QUESTION BANK

Name of the Department : Electrical and Electronics Engineering

Subject Code & Name : ORO551 & RENEWABLE ENERGY SOURCES

Year & Semester : III & V

Branch : ECE

UNIT I

PRINCIPLES OF SOLAR RADIATION

PART-A

1. Define: Energy. What are the different forms of energy?

Energy is the capacity for doing work, generating heat and emitting light. It is measured in terms of the total amount of work that the body can do.

Different form of energy

1. Mechanical energy(kinetic and potential)
2. Thermal (or) heat energy
3. Chemical energy
4. Electrical energy
5. Nuclear energy
6. Electromagnetic energy
7. Gravitational energy.

Electron in the outer most shell of an atom is called valence electron.

2. List the non –conventional energy sources.

The various non-conventional energy sources are as follows:

- Solar energy
- Wind energy
- Energy from biomass and biogas
- Ocean thermal energy conversion
- Tidal energy
- Geothermal energy
- Hydrogen energy
- Fuel cells
- Magneto-hydrodynamics generator
- Thermionic converter
- Thermo-electric power.

The space between the valence and conduction band is said to be forbidden energy gap.

3. Write the advantages of non –conventional Energy sources.

The leading advantages of non-conventional energy sources are:

1. They do not pollute the atmosphere
2. They are available in large quantities.
3. They are well suited for decentralized use.

4. Describe briefly conventional and nonconventional energy sources.

Commercial or conventional Energy sources:

Coal, oil, gas, uranium and hydro are commonly known commercial E.S.

1. Coal - 32.5%
2. Oil – 38.3%
3. Gas – 19.0%
4. Uranium – 0.13%
5. Hydro – 2.0%
6. Wood – 6.6%
7. Dung – 1.2%
8. Waste – 0.3%

World energy supply comes mainly from fossil fuels.

6. What is meant by primary and secondary energy sources? Give examples.

Primary energy sources can be defined as sources which are either found or stored in nature. These energy sources provide a net supply of energy. Ex. Coal natural gas, oil, biomass, solar, tidal, hydro and nuclear energy.Secondary sources of energy are derived from the primary energy sources. Producing electrical energy from coal and producing hydrogen from hydrolysis of water are ex of this type of energy.

7. Write short notes on renewable sources of energy.

Renewable sources of energy is the energy obtained from regenerative or virtually inexhaustible sources of energy occurring in the natural environment such as solar energy, wind energy etc. This type of energy is passing through the environment irrespective of there being a man-made device to intercept and harness the power.

8. List down the environmental impacts associated with in solar power.

i) Land use and habitat loss
ii) Water use
iii) Use of hazardous materials in manufacturing
iv) LIFE- cycle global warming emissions.

9. Define: solar constant.

Solar constant is the amount of energy received in unit time on a unit area perpendicular to the sun's direction at the mean distance of the earth from the sun.

10. Mention the application of solar energy.

1. Passive heating applications.
2. Solar thermal energy applications of medium temperature and high temperature.
3. Solar to electrical energy direct conversion by photo-voltaic cells (PV cells or solar cells) for low and medium power ratings.
4. Large solar central receiver thermal power plants in MW range.

11. Define: beam radiation and diffuse radiation.

Beam radiation: solar radiation that has not been absorbed or scattered and reaches the ground directly from the sun is called direct solar radiation or beam radiation.

Diffuse radiation: It is the solar radiation received from the sun after its direction has been changed by reflection and scattering by the atmosphere.

12. Define hour angle.

Hour angle is the angle through which the earth must turn to bring the meridian of a point directly in the line with the sun rays. It is equivalent to 15 degree per hour.

13. What is Zenith angle?

Zenith angle is a vertical angle between the sun rays and a line perpendicular to the horizontal plane through the point.

It is denoted as Qz and $Qz=\pi/2-\alpha$

Where α = solar altitude.

14. What is the use of sunshine recorder?

The duration of bright sunshine in a day is measured by means of a sunshine recorder.

15. What is pyrheliometer and pyranometer?

Pyrheliometer: is an instrument which measures the beam radiation.

Pyranometer: Is an instrument which measures the total or global radiation over a hemispherical field of view.

16. Define local apparent time.

The time used for calculating the hour angle ω is the local apparent time. It can be obtained from the standard time observed on a clock by applying two corrections.

Majority carrier: holes and minority carrier: electrons.

17. What is angle of latitude?

Angle of latitude is the angle between equatorial plane of earth and line joining the point on the earth's surface and earth's centre.

