Model Question Paper-2 with effect from 2021(CBCS Scheme)

US N | | | | | | | | | | |

Sixth Semester B.E. Degree Examination

Renewable Energy Power Plant

TIME: 03 Hours **Max. Marks: 100**

SET - 3

Note: 01. 02. Answer any **FIVE** full questions, choosing at least **ONE** question from each

MODULE THESE ANSWERS FROM NOTES

		Module -1 DOWNLOAD	Bloom's Taxonomy Level	COs	Marks
Q.01	a	Explain the need of non conventional energy sources The need for non-conventional energy sources arises from several critical factors that highlight the limitations and challenges associated with traditional energy sources, particularly fossil fuels. Here are some key reasons: 1. Depletion of Fossil Fuels : Oil production is expected to gradually decline after reaching its peak around 2015, with most of the world's oil reserves potentially being depleted by the end of this century. This decline poses a significant risk to energy security, as oil currently meets about 30% of global energy demand and powers most transportation systems. 2. Environmental Concerns : Conventional energy sources, especially fossil fuels, contribute to environmental degradation, including air pollution and greenhouse gas emissions. Non-conventional energy sources, such as solar and wind, are much cleaner and have a lower environmental impact, making them more sustainable options for the future. 3. Economic Viability : As fossil fuel resources become scarcer, the costs associated with extraction and production are likely to rise. Non-conventional energy sources, while initially requiring investment in technology and infrastructure, can ultimately lead to lower operational costs and greater energy independence. 4. Diverse Energy Portfolio : Relying solely on fossil	L2	CO 1	10

vtucloud.in

JOIN WHATSAPP CHANNEL OR GROUP

		fuels makes energy systems vulnerable to market fluctuations and geopolitical tensions. Incorporating non-conventional energy sources into the energy mix can enhance energy security and resilience. 5. Technological Advancements : Innovations in technology are making non-conventional energy sources more efficient and economically feasible. For instance, advancements in solar panel technology are improving energy capture and reducing costs, making solar energy a more attractive option. 6. Sustainability : Non-conventional energy sources, such as solar, wind, and hydroelectric power, are derived from natural processes that are continuously replenished. This sustainability is crucial for meeting current and future energy needs without depleting resources. 7. Global Energy Demand : The global demand for energy is expected to continue rising, driven by population growth and economic development. Non-conventional energy sources have the potential to meet this demand sustainably and indefinitely.			
	b	Explain merits and demerits of any three non conventional energy Sources Sure! Let's explore the merits and demerits of three non-conventional energy sources: solar energy, wind energy, and geothermal energy. 1. Solar Energy Merits: - Abundance: Solar energy is incredibly abundant. The Earth receives about 1.8 × 10^11 megawatts (MW) of solar power, which is thousands of times greater than the current consumption rate of all commercial energy sources. - Environmentally Friendly: It is a clean energy source, producing no harmful emissions during operation, which helps combat climate change. - Sustainability: Solar energy is renewable and can meet current and future global energy needs indefinitely, as long as the sun shines. Demerits: - High Initial Costs: The installation of solar panels and systems can be expensive, which may deter some users.	L2	CO 1	10

