of water from liquid to vapour state is called transpiration.
184. Run-off can also be named as discharge or stream flow.
185. Hydrograph indicates the power available from the stream at different times of day, week or year.
186. The basic concept of unit hydrograph is that the hydrographs of run-off from two identical storms would not be same.
187. Flow duration curve is plotted between flow available during a period versus the fraction of time.
188. Flow duration curve cannot be used for preliminary studies.
189. The 'firm power' is also known as the 'primary power'.
190. A 'mass curve' is the graph of the cumulative values of water quantity (run off) against time.
191. The mass curve will always have a negative value.
192. Those pairs of atoms which have the same atomic number and hence similar chemical properties but different atomic mass number are called isotopes.
193. Those atoms whose nuclei have the same number of neutrons are called isotones.
194. The phenomenon of spontaneous emission of powerful radiations exhibited by light elements is called radioactivity.
195. Radioactive radiations are less penetrating.
196. Prompt-fission gamma rays are produced as a result of the fissioning of a U^{235} (or other fissible material) nucleus.
197. Capture gamma rays are emitted by nucleus of an atom instantaneously upon the capture of a neutron.
198. The amount of mass defect is inversely proportional to the amount of energy released.
199. The intensity of emitted radiation is termed activity.
200. Half life represents the rate of decay of the radioactive isotopes.
201. The mean life is twice half life.
202. During a nuclear reaction, the charge in mass of the particle represents the release or an absorption of energy.
203. When a fast moving neutron hits the U^{235} nucleus, the nucleus is excited and there is an emission of gamma quantum.
204. When the nucleus is excited too much, it splits into four mostly equal masses.

205. Cross-sections are measures of the probability that a given reaction will take place between a nucleus or nuclei and incident radiation.

206. Fission is accompanied by the emission of neutrons and gamma rays.

207. The release of about 1.2 neutrons/fission makes it possible to produce sustained fissioning.

208. A chain reaction is that process in which the number of neutrons keeps on multiplying rapidly (in geometrical progression) during fission till whole of the fissionable material is disintegrated.

209. If K (multiplication factor) > 1, chain reaction cannot be maintained.

210. The minimum quantity of fuel required for any specific reactor system is called the 'critical mass'.

211. 'Nuclear fusion' is the process of combining or fusing two lighter nuclei into a stable and heavier nuclide.

212. In heterogeneous reactor the fuel and moderator are mixed to form a homogeneous material.

213. Light water, heavy water and graphite are the most common moderators used in reactors.

214. A breeder reactor converts fertile materials into fissionable materials such as U^{238} and Th^{232} to Pu^{239} and U^{233} respectively besides the power production.

215. The reflector of the reactor consists of an assemblage of fuel elements, control rods and coolant.

216. In a nuclear reactor the function of a moderator is to slow down the neutrons from high velocities.

217. A reactor coolant should have high viscosity.

218. In a pressurised water reactor (PWR) water acts both as coolant as well as moderator.

219. In a boiling water reactor enriched fuel is used.

220. In a gas cooled reactor there is ample corrosion problem.

221. Sodium-graphite reactor is one of the typical liquid metal reactor.

222. The specific power of a breeder reactor is very high.

223. The proportion of the fissible material in the fuel is of considerable importance in determining the critical size of the reactor.

224. The capital cost of a nuclear power station is always high.

225. The maintenance cost of a nuclear power station is always low.

226. The disposal of fission products is a big problem.

227. The main purpose of design and operation of the plant is to bring out the cost of energy produced to minimum.

228. Demand factor = $\dfrac{\text{connected load}}{\text{maximum demand}}$.

229. Load factor = $\dfrac{\text{average load}}{\text{maximum demand}}$.

230. Diversity factor = $\dfrac{\text{maximum demand of entire group}}{\text{sum of individual maximum demands}}$.

231. The utilisation factor is defined as the ratio of the maximum generator demand to the generator capacity.

232. Traction load includes electrical power need for pumps driven by electric motor to supply water to fields.

233. The peak load indicated by the load curve/graph represents the maximum demand of the power station.

234. The area under the load duration curve and the corresponding chronological load curve is equal and represents total energy delivered by the generating station.

235. Firm power may also be called prime power.

236. Hot reserve is that generating capacity which is not in operation but can be made available for the service.

237. Spinning reserve is that reserve generating capacity which is connected to the bus and is ready to take the load.

238. Interest is the difference between money borrowed and money returned.

239. Straight line method of calculating depreciation cost is most cumbersome and is rarely used.

240. Sinking fund method is based on the conception that the annual uniform deduction from income for depreciation will accumulate to the capital value of the plant at the end of the life of the plant or equipment.

241. Maintenance includes periodic cleaning, greasing, adjustments and overhauling of the equipment.

242. As the capacity of the unit decreases there is a corresponding reduction in floor space per kW.

243. Primemovers used for industrial purpose should be non-condensing so that steam after exhausting could be used for processing.

244. As the capacity of diesel engines is limited therefore they are not suitable for bigger power stations.

245. Diesel power stations should be worked for fluctuating loads or as standby.

246. Running of large sets for long periods at lower than maximum continuous rating decreases the cost of unit generated.

247. The useful life of a power plant is that after which repairs become so frequent and extensive that it is found economical to replace the power plant by a new one.

248. The useful life of a diesel power plant is about 70 years.

249. The fixed charges of a hydro-plant depend upon the station output.

250. The general input-output may be represented as follows :

$$I = a + bL + cL^2 + dL^3$$

where I = Input

L = Output

a, b, c and d = Constants.

251. Incremental rate is defined as the ratio of additional input required to increase additional output.

252. Hopkinson demand rate method charges the consumer according to his maximum demand only.

253. The main feature of the tidal cycle is the difference in water surface elevations at the high tide and at the low tide.

254. Sedimentation and silteration of basins are the problems associated with tidal power plants.

255. The solar farm consists of a whole field covered with parabolic trough concentrators.

256. In case of 'solar farm' temperature at the point of focus can reach several thousand degrees celsius.

257. Geothermal energy is the heat from high pressure steam coming from within the earth.

258. The source of heat for a thermoelectric generator may be a small oil or gas burner, a radioisotope or direct solar radiation.

259. Work function is defined as the energy required to extract an electron from the metal.

260. A solar cell is much different from a photovoltaic cell.

261. A solar cell is very costly.

262. MHD generator is a device which converts the heat energy of a fuel directly into electrical energy without a conventional electric generator.