18. What is total radiation?

Total radiation is the beam and diffuse component of solar radiation which are absorbed in flat plate type collectors**.**

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19. What are the factors considered in collecting solar radiation data?

a) Solar power calculations with reference to the movement of the, latitude of the location etc.

b) Hourly measurement of solar radiation at the location and calculation of daily average global radiation for the month, monthly average global radiation for the year and yearly average global radiation for few years.

20. Name the types of solar radiation data.

a) Typical meteorological year (TMY) data sets.
b) Solar radiation atlas map.

21.List down the information contained in solar radiation data.

1. Whether it is measured or computed.
2. Whether it is direct, diffuse or global
3. Whether it is hourly, daily or monthly.
4. What is the receiving surface orientation? Whether it is incident on a horizontal or inclined surface.
5. What is the azimuth of the surface?
6. What is the time or time period of measurement?
7. Whether it is averaged? If so, what is the time period over which it is averaged?
8. What type of instrument is used for measurement?

22. Define the terms i) Zenith angle ii) Solar azimuth angle iii) Incident angle

i)Zenith angle (θZ)

It is the angle between the sun‘s rays and a line perpendicular to the horizontal plane through the point P. i.e., the angle between the beam from the sun and the vertical. Zenith angle is complimentary angle of sun‘s altitude angle.

$$\theta Z = \pi/2 - \alpha$$

ii) Solar azimuth angle (γS)

It is the solar angle in degrees along the horizon cost or west of north or it is the horizontal angle measured from the north to the horizontal projection of sun‘s rays. It is considered +ve when measured west wise.

In terms of basic angles, $\cos\emptyset(\theta\_Z) = \cos\emptyset.\cos\omega.\cos\delta+\sin\emptyset.\sin\delta$

iii) Incident angle (θ)

It is the angle being measured from a plane and is equal to the angle between the beam of rays and normal to the plane.

PART-B

1. Write short notes on:

   i) Conventional or non –renewable energy sources.

   ii) Renewable energy sources

2. Explain the global potential of renewable energy sources.

3. Enumerate of new and renewable energy sources in India.

4. i) Enumerate the environmental impact of solar energy

   ii) Define clarity index and concentration ratio.

5. Write short notes on solar radiation data. List the various information contained in solar radiation data.

6. Enumerate the methods of measuring global solar radiation using various pyranometers.

7. i) How is the average solar radiation estimated? Explain in detail.

   ii) Compare pyrheliometer and pyranometers.

8. Describe the measurement of diffuse radiation using a suitable type of instrument.

UNIT II

SOLAR ENERGY COLLECTION

PART-A

1. State the advantages and disadvantages of concentrated collector over flat plate collector.

Advantages of Flat plate collector:

1. Of using both beam and diffuse solar radiations
2. They do not require orientation towards the sun.
3. They require little maintenance.
4. Mechanically simpler than the concentrating reflectors, absorbing surfaces and orientation devices of focusing collectors

Drawbacks of using water as fluid:

1. Freezing in the collector tubes in the cold climates during cold nights. (ethyline glycol is added to prevent)
2. Corrosion of the metal tubes.

2. What are the main components of a flat plate collector ? Explain the function of each.

Basic Components of Flat plate collectors:

1. A transparent cover which may be one or more sheets of glass or radiation transmitting plastic film or sheets.
2. Tubes, fins, passages or channels are integrate with the collector absorber plate or connected to it, which carry the water, air or other fluids.
3. The absorber plate, normally metallic or with a black surface although a wide variety of other materials can be used with air heaters.
4. Insulation, Which should be provided at the back and sides to minimize the heat losses. (fiber glass or styro-foam)
5. The casing or container which enclose the other components and protects them from the weather.

3. State the Various characteristics features of a solar collector system.

1. The temperature of working fluid such as a low temperature, medium temperature and high temperature.
2. Whether tracking system is used or not. If used what type of tracking system used i.e. tracking type or non-tracking type and tracking in one plane or two planes.
3. Cost of the solar collector system.
4. Design of the solar collector system
5. Layout and configuration of collectors in the solar field.

4. What are the important aspects of solar collector system?

1. Concentration ratio
2. Temperature range
3. Absorption / reflection ratio.
4. Collector efficiency.

5. Define concentration ratio

Concentration ratio(CR)=kW/m^2 in solar radiation on surface / kW/ m^2 on surface of focus of collector

6. List down the factors affecting solar collectors system's efficiency.

1. Shadow effect.
2. Cosine loss factor.
3. Reflective loss factor.

7. What is collector efficiency?

Collector efficiency= energy collected by the collector(J) / energy incident on the collector (J)

8. Define reflective loss factor.

The collector glass surface and the reflector surface collect dust, dirt and moisture. The reflector surface gets rusted, deformed and losses the shine. Therefore the efficiency of the collector is significantly reduced with the passage of time. This effect is called reflective loss factor.

