

EI 2021 POWER PLANT INSTRUMENTATION

UNIT I

(PART-A)

1. What are the thermal power plant (Steam) circuits?

Coal and ash circuit, Air and gas circuit, Feed water and steam circuit, Cooling water circuit

2. What are the two major advantages of thermal power plant?

- (i) The power generation is not dependent on nature's mercy
- (ii) Transmission cost and transmission loss are less.

3. What do you understand by water hammer?

When there is sudden increase of pressure in the penstock due to sudden back flow of water, the load on the turbine is reduced. The sudden rise of pressure in the penstock is known as water hammer.

4. State any two major advantages of hydel power plant.

- (i) No air pollution
- (ii) water is the cheapest source of energy and it is renewable.

5. What are the components of nuclear I power plant ?

- (i) Nuclear reactor
- (ii) Steam generator
- (iii) Condenser
- (iv) Turbine
- (v) Power generator.

6. Explain the term nuclear fission.

The U^{235} exists in the isotope form and it is unstable. When a neutron enters the nuclear of U^{235} , the nuclear splits into two equal fragments and release 2.5 fast moving neutrons with a velocity of 1.5×10^7 m/sec and also large amount of energy. This is called nuclear fission.

7. What is the function of moderator and give examples?

The moderator is to reduce the energy of neutrons evolved during fission in order to maintain the chain reaction. Example. Heavy water and ordinary water

8. State any two application of the diesel power plant?

- (i) Used in central station for small or medium power supplies
- (ii) Used as peak load plants in combination with thermal or hydro-plants.

9. State any two application of gas turbine power plant?

- (i) Used in jet, aircraft and ships.
- (ii) Stand by plants for hydro electric power plants.

10. What is the use of regenerator?

In the regenerator the heat of the hot exhaust gases of high pressure turbines. It is placed in between high pressure and low pressure turbines.

11. Write principle of Solar cell?

Solar cells directly convert solar energy to D.C. power. These cells are made of semiconductors that generate electricity when they absorb light. The silicon cell consists of a single crystal of silicon into which a doping material is diffused to form a semiconductor.

12. Write importance of instrumentation in power plant.

- (i) Safety
- (ii) Automatic control operation
- (iii) Efficiency

13. Write some nuclear fuels.

Fuel of nuclear reactor should be fissionable material which can be defined as an element of isotope whose nuclei can be caused to undergo nuclear fission by nuclear bombardment and produce a fission chain reaction. U^{233} U^{235} and Pu^{239} .

14. What is a function of surge tank?

Surge tank is a reservoir fitted to the penstock at a point near to the turbine. When the load on the turbine decreases the gates of the turbine are closed partly by the governor to adjust the rate of flow of water in order to maintain constant speed of the runner. When the gates are closed the water moving to the turbine has to move backward. This backward moving water is stored in the surge tank. Similarly when the load on the turbine increases the turbine gates are opened by the governor and increased demand of water is partly met by the water stored in the surge tank. Thus the surge tank controls the water when the load on the turbine decreases and supplies water when the load on the turbine increases.

15. What is a function of super heater?

The steam produced in the boiler is nearly saturated. This steam as such should not be used in the turbine because the dryness fraction of the steam leaving boiler will be low. This results in presence of moisture, which causes corrosion of turbine blades. To raise the temperature of steam super heater is used.

16. What is a function of Reheater?

The steam produced in the boiler is nearly saturated. This steam as such should not be used in the turbine because the dryness fraction of the steam leaving boiler will be low. This results in presence of moisture, which causes corrosion of turbine blades. To raise the temperature of steam more the steam from the super heater is again heated the reheater.

17. What is a function of Penstock?

Penstock is a closed pipe or tunnel which is used to carry water from the dam or forebay to the turbine. It is desirable that the penstock should be sloping towards the power house and it's made up of steel, reinforced concrete and wood.

18. What is isotopes? Give example.

The same atomic number but with different mass numbers ie different number of neutrons known as isotopes. The isotope may be stable or radioactive. **Example:** deuterium, tritium

19. What is a function of Economizer?

In order to utilizing the heat accompanying combustion gases leaving the furnace, the gases are passed through the heat recovery equipment such as economizer and air pre heater. Economizer is a device intended for heating the feed water by means of flue gases from the boiler.

20. What is a function of Control rods?

Control rods in the cylindrical or sheet form are made of boron or cadmium. These rods can be moved in and out of the holes in the reactor core assembly. Their insertion absorbs more neutrons and damps down the reaction and their withdrawal absorbs less neutrons. Thus shifting control rods this may be done manually or automatically controls power of reaction.