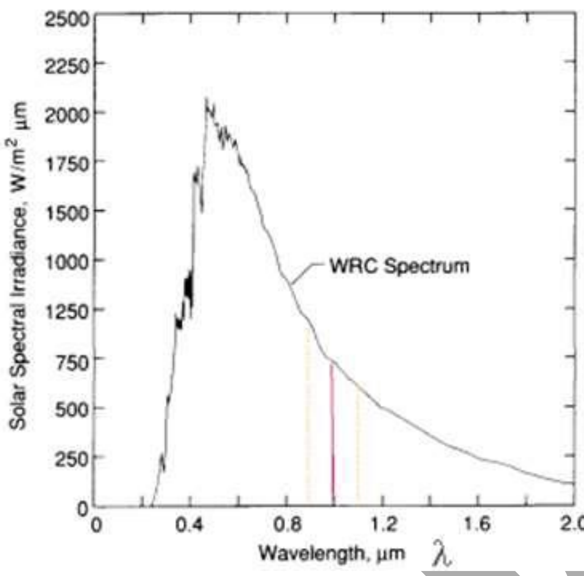
JOIN WHATSAPP CHANNEL OR GROUP

vtucloud.in

		- Intermittency: Solar energy generation is dependent on sunlight, which varies by time of day and weather conditions, necessitating energy storage solutions that can add to costs. - Space Requirements: Large areas are often needed for solar farms, which can be a limitation in densely populated regions. 2. Wind Energy Merits: - Renewable and Sustainable: Wind energy is derived from natural wind currents and is inexhaustible as long as the sun shines and the Earth rotates. - Low Operating Costs: Once a wind turbine is installed, the cost of operation and maintenance is relatively low compared to fossil fuels. - Minimal Environmental Impact: Wind energy generation produces no emissions, making it a clean alternative to fossil fuels. Demerits: - Intermittency: Wind energy is also variable, as it depends on wind speed and direction, which can change unpredictably. - Noise and Aesthetic Concerns: Wind turbines can produce noise and may be considered unsightly by some communities, leading to opposition against new installations. - Impact on Wildlife: Wind farms can pose threats to birds and bats, which may collide with turbine blades. 3. Geothermal Energy Merits: - Reliable and Consistent: Geothermal energy provides a stable and continuous power supply, as it is not dependent on weather conditions. - Low Emissions: It has a much lower carbon footprint compared to fossil fuels, contributing to reduced greenhouse gas emissions. - Small Land Footprint: Geothermal plants require less land compared to solar or wind farms, making them suitable for areas with limited space. Demerits: - Location Specific: Geothermal energy is site-specific, meaning it can only be harnessed in areas with suitable geological conditions, such as near tectonic plate boundaries.			

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

		- High Initial Costs: The drilling and exploration required to access geothermal resources can be expensive and risky. - Potential for Induced Seismicity: There is a risk of inducing small earthquakes during the extraction process , which can raise concerns among local communities.			
OR					
Q.02	a	Explain spectral distribution of extra-terrestrial radiation  The spectral distribution of extra-terrestrial radiation refers to the way solar radiation is distributed across different wavelengths as it reaches the outer edge of Earth's atmosphere. This radiation is primarily emitted by the sun and spans a wide spectrum, ranging from approximately 0.1 to 4.0 micrometers (µm). At the top of the atmosphere, the average extraterrestrial irradiance is about 1367 W/m^2, although this value can vary by ±3% as the Earth orbits the sun. The sun emits a significant amount of its energy in the ultraviolet (UV), visible, and infrared (IR) regions of the spectrum. Specifically, about 7% of the sun's emission falls within the UV range (0.1 to 0.4 µm), while approximately 44% is in the visible light range (0.4 to 0.71 µm), and the remaining 48% is in the infrared range (0.71 to 4.0 µm). The solar constant, which is a measure of the flux density of solar energy received per unit area at the mean distance of the Earth from the sun, is crucial for understanding this distribution. It is defined as the amount of solar energy received in unit time on a unit area perpendicular to the sun's rays. The standard value for the solar constant was revised to 1367 W/m^2 based on measurements taken after 1970.	L2	CO 2, CO 3, CO4	10