9. What are the two types of flat plate type collector?

i) Non concentrating or flat plate type solar collector.
ii) Concentrating (focusing) type solar collector.

10. Name the various types of air heaters operated by solar principles.

1. Solar air heater with non porus absorber.
2. Solar air heater with porous absorber.

11. Write down the applications of solar air heaters.

1. Heating green house building
2. Drying agriculture products
3. Heat source for a heat engine.
4. Air- conditioning buildings.

12. What are the factors affecting performance of flat plate collectors?

1. Incident solar radiations falling on the solar collector.
2. Number of cover plates.
3. Slope of the flat plate collector which is tilted at an angle of latitude of the location.
4. Spacing between absorber plate and cover plate. Internal hat losses prevented by providing more space.
5. Inlet temperature of the working fluid.
6. Dust deposited on the cover which should be minimized for obtaining higher efficiency.

13. What is heliostat?

Heliostat is a large and flat reflecting mirror with a provision to track the sun in two plants. The solar rays are reflected by each individual heliostat onto the central receiver mounted on a tall tower. A central receiver is mounted on a tall tower.

14. What are the different types of concentrating collector?

1. Line focusing
2. Point focusing type.

15. What are the main types of concentrating collector?

1. Parabolic through collector.
2. Mirror strip reflector.
3. Fresnel lens collector.
4. flat plate collector with adjustable mirrors.

16. What are the advantages of concentrating collector?

1. The reflecting surface of the concentrating collector requires less material and structurally simpler than flat-plate collectors.
2. The absorber area of a concentrator system is smaller than a flat-plate system.
3. The area from which the het is lost to smaller than a flat-plate collectors.
4. It can be used for electric power generation.

17. What are the disadvantages of concentrating collector?

1. In concentrating collectors, only the beam component is collected because the diffuse component cannot reflect.
2. Costly orienting systems must be used to track the sun.
3. Additional maintenance is required to retain the quality of reflecting surface against dirt, weather and oxidation.
4. It is non-uniform flux on the absorber whereas the flux in flat-plate collectors is uniform.
5. Optical losses and interrupt loss are in energy balance.

18. Define stratification.

Stratification is defined as a natural process in which both warmth and density of water are inversely proportional properties. The warm water always settles at the top of cold water. The process takes place in a stratified thermal energy storage tanks in terms of two operations such a charging and discharging**.**

PART-B

1. How is solar energy systems classified? Give brief explanation of these systems.
2. What are the solar collectors? How are the solar collectors classified?
3. i) List the important aspects of solar collector system.

   ii)Describe the various factor affecting the solar collectors system's efficiency.
4. Explain the construction and working of liquid heating flat-plate collectors with a neat sketch.
5. Explain the construction and working of solar concentrating collectors with a neat sketch.
6. i) With a neat sketch explain the modified flat plate collector.

   ii)Explain the sola air heater with neat sketches.
7. Describe the construction and working of paraboloidal dish collector with sketches.
8. i) Explain in detail about thermal power generation.

   ii)Explain the analysis of a central power receiver system.

UNIT III
SOLAR ENERGY STORAGE AND APPLICATIONS

PART-A

1.With the help of neat diagram ,Explain the construction and working principle of a solar pond.

The sun is the largest source of renewable energy and this energy is abundantly available in all parts of the earth. It is in fact one of the best alternatives to the non-renewable sources of energy. One way to tap solar energy is through the use of solar ponds. Solar ponds are large-scale energy collectors with integral heat storage for supplying thermal energy. It can be use for various applications, such as process heating, water desalination, refrigeration, drying and power generation.

2. Define stratification.

Stratification is defined as a natural process in which both warmth and density of water are inversely proportional properties. The warm water always settle at the top of cold water. The process takes place in a stratified thermal energy storage tanks in terms of two operations such a charging and discharging.

3. Name the types of solar energy storage methods.

1. Thermal energy storage
2. Sorption storage
3. Chemical energy storage.

4. List down the methods of thermal energy storage.

1. Sensible heat storage.
2. Latent heat storage.
3. Stratified storage.

5.Briefly explain the principle of sensible heat storage.