21. What is cogeneration?

The steam which is fed to the turbine is taken out of it before the turbine exhaust. It is called extracted or bleeds steam. Exhaust steam or bleed steam is used for space heating, refrigeration and process heat i.e. can be used for other power generation plants.

22. What is fission? Give some fission materials.

Nuclear materials that will undergo a division of the atomic nucleus into two or more fission fragments with an accompanying release of large amounts of energy and more neutrons are called fissile materials. Fission is usually triggered by the capture of neutron, but some atoms undergo spontaneous fission. Example Pu^{239} , U^{235} .

23. What are the types of solar energy collectors?

(i) Flatplate (ii) Concentrating (iii) Line focusing (iv) Point Focusing.

24. How wind energy is converted into electrical energy?

Wind energy is used to run windmill which in turn drives a generator to produce electricity. A windmill converts the kinetic energy of moving air into mechanical motion that can be either used directly to run the machine or to turn the generator to produce electricity.

25. What are advantages and disadvantages of hydro plant.

Advantages

i) water is the cheapest and reliable source of generation. ii) It can meet variable load demand. iii) Running cost is low, maintenance cost low. iv) No ash handling system, No fuel transportation

Disadvantages.

- (i) Initial cost is high
- (ii) It takes fairly long time for the erection of the plant.
- (iii) Hydro electric plants are fairly situated away from the load centers. Therefore cost of transmissions lines and losses in them will be more.
- (iv) Power produced by the plants depends upon the quantity of water which in turn is dependent upon the rain fall.

Unit II – Part A

1. Write the principle of ionization chamber or ionization smoke detectors.

Ionization chamber: it works on the principle that electrically charging the air with an open detector chamber; the charged air being electronically measurable and can be monitored. It consists of a small radioactive source, which irradiates the space between the electrodes with alpha particles, thus creating ions of both signs whose movement towards respective electrodes constitutes a minute electric current.

2. Write the principle of fire alert ionizing chamber.

The principle operation of fire alert ionization chamber detector is basically simple series resistance, capacitance (RC) circuit. The charging current to charge the capacitor (C) is supplied by the ionizing air in the sample chamber, which constitutes the resistance (R). The charge carriers are a mixture of electrons and positive ions produced by high velocity alpha particles. The positive ions enter the sample chamber. The circuit resistance varies according to the conditions whether it is at normal or firing.

3. What is the principle of steam purity meter?

Sodium flame photometer is used to measure the steam purity. The sample is mixed with the gas at controlled pressure and then it is ignited to burn with a broad flame. The light from the flame is collected and focused on a photocell. The intensity of emitted light is proportional to the sodium content in the sample.

4. What are primary measurements of power plant?

- Pressure measurement of steam, feed water, turbine bleeds, heater steam and deaerator, drafts an very low pressures.
- Temperature measurement of superheated steam, feed water and gas temperature.
- Flow measurement of super heated steam feed water , fuel and air blow.
- Level measurement of boiler drum water level.

5. What is the principle of smoke density measurement?

Smoke meter works on the principle of passing a focused light beam through the duct or chimney on a photocell and the variations in the signal of the photocell circuit will be a measure of the variation of the obstruction of the light source due to the smoke and dust in the gases.

6. What is the principle of radiation detector?

Radiation always consists of charged particles such as alpha and beta rays and the detector materials are chosen so that charged particles i.e. ions are produced as the radiation is absorbed or passes through the detector. The charged particles are collected on an electrode in the detector, resulting in a measurable electric signal.

7. What do you mean by swelling effect of boiler drum level?

Swell: when the boiler load is increased, the concentration of steam bubbles under the water surface increases, the result is that the volumetric proportions in the water steam mixture changes and average density of the mixture decreases, and volume of the volume of the steam-water mass increases. This causes an immediate increase in the drum level even though additional water has not been added. This effect of a sudden increase in drum water level as the steaming rate is increased is known as well.

8. What are the types of radiation detectors?

Ion chamber, Geiger-Muller, Semiconductor, Fission chamber, Scintillation crystal.

9. What are the instruments used to measure feed water temperature?

These temperatures are frequently recorded and are measured by thermometers with pressure filled thermal expansion elements. Resistance or thermocouple type elements are also used.

10. What are the different methods of power factor measurement?

- i) Electro dynamic instruments
- ii) Ferro dynamic instruments.

11. What are secondary power plant measurements?

Measurement of smoke density, pH and electrical conductivity of boiler water and feed water, speed of turbine.

12. What are parameters involved in measuring electrical measurements in power plants?

Current and voltage: moving coil & moving iron meters.