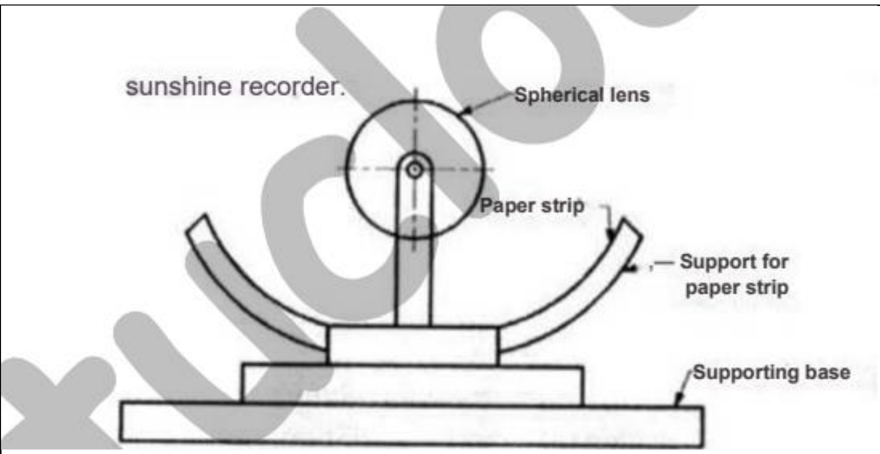
vtucloud.in

JOIN WHATSAPP CHANNEL OR GROUP

		As solar radiation travels through the atmosphere, it undergoes absorption and scattering, which affects the intensity and spectral distribution of the radiation that ultimately reaches the Earth's surface. Absorption primarily occurs due to gases like ozone and water vapor, while scattering is caused by both gaseous molecules and particulate matter in the atmosphere. This results in a complex interplay of direct and diffuse radiation that is critical for various applications, including solar energy utilization.			
	b	Explain with neat sketch working of sun shine recorder The sunshine recorder is an instrument designed to measure the duration of sunshine at a specific location. It operates by recording the amount of solar radiation received over a period of time. Here's a detailed explanation of its working, along with a description of its components: Working of Sunshine Recorder 1. Structure : The sunshine recorder consists of a semi-circular shading ring and a thermopile element. The shading ring is fixed in such a way that its plane is parallel to the path of the sun across the sky. This design ensures that the thermopile element is shaded from direct sunlight at all times. 2. Measurement Principle : The thermopile element is sensitive to temperature changes. When sunlight hits the thermopile, it heats up, and the temperature change is proportional to the amount of solar radiation received. However, since the thermopile is shaded from direct sunlight, it only measures the diffuse radiation coming from the sky. 3. Recording Sunshine Duration : The sunshine recorder typically includes a recording device that tracks the temperature changes over time. As the sun moves across the sky, the amount of diffuse radiation varies, and this variation is recorded. The data can then be analyzed to determine the total duration of sunshine for a given period.	L2	CO2, CO 3, CO 4	10

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP



Module-2

[DOWNLOAD](#)

Q. No.		Question	RBT Level	CO	Marks
Q. 03	a	With a neat sketch explain working of liquid flat plate collector	L2	CO 2, CO 3, CO4	10

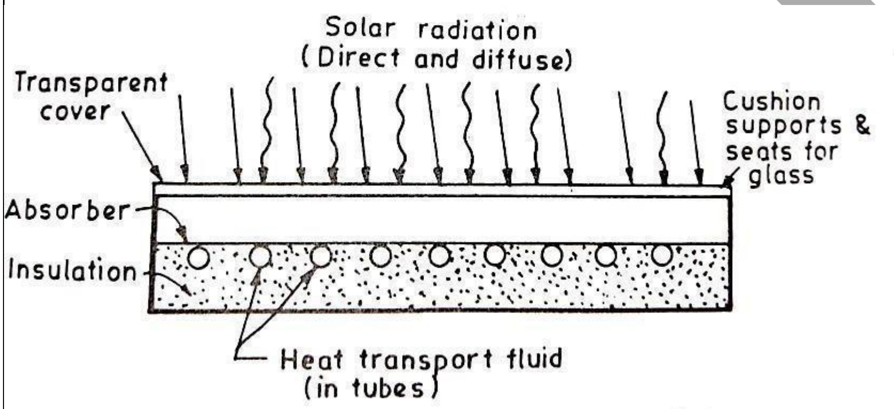


Fig. 3.3.1. Selection through typical flat-plate collector.

A liquid flat plate collector (FPC) is a type of solar collector designed to absorb solar energy and convert it into heat, which is then transferred to a liquid medium, typically water. Here's a detailed explanation of its working along with a neat sketch description:

Working of a Liquid Flat Plate Collector

1. Structure :
   - The FPC consists of a flat, insulated casing, usually made of wood or plastic, with dimensions approximately 2m x 1m x 15cm.
   - Inside the casing, there is an insulator at the bottom to minimize conductive heat loss. Common insulating materials include mineral wool, glass wool, fiberglass, or thermocol.