In sensible heat storage, thermal energy is stored by raising the temperature of a solid or liquid by using its heat capacity. SHS system utilizes the heat capacity and the change in temperature of the material during the process of charging and discharging. The amount of heat stored depends on the specific heat of the medium, temperature storage and amount of storage material.

6.State the advantages of rocks for solid sensible heat storage.

a) Rocks are not toxic and non-flammable.
b) Rocks are inexpensive
c) Rocks act both as heat transfer surface and storage medium.
d) The het transfer between air and a rock bed is good due to the very large heat transfer area and the effective heat conductance of the rock pile is low due to the small area of contact between rocks.

7. What is the basic principle of latent heat storage?

Latent heat storage uses the latent heat of the material to store thermal energy latent heat is the amount of heat absorbed or released during the change of the material from one phase to another phase.

8. Classify phase change materials(PCM)

1. Organic PCM
2. Inorganic PCM
3. Eutectic PCM.

9. What are the advantages of latent heat storage?

i) It includes large density of heat storage and constant temperature.

ii) The process is completely reversible and it can be repeatedly utilized without degradation.

10. Write down the advantages of stratified heat storage.

i) Energy efficiency.
ii) Optimum process.
iii) Reliable material.

11. What are the factors to be considered while selecting the method of storage?

i) The temperature range over which the storage has to operate.
ii) The capacity of the storage has a significant effect on the operation of the rest of the system.
iv) Heat losses from the storage have to be kept to a minimum. Heat losses particularly important for long-term storage.
iv) The rate of charging and discharging.
v) Cost of the s storage unit.

12. What are the different zones names of solar pond?

A solar pond has three zones. The top zone is the surface zone, or UCZ (Upper Convective Zone), which is at atmospheric temperature and has little salt content. The bottom zone is very hot, 70°– 85° C, and is very salty. It is this zone that collects and stores solar energy in the form of heat, and is, therefore, known as the storage zone or LCZ (Lower Convective Zone). Separating these two zones is the important gradient zone or NCZ (Non-Convective Zone).

13. List down the factors in determining the optical transmission properties and collection efficiency of solar ponds.

i) Salt concentration
ii) The quantity of suspended dust or other particles.
iii) Surface impurities like leaves or debris, biological material like bacteria and algae.
iv) The type of salt

14. What are the applications of solar pond?

i) Power generation.
ii) Space heating and cooling.
iii) Crop drying
iv) Desalination.
v)Process heat.

15. State any four advantages and disadvantages of solar pond.

Advantages.

i)It provide low investment costs per installed collection area.
ii) Thermal storage is incorporated into the collector and it is of very low cost.
iii)Diffuse radiation(cloudy days) is fully used.
iv)Very large surfaces can be built. thus, large scale energy generation is possible.

Disadvantages.

i)It need large land area to function properly.
ii)The accumulate salt crystals have to be removed periodically and it adds maintenance expense.
iii)it can be only operated only operate in sunny days and if the site shaded by tall trees or building, it may not work properly.

16. Name the components of a solar water heater..

i) A flat plate collector to absorbs solar radiation and convert it into thermal energy.
ii) Storage tank to hold water for use and cold water feeding the flat plate collector.
iii) Connecting pipes inlet and outlet for feeding cold water from the storage tank and taking hot water to the storage tank or point of use.

16. What is passive solar heating?

Passive solar energy technologies absorb solar energy, store and distribute it in a natural manner without using mechanical elements and also use natural ventilation.

17. Classify solar cooker.

i) Flat plate box type solar cooker with or without reflector.

ii) Multi reflector type solar cooker.

iii) Parabolic disc concentrator type solar cooker.

18. List down the methods of solar drying.

i) Open sun drying
ii) Direct solar drying
iii) Indirect solar drying

19. Mention the advantages of solar distillation

i) Low energy consumption.
ii) No fuel required
iii) Low maintenance cost.
iv) No pollution.
v) Simple design.

20. What is a solar cell?

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

21. What is the efficiency of a solar cell?

Efficiency of a solar cell= electrical power output / power intercepted

22. What are the components of PV system?

1. Solar cell array. 2. Load leveler, 3. Storage system. 4. Tracking system

23. What are the applications of solar PV system?

1. Water pumping sets for micro irrigation and drinking water supply.
2. Weather monitoring.
3. Rail way signaling equipment.

PART-B

1.Discuss about on any solar energy storage.

2. Discuss in detail about various solar energy storage method.

3. i) Write short notes on solar fuels.
ii) Discuss the working of solar cooker.