Power: electro dynamometer, induction type instruments.

Power factor: Electro dynamic instruments & Ferro dynamic instruments.

13. How the air flow is measured?

This variable is rarely recorded on a quantitative basis and frequently employs the effect of the total flow of gases through the boiler. Close proportionality exists between actual airflow and total gas produce flow. Determination of total air supplied was at one time provided solely by Orsat analysis. It is also done by the use of field combustion tests. Combustion airflow is measured with some form of primary measuring element that is installed as a part of the boiler duct and fan system. This is used with a differential pressure measurement device.

15. How voltage is measured in power plants?

Voltmeters are connected in parallel with the circuit whose voltage is to be measured. the power loss in voltmeters is V^2/R , where v is the voltage to be measured and r is the resistance. The type of instrument used is permanent magnet moving coil, electro dynamometer and hot wire, induction type.

16. Why drum level measurement is critical?

Since, the drum is kept at higher level from the ground level, it is not possible to measure the level of the drum by manually, and so slight glass technique is used for measurement.

17. What is the use of dust monitor?

The central electricity research laboratory collects the sample of grit and dust on a glass plate and measures the obstruction caused by deposition using optical means. This instrument particularly gives a warning of an emission likely to cause a nuisance.

18. What is the difficulty in slight glass technique in boiler level measurement?

The measurement of drum level is difficult by manual mode, so, we are adapting slight glass technique. the difficulty in slight glass technique is parallax error .

19. How to measure frequency of the electrical signal?

The output of electrical signal is pure sine waveform in case of AC signal. It can be measured by amplitude and time division pre second. The measuring device can be an CRO. $F=1/T$

20. What do you mean by shrinking effect of boiler drum level?

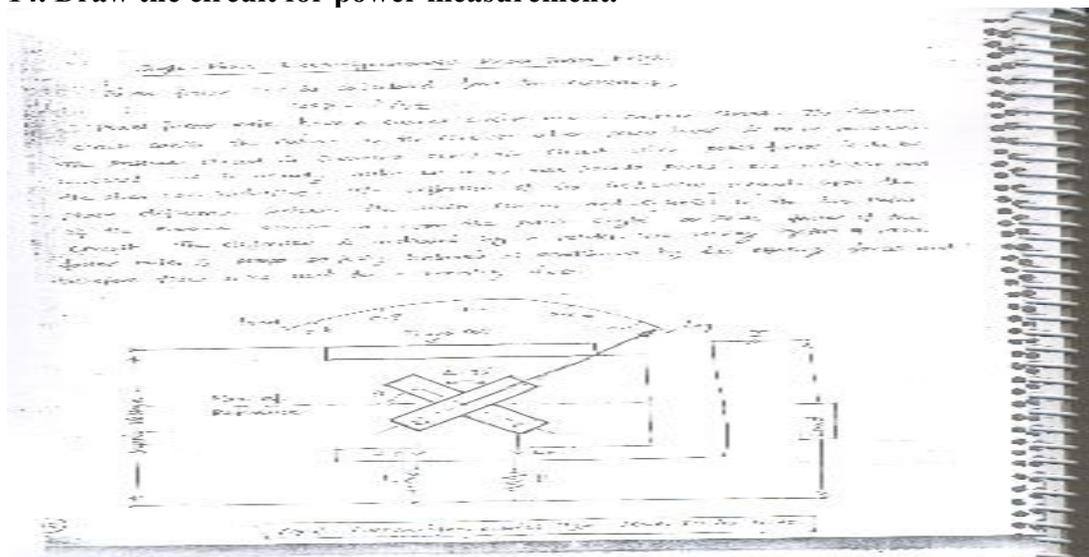
when the boiler load is reduced, the concentration of steam bubbles in the mixture, average density of the mixture increases, and volume of the steam-water mass decreases. The effect is an immediate reduction in the drum level although the mass of water and steam hasn't changed. This effect of a sudden reduction in drum water level on a decrease in steaming rate is called shrink.