2. Absorber Plate :
   - Above the insulator, there is an absorber plate made of a good thermal conductor, such as aluminum or copper.
   - This plate is coated with a black material to enhance its

JOIN WHATSAPP [CHANNEL](#)
OR [GROUP](#)

		ability to absorb solar radiation. The black coating is often applied through chemical treatment, and selective coatings may be used to maximize absorption while minimizing thermal emission. 3. Absorber Tubes : - The underside of the absorber plate features absorber tubes that run along its length. These tubes are also made of the same material as the absorber plate. - A heat-absorbing medium, typically water, circulates through these tubes. As solar radiation heats the absorber plate, the water in the tubes absorbs this heat, causing its temperature to rise. 4. Glass Cover : - A transparent glass cover is placed above the absorber plate. This cover serves to create a greenhouse effect, allowing solar radiation to enter while reducing heat loss through convection and radiation. 5. Heat Transfer : - The heated water is then collected and can be used for various applications, such as space heating, domestic hot water supply, or even in industrial processes.			
	b	Explain how Solar Energy can be used for Solar drying and cooking	L2	CO2, CO 3, CO 4	10

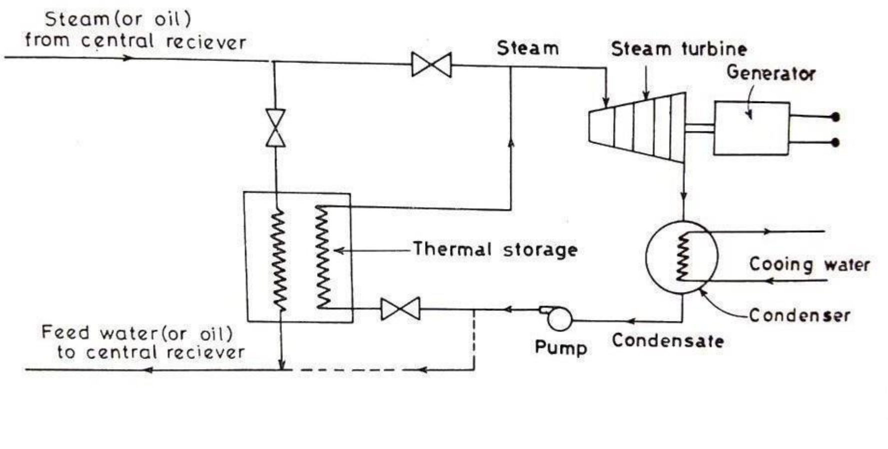
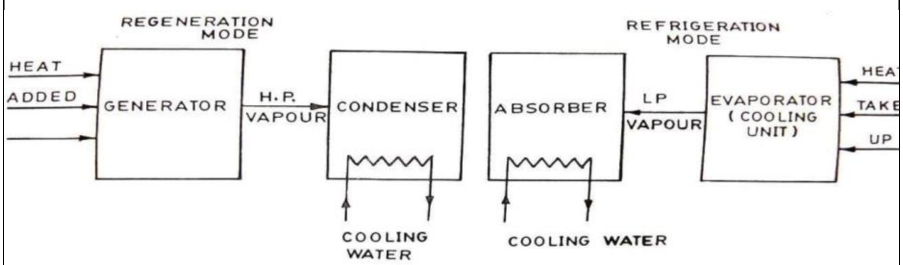


Fig. 5.5.6. Electric power generation using thermal storage.



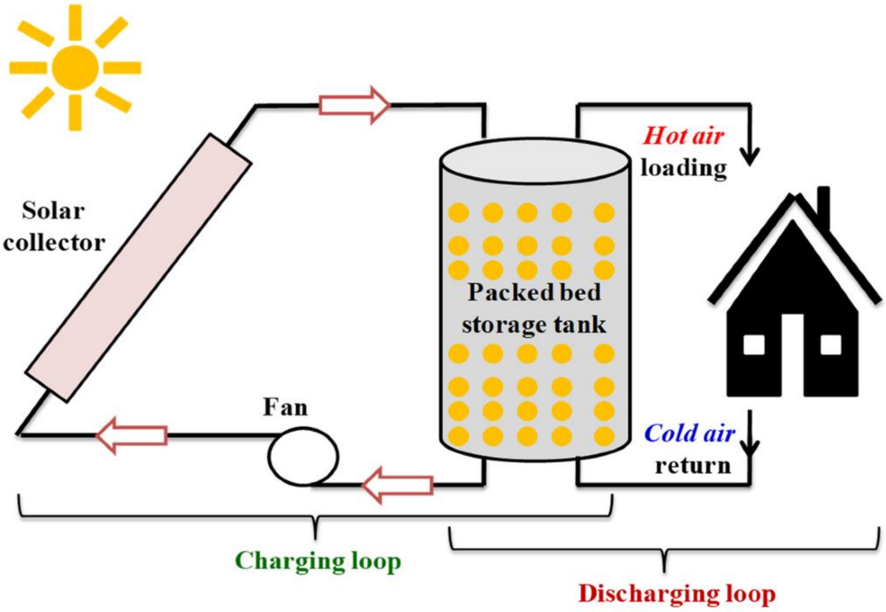
Solar energy can be effectively harnessed for both solar