4. Enumerate the working of any two solar heating devices.

5. Explain briefly the working of solar pond with neat sketch.

6. Explain the construction and configuration of solar cells.

7. (i) Describe the working of solar furnace works .
(ii) Explain how foods are dried using solar energy.
(iii) Describe the working of solar furnace PV water pumping.

8. Explain briefly the working of solar distillation with neat sketch.

UNIT IV
WIND ENERGY AND BIOMASS ENERGY
PART-A

1. Classify the wind energy conversion systems.

- Vertical axis type
- Horizontal axis type

2. Describe History of Wind Machines.

Since ancient times, people have harnessed the wind‘s energy. Over 5,000 years ago, the ancient Egyptians used the wind to sail ships on the Nile River. Later, people built windmills to grind wheat and other grains. The early windmills looked like paddle wheels. Centuries later, the people in Holland improved the windmill. They gave it propeller type blades, still made with sails. Holland is famous for its windmills. In this country, the colonists used windmills to grind wheat and corn, to pump water, and to cut wood at sawmills. Today, people occasionally use windmills to grind grain and pump water, but they also use modern wind turbines to make electricity

3. Explain the working of a wind energy conversion system for Generation of electricity.

Horizontal Axis Wind Turbines (HAWTs)

Horizontal-axis wind turbines (HAWT) get their name from the fact that their axis of rotation ishorizontal. They have the main rotor shaft and electrical generator at the top of a tower, and arepointed into the wind. The variability of wind distribution and speed brings up the requirement ofa gear system connected to the rotor and the generator. The gear system enables a constant speedof rotation to the generator thus enabling constant frequency generation. Turbine blades are madestiff in order to prevent the blades from being pushed into the tower by high winds. Downwindmachines have also been built, as they no longer require a yaw mechanism to keep them facingthe wind, and also because in high winds the blades can turn out of the wind thereby increasing drag and coming to a stop. Most of the HAWTs‘ are upwind as downwind systems cause regular turbulence which may lead to fatigue.

4. What are the advantages and disadvantages of HAWT?

HAWT advantages

• Variable blade pitch, which gives the turbine blades the optimum angle of attack. Changing the angle of attack provides greater control over power generated and enables maximum efficiency.
• As wind energy increases with height, the tall tower in the HAWT gives access to higher wind speed. In some cases increase of even 10m height leads to increase in wind speed by 20 %

•In HAWTs'the blades move horizontally that is perpendicular to the wind and hence has minimum drag and they receive power throughout the rotation.

•HAWT disadvantages

•Due to inherent large structures, construction costs are very high and so are transportation costs.

•Civil construction is costly due to erection of large towers.

•Wind turbine operation often leads to production of electronic noise which affects radar sites.

• In case of downwind HAWTs'the regular turbulence produced leads to structural failure.

• HAWTs require an additional yaw control mechanism to turn the blades toward the wind.

5. Explain the functions and short notes of a different component of WECS.

Anemometer, Blades, Brake, Controller, Gear box, Generator, Nacelle, Pitch, Rotor, Tower, Wind vane, Yaw drive.

6. Write the characteristics of wind energy?

i) Wind-power systems do not pollute the atmosphere.

ii) Fuel provision and transport are not required in wind power systems.

Iii) Wind energy when produced on small scale, cheaper.

7. What are factors affecting the wind energy efficiency?

i) It is fluctuating in nature.

ii) Due to its irregularity it needs storage devices.

iii) Wind power generating systems produce ample noise.

8. What are the types of wind mills?

i) Multi blade wind mill.

ii) Savonius type

iii)Darrieus type.

9. Define capacity factor.

The ratio between actual productivity in a year and theoretical maximum is called capacity factor. The typical capacity factors are 20-40%.

Capacity factor= Actual productivity in a year / Theoretical maximum productivity in a year

10. How will you define wind energy penetration?

Wind energy penetration is defined as the fraction of energy produced by from the total available generation capacity. Since the output obtained from the power amplifier is very large, it is known as large signal amplifier.

11. Define Betz limit of a wind turbine.

Betz limit is the theoretical limit assigned to efficiency of a wind turbine.

12. What is meant by stalling?

If the air pressure increases on temperature low pressure side, enormous turbulence is produced which reduces the lift force and it leads to increase the drag significantly called stalling.

13. Write down any two advantages and disadvantages of VAWT.

Advantages:

i) VAWT's may be build at locations where taller structures are prohibited.

ii) VAWT's situated close to the ground can take the advantage of locations where hilltops ridgelines and it passes funnel the wind. It increases the wind velocity.