21. What is the principle of Electro dynamometer?

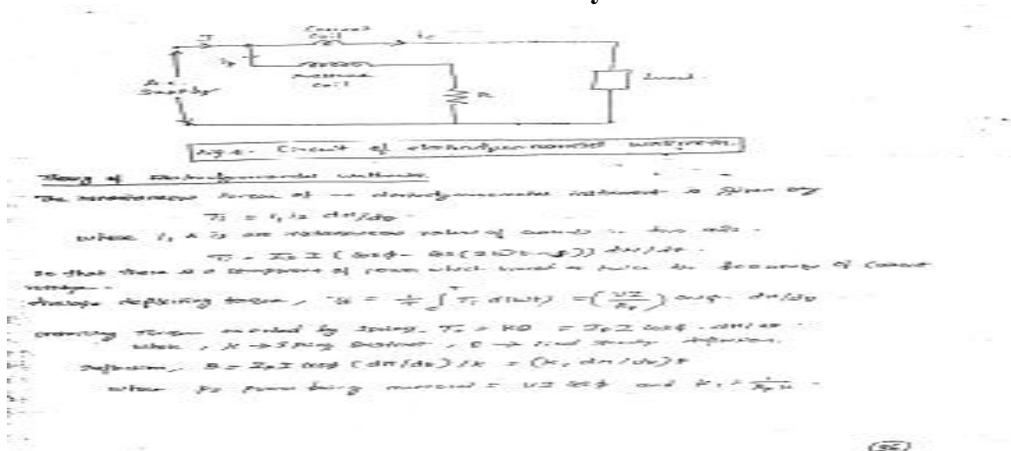
By taking up a permanent magnet moving coil, it would have a torque in one direction during one half of the cycle and an equal effect in other direction

In electro-dynamometer instruments the field can be made to reverse simultaneously with the current in the movable coil if the field coil is connected in series with the movable coil.

14. Draw the circuit for power measurement.



22. Draw the circuit for wattmeter electro-dynamometer?



UNIT III PART A ANSWERS

1. Why flue gas has to be measured?

The complete combustion of fuel and the analysis of flue gas to find it out is very important thing in thermal power stations. The amount of heat developed when a fuel is burnt depends upon the completeness of combustion. The indication of incomplete combustion can be obtained by detection of carbon monoxide in flue gas.

2. What is the principle of Thermal Conductivity analyzer?

It works on the principle that thermal conductivity of the gases is compared with the reference gas. It consists of chambers forming a wheatstone bridge the change in thermal conductivity changes the resistance of the one arm of the wheatstone bridge. The change in resistance causes unbalance voltage. The voltage across the diagonal is the proportional to the gas being analyzed.

3. What is the principle of steam purity meter?

Sodium flame photometer is used to measure the steam purity. The sample is mixed with the gas at controlled pressure and then it is ignited to burn with broad flame. The light from the flame is collected and focused on a photocell. The intensity of the emitted light is proportional to the sodium content in the sample.

4. What is the principle of paramagnetic analyzer

The instrument makes use of the magnetic properties of gases for its operation. Gases that are paramagnetic seek the strongest part of the field. Oxygen is strongly paramagnetic. Paramagnetic susceptibility decreases as oxygen becomes nitric oxide and nitrogen oxide in that order. Where the properties of the carrier gas do not vary within too wide limits and the gas mixture does not contain appreciable amount of nitric oxide. This magnetic phenomenon can be used in determination of percentage of oxygen to a high degree of accuracy.

5. What is the principle of chromatography

Chromatography is a physical measurement method which allows the continuous measurement of the amounts of each constituent in a complex vapour or gas mixture. It is the method which physically separates and quantitatively identifies two or more components of a mixture.

6. What is the effect of variation of feed water PH?

Corrosion resulting from low PH will lead to pitting and eventual failure of tubes. A high PH will lead to unwanted precipitation of scale forming components.

7. What is the effect of high electrical conductivity in boiler water?

High electrical conductivity in boiler water is indicative of the presence of considerable solids. These results in foaming in the drums excessive carry over and scaling of super heater tubes and turbine blades.

8. What is fuel analyzer?

For a fuel composition CO₂ record can be related to total air and an index of combustion conditions is obtained. Where the carbon hydrogen ratio of a fuel varies or the percentage of fuels in a multi fuel installation changes the required CO₂ at each condition must be supplied from the operators knowledge.

9. What is flue gas analyzer?

In the power plant measurement of oxygen and carbon monoxide in the flue gases is very good index of the excess air and the most economical combustion. The indication of incomplete combustion can be obtained by detection of carbon monoxide in the flue gases. The amount of CO presents in flue gases determine the combustion efficiency.

10. What are the different types of measuring PH ?

Two methods are adopted for measurement of PH

- i) Colorimetric methods
- ii) Electrical methods

11. What are the different types of chromatography?

Gas chromatography

i) Gas/ liquid(Partition) ii) Gas /solid (Adsorption)

Liquid Chromatography

Paper - Liquid / liquid(Partition)

Column - Liquid/Solid (Adsorption)

Thin layer - Gel permeation

Ion Exchange

12. What is the different section of gas chromatography?

Analysis section: It consists of valves ,columns, detectors etc.

Control section: It consists of programmer, recorder, stream selector, peak-picker memory unit and other auxiliary units.

13. What are the different methods of gas analysis?

Paramagnetic oxygen analyzers, Thermal conductivity analyzer, Infrared absorption analyzers
Selective light absorption, Electrical conductivity, Depolarization

14. What are the advantages and disadvantages of dissolved oxygen analyzer?

Advantages

The measurement of dissolved oxygen content in feed water in thermal power plant is very important because the excessive oxygen content can cause corrosion of metallic parts. Accuracy = + 5%. Sensitivity= 0.1 parts per billion

Disadvantages

This instrument is not very sensitive to detect very low concentrations.

It registers a change in dissolved oxygen content in 5 to 20s after sample water enters the instrument.

15. What are the limitations of liquid chromatography?

- The choice correct column/solvent combination for a given separation is both time consuming and costly
- The life span for liquid chromatograph column (dependent on many variables) is of the order of 800 injections
- The minor amount of impurities in the process accumulate on the column and change its characteristics and thus affect the analysis.
- The accuracy is +1% but its sensitivity is less.
- Lack of universal detector and stable one
- Availability of reliable control valves to operate at high pressures and resistant to the effect of common organic solvent poses some problems.

16. What are the limitations of gas chromatography?

- The efficiency depends on the size, composition and mode of injection of the sample , type and rate of flow carrier column length, area and packing material column temperature.
- Analyzer housing should be suitably designed for hazardous areas, provide a temperature controlled enclosure and provide protection against physical abuse.
- General precautions are to be made to achieve sensitivity.

17. Define PH

The important property of aqueous solution is their acidity or alkalinity. Acidity or alkalinity of an aqueous solution can be expressed in terms of hydrogen ion or hydroxyl ion concentration. Hydrogen ion concentration in terms of hydrogen ion exponent pH which is logarithm of the reciprocal of the Hydrogen ion concentration and mathematically expressed as $pH = -\log_{10}[H^+] = \log 1/[H^+]$.

18. Why we need pollution monitoring instruments?

It is necessary to monitor changes taking place in the quality of the environment for initiating efforts to control it. Pollution monitoring is thus complex task which involves systematic collection and evaluation of physical, chemical, biological, and related information pertaining to environmental quality and effluent discharges.

19. How the hydrocarbon enter into the atmosphere?

The hydrocarbon enter into the atmosphere from variety of sources like

- Petroleum refining process
- Incomplete combustion of organic fuels
- Evaporation of fuels and solvents

Gasoline is the major source of their emission from IC engine since they exhaust unburned and partially burnt hydrocarbon. Methane is the major component of hydrocarbon emission.

20. What is the use of CO2 recorder?

The Carbon Dioxide Analyzer provides accurate, on-line determination of dissolved carbon dioxide as well as specific, cation, and degassed conductivity measurements in ultrapurewaterprocesses.

As a steam constituent, carbon dioxide can form carbonic acid and carbonate on dissolution in water. This can severely affect not only cycle corrosion, but mask early condensate pH and conductivity measurements in cycle regions where condensation sets in. The most important paths for CO₂ ingress are air and cooling waterinleakage, makeup water,

21. Why do we need to analyze oxygen content in flue gas?

The absence of O₂ in fluegas increase the combustion rate. Hence heat transfer rate and combustion efficiency also high .

22. What do you mean by deaerated water?

Before the water is feed into the boiler the entrained of dissolved gases such as carbon dioxide and oxygen should be eliminated. Otherwise corrode the heat exchangers and boiler tubes.

23. What is the indication of incomplete combustion in boiler?

The indication of incomplete combustion in boiler is the large amount of CO present in the flue gas and it will reduce the heat.

24. How the carbon monoxide emitted into the atmosphere?

The carbon monoxide emitted into the atmosphere due to
Incomplete oxidation of fossile fuels takes place.
Automatic exhaust and deep mining operation

25. Name any two instruments to find CO in flue gas?

Non-dispersive infrared analyzer. Gas chromatography

UNIT-IV PART-A

1) Why monitoring of shell temperature is so important?

The boiler is fitted with various mounting and accessories. the hot water and steam rise up through the uptake header into the boiler shell where steam separates from the water and collects in steam space. Variations in shell temp. Affect the production of steam.

2) Where is the steam pressure measured?

It is measured at the drum in the main steam header, and frequently in turbine throttle

3) What is the necessity of steam temperature control?

It is used to obtain a constant superheat temperature at all boiler loads; the primary benefit is to improve the economy conversion of heat to mechanical power.

4) What is the effect of high electrical conductivity in boiler water?