Disadvantages:

i) The stress in each blade due to wind loading changes sign twice during each revolution as the apparent wind direction moves through 360^0.

ii) While VAWT'S parts are located on the ground, they are also located under the weight of the structure above it which can make changing out parts nearly impossible with out dismantling the structure if not designed properly.

14.List down the parameters considered in designing wind turbine rotors.

i) Solididity
ii) Tip-speed ratio
iii) Performance coefficient.
iv) Torque.
v)Rotor power control

15. Define solidity.

Solidity is defined as the percentage of the circumferences of the rotor which contains the material instead of air.

16. What is tip speed ratio?

TIP-speed ratio is defined as the ratio of the speed of the blade tip of a wind mill rotor to the speed of the free wind. It is a measure to know the gearing ratio of the rotor.

17. Classify wind power plants.

1. Remote wind power plant.
2. Hybrid wind power plant
3. Small wind turbine.
4. Grid connected wind power plant.
5. Wind fan.

18. Mention the sites selected to install wind mills.

1. Plane sites
2. Hill top sites.
3. Sea- shore sites.
4. Off-shore shallow water sites.

19. What do you understand by zero energy houses?

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

20. Define biomass

Biomass is biological material from living, or recently living organisms, most often referring to plants or plant-derived materials. As a renewable energy source, biomass can either be used directly, or indirectly -- once or converted into another type of energy product such as biofuel. Biomass can be converted to energy in three ways: thermal conversion, chemical conversion, and biochemical conversion.

21. Give a descriptive classification of biomass resource.

Hey are classified as

1. Bio fuel.
2. Bio alcohols.
3. Bio gas.

22. Discuss the process of biogas generation.

Organic substances exist in wide variety from living beings to dead organisms . Organic matters are composed of Carbon (C), combined with elements such as Hydrogen (H), Oxygen (O), Nitrogen (N), Sulphur (S) to form variety of organic compounds such as carbohydrates, proteins & lipids. In nature MOs (microorganisms), through digestion process breaks the complex carbon into smaller substances.

The digestion process occurring in presence of Oxygen is called Aerobic digestion and produces mixtures of gases having carbon dioxide (CO2), one of the main –green houses responsible for global warming.

The digestion process occurring without (absence) oxygen is called anaerobic digestion which generates mixtures of gases. The gas produced which is mainly methane produces 5200-5800 KJ/m3 which when burned at normal room temperature and presents a viable environmentally friendly energy source to replace fossil fuels (non-renewable)

23. What are the factors affecting biogas generation. Explain them briefly.

Factors affecting Biogas production:

1. Substrate temperature

2. pH level
3. Mixing Ratio
4. Loading Rate
5. Hydraulic Retention time
6. Nitrogen inhibition
7. C/N ratio
8. Agitation
9. Toxicity
10. Solid concentration
11. Seeding
12. Metal Cations
13. Particle size
14. Additives
15. BOD
16. COD
17. Heating

24. What are the different models of biogas plants in India?

Main types of simple biogas plants:

- Balloon plants,
- Fixed-dome plants,
- Floating-drum plants types.

25. What are the different types of biomass waste?

1. Urban waste.
2. Process waste.
3. Agriculture waste.
4. Forest waste.
5. Fishery and poultry.
6. Animal and human excreta.

26. What are advantages of bioenergy?

1. It is a renewable source.
2. The pollutant emissions from combustion of biomass are usually lower than fossil fuels.
3. Commercial use of biomass may avoid or reduce the problems of waste disposal in other industries.
4. Use of biogas plants apart from supplying clean gas also leads to improved and stabilized sanitation.
5. The forestry and agricultural industries which supply feed stocks also provide substantial economic development opportunities in rural areas.
6. The energy storage is an in-build feature of it.

27. What are the disadvantages of bio energy?

1. It is dispersed and lead intensive source.
2. It is often of low energy density.
3. It is also labour intensive and the cost of collecting large quantities of biomass for commercial application is significant.

28. What are the major categories of biomass conversion process?

1. Direct combustion (incineration)
2. Thermo chemical conversion.
3. Biochemical conversion.

29. What is carbonization?

Wood is heated with a restricted air flow to form a high carbon product by removing volatile materials from. It is termed as carbonization.

30. What is fermentation?

It is the breakdown of complex molecules in organic compound under the influence of ferment such as yeast, bacteria, and enzymes.