It is an indicative of the presence of considerable solids. these result in foaming in drums, excessive carry over and scaling of super heater tubes and turbine blades.

5) What is the difference between forced draft and induced draft fans?

A fan or air blower that takes suction from the atmosphere and forces combustion air through the system is called forced draft fan

A fan at the end of the boiler flow system path that takes its suction from the boiler flue gas stream and discharges the flue gas to the stack is called induced draft fan.

6) What is reheat control?

The reheat consists of gas bypass for its primary section and spray water injection between the primary and final reheat section. when the gas bypass dampers closes, max. heat transfer to reheat primary section takes place to boost the reheat temperature particularly at low loads. the spray water injection is used to balance this heating effect by tending to cool the steam that is to buck the reheat temperature

7) What is ratio control?

Ratio control consists of a feed back controller whose set pt. is in direct proportional to an uncontrolled variable. if the load falls suddenly there is a temporary rise in steam pressure because of the fixed relationship between fuel flow and airflow, there is a resultant reduction in fuel input.

8) What is the necessity of superheated steam flow measurements?

Regulating firing rate may depend on steam pressure. In some installations a constant steam flow may be required for one or more boilers in combination, while other boilers connected to the same header are used for controlling steam pressure.

9) What is furnace implosion?

A hazard to boiler that was rarely experienced is furnace implosion. under certain conditions, the negative pressure on the walls of the furnace, boiler and ductwork can create forces great enough that these walls cave inward, doing considerable damage and extensive unit outage. This hazard is usually experienced only on electric utility boilers.

10) What is furnace draft control?

The simplest form of the furnace draft control loop uses a simple feed back control loop. in this case the control of airflow is usually assigned to the forced draft with the furnace draft control regulating the level of induced draft. it is most desirable to measure airflow on the forced draft side of the furnace. assigning airflow control to forced draft tends to reduce interaction between the airflow and the furnace draft loops. the airflow capacity is changed by modulating the forced draft. the resulting change in furnace draft feeds back to the controller, causing a series change to the induced draft.

11) What is desuperheater?

To control the temp. of steam a desuperheater is used. Some quantity of cold water is injected into or around the pipe carrying the steam. This causes the evaporation of water so injected and thus the temp. of steam is lowered.

12) What is deaeration?

Before the water is put into the boiler, entrained or dissolved gases such as CO₂ and O₂ should be eliminated. Eliminating the entrained or dissolved gases before the can enter the boiler is called deaeration and is done by a deaerating heater.

13) What is attemperator?

Attemperator is shell and tube heat exchanger and is used to control the steam temp. Steam is cooled or to remove a variable amount of the heat in heat exchanger.

14) What are the types of feed water control?

Single element, Two element, Three element

15) What are the waterside control mechanisms in steam temperature control?

i) spray mechanism (ii) steam temp. control using a control valve to divert part of steam (iii) use of shell and tube heat exchanger in the saturated steam line between the boiler and the super heater.

16) What are the types of super heater?

- (i) convective super heater (ii) radiant super heater

According to location (i) over deck(ii) inter deck (iii) inter tube (iv) inter bank.

17) What are the requirements to be considered for firing due to load change?

When considering changes of steam pressure, the steam pressure does not change immediately on load change or in proportional to load change. so pressure drop cannot resorted without over firing for the load being carried. the reverse occurs on a rise in pressure, when boiler must be under fired so that the excess energy is used for steam production.therefore,the time constant of boiler is large when compared with other possibly short time constants of a control system. this must be taken into consideration when setting up an automatic boiler control system.

18) What are the methods used for steam temperature control?

- i) heat exchanger type deheater, (ii) spray type deheater, iii) Tilting burners or burner pattern, (iv) super heater gas by pass control and fire control mechanism.

19) What are the methods used for drum level measurement?

- (i)sight gage glass technique(ii) drum level transmitter(iii) probe type(iv)tube expansion type.

20) What are the functions of super heater and reheater?

The steam produced in the boiler is nearly saturated. This steam as such should not be used in the turbine because the dryness fraction of the steam leaving boiler will be low. This results in presence of moisture, which causes corrosion of turbine blades.

21) What are the feed water control objectives?

- *control the drum level to a set pt.
- *minimize the interaction with the combustion control system.
- *make smooth changes in the boiler water inventory as boiler load changes
- * Properly balance the boiler steam output with feed water input.

22) What are the effects of feed water pressure variation?

The performance is seriously degraded by variations in feed water pressure.such feed water pressure variations change the relationship between steam flow and feed water flow. Boiler drum level is then forced to develop an offset from the set pt. in order to bring the steam flow and feed water flow into unbalance.

23) What are the effects of feed water pressure variation in drum level control?

The desired control objective cannot be obtained because it has serious draw backs if the feed water control valve pressure is differential and thus the control valve flow characteristics are not always same. The performance is seriously degraded by variations in feed water pressure.such feed water pressure change the relationship between the steam flow and feed water flow

24) What are the drawbacks of single element feed water control?

- i) If the controller were proportional, a greater drum level offset would occur as boiler load is changed.
- ii) The basic reason for drum level variations around the set pt. represents a specific quantity of water over the entire boiler range.

25) What are the draft losses in boiler?

Boiler combustion air and flue gas flow through a system that includes the boiler furnace. Duct work and various types of heat transfer surface. The driving force for this is an air or flue gas pressure or draft. The combustion air originates in the atmosphere, eventually its derivative, the flue gas is exhausted to the atmosphere. The total draft or pressure is divided up by all those elements in the flow path that tend to resist the flow. he amount of the pressure differential for each of these elements is called as draft loss

UNIT – V PART A

1. Enlist the various components of cooling system

- i) Condenser, ii) Cooling towers, iii) Pumps and pipes

2. Why do we need a turbine governor?

3. How steam temperature affects efficiency of boiler?

The boiler steam temp is also affected by the cleanliness factor, the fuel being fired. The imbalance between fuel input and steam output and excess combustion air. Variation in steam temperature causes latent heat loss of water vapour in the flue gas. Therefore affects boiler efficiency.

4. How to measure speed of turbine?

Vibrating reed tachometer, Stroboscope, clock type tachometer and revolution counter are various instruments used for measuring speed.

5. Why do we need to measure vibration of turbine blades?

The balancing of large rotating steam turbine is a critical component in ensuring the reliable operation of the plant. Most large steam turbines have sensors installed to measure the movement of the shaft in their bearing.

6. Name the sensors used in measuring vibration?

- i) Vibration pickups ii) Vibrometers iii) Electrical vibration pickups iv) mechano-electrical absolute vibration pic

7. How to steam pressure is inter linked with turbine governors?

Governing of stem turbine means to regulate the supply of steam to the turbine to maintain speed of rotation sensibly constant under varying load condition. Therefore variation in steam pressure causes variation in supply of steam to the turbine.

8. What do you mean by high pressure and low pressure turbine?

In typical large power stations the steam turbines are split into three separate stages the first being the high pressure, the second the intermediate pressure and third the low pressure. After the steam has passed through HP stage it is returned to the boiler to be reheated to its original temperature. The reheated steam then passes through the IP stages and finally to the LP stage of the turbine.

9. What is the use of auxiliary steam?

Auxiliary steam extracted from turbine at various points (ie extracted pressure) can be used for cogeneration.

10. What are turbine losses?

- Steam turbine losses include exhaust, mechanical, generator, radiation etc.
- Mechanical losses include bearing losses, oil pump losses and generator losses.
- Generator losses include electrical and mechanical losses.
- Exhaust losses include the kinetic energy of the steam as it leaves the last stage and pressure drop from the exit of last stage to the condenser stage.

11. List the methods to control the steam pressure.

- (i) On-off control (ii) proportional plus integral feedback control (iii) feed forward plus feedback.

12. Why do we need to control lubricant oil?

High pressure oil is injected into the bearing to provide lubrication. The oil is carefully filtered to remove solid particles. Specially designed centrifuges remove any water from the oil. The centrifuges were approaching an expensive overhaul; high speed centrifuges can damage the additive package of oil.

13. Define turbine efficiency.

It is defined as the ratio of net output of the turbine to the power that should be ideally produced by the turbine. Network output of the turbine is always less than ideal output.

14. What are the types of gas turbine?

Cycle: (i) Open cycle (ii) Closed cycle. **Application:** (i) Aircraft (ii) Locomotive (iii) Marine (iv) Transport

Number of shafts (i) Single shaft (ii) Multi shaft. **Fuel:** (i) Liquid (ii) Solid (iii) Gas

Type of load (i) Peak load plant (ii) Standby load plant (iii) Base load plant

15. List the methods to measure speed of turbine.

(i) Bypass governing (ii) Nozzle control governing (iii) Throttle governing

16. How to control the shell temperature?

For controlling the shell temperature, proper insulation should be done in order to avoid leakage in temperature on the surface of the boiler, if the temp. Decreases then gradually the steam gets decreased which in turn decreases the speed of turbine.

17. How to control the speed of turbine?

The speed of the turbine can be controlled by the steam connected in the boiler section with the help of control valve, based upon the demand and requirements.