31. What is hydrolysis?

Hydrolysis is the technology which converts cellulose into alcohol through fermentation.

PART-B

1. Write short notes on the following:

   a. Source of wind.

   b. Wind energy potential.

2. Write short notes on the principle of wind energy conversion systems.

3. Discuss the working of horizontal axis wind turbine with a neat sketch.

4. Explain in detail about the various types of wind energy systems.

5. Discuss the working of vertical axis wind turbine with a neat sketch.
6. What are the biomass energy conversion processes? Explain any one of them in detail.
7. Briefly explain the construction and working of any two biomass gasifies.
8. i) Describe the combustion characteristics of bio-gas.
   ii) Explain biogas utilization for cooking.
9. Write short notes on IC engine operation using biogas and enumerate modification of internal combustion engines for using biogas.
10. Explain the working of continuous process biogass plant.

UNIT V

GEOTHERMAL ENERGY

PART-A

1. What is geothermal energy?

Geothermal energy is the heat from high pressure steam coming from within the earth. It is renewable source of energy derived from the rain water in the earth heated to over 180^0 C by subterranean.

2.What are the applications of geothermal energy?

1. Generation of electric power
2. Space heating for buildings
3. Industrial process heat.

3. List some geothermal fluids.

1. Hot water
2. Hot brine
3. Wet stream.
4. Combination of above.

4. What are the forms of geothermal energy stored deeply inside the earth?

1. Hot water springs
2. Fumaroles.
3. Volcanic eruptions.

5.What are the important criteria while selecting the geothermal energy?

1. Temperature of geothermal fluid, ^{0} C.
2. Discharge rate, m^3 / day.
3. Useful life of production well, years.
4. Mineral contents gram/$m^{3.}$

6. What are the different types of geothermal energy deposits?

1. Hydro-geothermal energy resources.
2. Petro- geothermal energy deposits.
3. Hot-dry rock.

7. List down the advantages of geothermal energy over other energy systems.

1. It is versatile in its use reliable source of energy.
2. IT is cheaper.
3. It delivers a greater amount of net energy.
4. It has highest annual load factor of 90% as compared to conventional plants.

8. List down the disadvantages of geothermal energy over other energy systems.

1. Overall efficiency for power production is low about 15% when compared to 35- 40 % for fessil fuel plants.
2. Drilling operation is noisy.
3. Large area is required for the exploitation of geo-thermal energy as much diffused.

9. Mention the types of Ocean thermal energy conversion (OTEC)

1. Open cycle (or) Claude cycle.
2. Closed cycle (or) Anderson cycle.

10. What is Open cycle or Claude cycle?

In this cycle, the seawater plays a multiple role of a heat source, working fluid, coolant and heat sink. Warm surface water enters an evaporator where the water is flash evaporated to steam under particle vacuum. Low pressure is maintained in the evaporator by a vacuum pump. The low pressure so maintained removes the non-condensable gases from the evaporator. The steam and water mixture from evaporator then enters a turbine, driving it thus generating electricity. The exhaust from the turbine is mixed with cold water from deep ocean in a direct contact condenser and is discharged to the ocean. The cycle is then repeated. Since the condensate is discharged to the ocean, the cycle is called open cycle.

11. What is flash evaporation?

In the evaporator the pressure is maintained at a value (0.0317 bar) slightly lower than the saturation pressure of warm surface water at 27□C (0.0356 bar). Hence, when the surface water enters the evaporator, it gets 'superheated'This. super heated water undergoes ‚volume boiling' causing the water to partially flash to steam.

The Common collector or Emitter follower amplifier is an example for voltage series feedback.

12. What is closed cycle?

Here, a separate working fluid such as ammonia, propane or Freon is used in addition to water. The warm surface water is pumped to a boiler by a pump. This warm water gives up its heat to the secondary working fluid thereby losing its energy and is discharged back to the surface of the ocean. The vapours of the secondary working fluid generated in the boiler, drive a turbine generating power. The exhaust from the turbine is cooled in a surface condenser by using cold deep seawater, and is then circulated back to the boiler by a pump.

13. Mention the advantages and disadvantages of OTEC.

Advantages of OTEC

1. Ocean is an infinite heat reservoir which receives solar incidence throughout the year.
2. Energy is freely available.

Disadvantage of OTEC

1. Efficiency is very low, about 2.5%, as compared to 30-40% efficiency for conventional power plants.
2. Capital cost is very high.