18. How to control the vibration of turbine blades?

A RELIABLE method of measuring the vibrations of the blades of a turbine while in motion is needed. A non-contact method is clearly preferable to one involving transducers (such as strain gauges coupled to slip-rings or miniature transmitters). There is a possibility of using a laser Doppler system for such a measurement.

19. How sulphuroxides enter into the atmosphere?

Heating

From industrial plants using high sulphur coal and other sulphur containing fossils.

20. How nitrogen oxides enter into the atmosphere?

The nitrogen oxides emitted to atmosphere from product of fuel combustion in furnaces and engine. The level ranges from 0.5 to 0.12 ppm

21. How superheat and reheat steam temperature is measured?

This is critical from the standpoint of safety and efficiency. It is commonly the source of regulation for final steam temperature control to prevent damage to turbine. These temperature are commonly measured by electrical instruments which employ resistance elements or thermocouples and electronic amplification.

22. What are the advantages and disadvantages of wet cooling?

- i) This type of cooling system is used is therefore heavily influenced by the location of the plant and on the availability (sea, large rivers, and lakes) of water suitable for cooling purposes.
- ii) High efficiency
- iii) One of the problem with wet towers is that in cold and humid climates the towers plume can create fog.

23. What are the advantages and disadvantages of dry cooling?

- Dry cooling systems are used where there is insufficient water or where the water is too expensive to be used in an evaporative system.
- Dry cooling systems are least used systems as they have a much higher capital cost, higher operating temperature and lower efficiency than wet cooling.

24. What is the use of alarm and annunciators?

An alarm in which interruption of electric current to a relay, caused, for example, by the breaking of a metallic tape placed at an entrance to a building, deenergizes the relay and causes the relay contacts to operate the alarm indicator. Also known as intrusion alarm.

An annunciator indicative of the current status of the application is then provided, if required. A menu screen with a listing of all items (e.g., missed calls, recorded voice memos, recorded messages, or data calls) may be displayed when requested, and additional information for a selected item may also be provided if requested. The annunciator is cleared if all items are cleared.

25. What are the different methods of dry cooling?

- Closed cycle dry cooling
- Indirect dry cooling

PART B

UNIT - I

1. Explain the block diagram and working of thermal power plant.
2. Explain the block diagram and working of hydro power plant.
3. Explain the block diagram and working of nuclear power plant.
4. Explain the block diagram and working of solar power plant.
5. Explain the working of wind power plant.
6. Write notes on importance of instrumentation in power generation.
7. Compare thermal power plant with nuclear power plant.
8. Compare hydel power plant with thermal power plant.
9. What are the factors to be considered while selecting the power plant.
10. What is co-generation. Explain in detail.

UNIT - II

1. Write briefly about a) Voltage measurement b) Current measurement
2. Write briefly about a) power measurement b) pressure measurement
3. Write short notes on a) Drum level measurement b) Pressure and temperature compensation techniques
4. Explain in detail the function of smoke density measurement and dust monitor
5. Describe about flow measurements involved in power plants
6. Describe temperature measurements in power plants in detail
7. Describe air flow control system.
8. Explain in detail about Steam temperature Measurement
9. Write notes on a) power factor measurement b) frequency measurement
10. Explain about various types of radiation detectors.

UNIT - III

1. Brief about analysis of impurities in feed water and steam
2. Explain about (a) Dissolved oxygen analyzer (b) Flue gas Oxygen analyzer
3. Brief about different methods of PH measurements
4. Explain the various methods about measurement of Oxidants(Ozone)?
5. Brief about carbon dioxide reorders and flame condition
6. Explain about (a) liquid chromatography (b) gas chromatography
7. Explain about different types of detectors in chromatography
8. Describe in detail about flue gas analysis
9. Explain about steam purity measurement and basic steaming process
10. Explain the various methods about measurement of nitrogen oxides

UNIT - IV

1. Describe in detail about interlocks in boiler.
2. Discuss various combustion control systems used in power plants
3. Describe three element feed water control system
4. Explain single element and two element drum level control.
5. Write about control loop interactions
6. Describe distributed control systems in power plants.
7. Explain briefly how the level is measured in drum level controller?
8. Describe various methods of controlling reheated steam temperature.
9. Explain the instrumentation diagram using feedback controller for boilers?
10. Describe fire side control mechanism of steam temperature control in detail?

UNIT -V

1. Describe in detail steam pressure control
2. Write short notes on speed and vibration monitoring and control
3. Explain in detail shell temperature monitoring and control
4. Describe in detail about cooling system used in thermal power plant