14. What are the applications of OTEC?

1. Open cycle OTEC plant is used to produce desalinated water which is mainly used for irrigation and human consumption.
2. A closed cycle OTEC plant is used as a chemical treatment plant.
3. The power generated by OTEC plants can be used in hydrogen production through water electrolysis process.

15. What are the basic principles of tidal power generation?

Tides are produced mainly by the gravitational attraction of moon and sun on the water of solid earth and oceans. About 70% of the tide producing force is due to the moon and remaining 30% is due to the sun.

16. What are the components of tidal power plants?

1. Dam or dyke.
2. Sluice ways.
3. Embankments.
4. Power house.

17. What are the modes of operations of tidal barrage power plants?

1. Ebb generation.
2. Flood generation.
3. Two-way generation.
4. Pumping and training.

18.Mention the major types of tidal stream generators.

1. Axial turbines.
2. Vertical and horizontal axis cross flow turbines.
3. Helical turbines.

19. What are the advantages of tidal power generation?

1. Tidal power in exhaustible.
2. Free from pollution.
3. These power plats do not damage large area of valuable land.

20. What are the disadvantages of tidal power generation?

1. The tidal ranges are highly variable and thus the turbines have to work on a wide range of head variation.
2. Construction in sea is found difficult.
3. Cost is not favorable when compared to other sources of energy.

21. Define wave energy.

Wave energy is energy of interchanging potential and kinetic energy in the wave.

22. List down the parameters involved wave data collection.

1. Height of the wave.
2. Period of wave.
3. Energy period
4. Energy density.
5. Power density.
6. power per unit width.

22. What are the wave energy converters?

The technologies developed to generate energy from waves and currents called hydrokinetic energy conversion devices are generally categorized as either wave energy converters.(WECs)

23. Mention the advantages of wave energy.

1. The wave energy naturally concentrated by accumulation at alla times, space and transported than wind and solar energies.
2. Wave conditions are predictable and hence, the energy is also predictable.
3. Wave from transportation across a plane perpendicular to the wave propagation direction at a good site is form 10 to 100 times large.
4. Wave power devices are not required to use large land masses such as wind or solar.

24. What are disadvantages of wave energy?

1. Difficult to maintenance, construction cost, life time and reliability due to wave energy available on the ocean.
2. Wave energy conversion devices must withstand the severe peak stresses during storms.
3. Irregularity of wave pattern in amplitude, phase direction makes it difficult to extract power efficiently.
4. Harnessing the power of it is difficult.

25. Define the term "hydrology".

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

26. What is hydrograph?

Hydrograph is a graph plotted for the rate of flow versus time past a specific point in a river or other channel or conduit carrying flow.

27. For which purposes hydro projects are developed?

1. To meet the power needs during peak and off peak requirements.
2. To run of the river.
3. To obtain a clean process of power generation.
4. To avoid suffering from the limitations of inflation on account of fuel consumption in the long run.

28. Define run-off.

Run-off is defined as the movement of land water to the oceans mainly in the form of rivers, lakes and streams.

29. Classify power plants on the basis of traditional use.

1. Concrete gravity dam type hydroelectric power plant.
2. Embankment dam type hydroelectric power plant.

30. What is fuel cells?

A fuel cell is a device that converts the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent.

31. Mention the important design features in a fuel cell

The most important design features in a fuel cell are:

- The electrolyte substance. The electrolyte substance usually defines the type of fuel cell.
- The fuel that is used. The most common fuel is hydrogen.
- The anode catalyst, which breaks down the fuel into electrons and ions. The anode catalyst is usually made up of very fine platinum powder.
- The cathode catalyst, which turns the ions into the waste chemicals like water or carbon dioxide. The cathode catalyst is often made up of nickel.

PART-B

1. Briefly explain the geothermal energy sources.
2. Classify the methods of harnessing the geothermal energy, and explain any two methods.
3. What are geo pressured resources and magma resources?
4. i) Write short notes on geothermal energy potential in India.
   ii) Explain the working principle of OTEC.
5. Explain the working principle of land based OTEC power plant.
6. Explain the working principle of floating OTEC power plant.
7. Enumerate the working principle of both open and closed cycle OTEC systems.
8. Short notes on i) Explain the wave energy potential.
   ii) Explain the working of any two wave-energy conversion devices.
9. Breifly explain the different components of mini hydroelectric power system and their design considerations.
10. i) Write short notes on economic of mini- hydel power plants (MHPP).
    ii) Describe the working principles of MHD systems.
11. Explain the principle of power generation using solar photovoltaic systems.
12. Discuss the principle of operation of a full cell with a neat sketch.