		drying and cooking, utilizing various technologies that capitalize on the sun's heat. Solar Drying: Solar drying involves using sunlight to remove moisture from food or other materials, which helps in preservation. This method is particularly beneficial in regions with abundant sunlight. The process typically involves placing the items to be dried in a solar dryer, which can be a simple structure that captures and retains heat. The heat from the sun warms the air inside the dryer, which then circulates around the items, evaporating moisture. This method is energy-efficient and can significantly reduce the time and cost associated with traditional drying methods. Solar Cooking: Solar cookers utilize sunlight to cook food, offering a sustainable alternative to conventional cooking methods that rely on fossil fuels or electricity. There are several types of solar cookers: 1. Box Cookers: The simplest form, first developed by Horace de Saussure in 1767, consists of an insulated box with a transparent lid. These cookers can reach temperatures between 50°C to 100°C and can be used even on partially cloudy days. 2. Concentrating Solar Cookers: These use reflectors to focus sunlight onto a cooking pot, achieving higher temperatures (up to 350°C). Common designs include flat plate, disc, and parabolic trough types. For instance, the Solar Kitchen in Auroville, India, employs a unique solar bowl technology that uses a fixed spherical reflector to track the sun, allowing it to cook up to 2,000 meals daily at temperatures around 150°C. Both solar drying and cooking not only reduce fuel costs and reliance on traditional energy sources but also contribute to improved air quality by minimizing smoke emissions. These methods are particularly advantageous in rural areas where access to conventional energy sources may be limited. Overall, solar energy provides a versatile and eco-friendly solution for food preparation and preservation.			
		OR			
Q.04	a	Explain Sensible Heat and Latent Heat Thermal Energy Storage	L2	CO2, CO 3,	10

vtucloud.in

JOIN WHATSAPP CHANNEL OR GROUP

CO 4



Sensible heat and latent heat are two important concepts in thermal energy storage, particularly in systems that utilize solar energy.

Sensible Heat refers to the thermal energy that causes a change in the temperature of a substance without altering its phase. For example, when water is heated, its temperature rises as energy is added. This energy is known as sensible heat. In thermal energy storage systems, materials such as water or rocks can store sensible heat. The amount of sensible heat stored is determined using the following formula:

Q=mcΔTQ = mc\Delta TQ=mcΔT

Where:

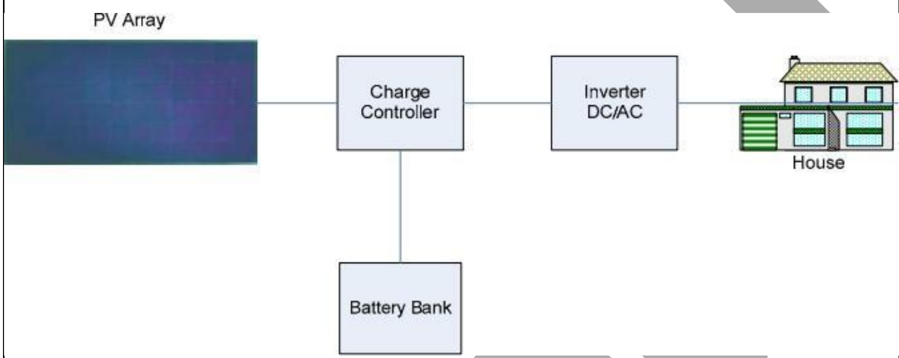
- QQQ is the heat energy stored (in joules),
- mmm is the mass of the substance (in kilograms),
- ccc is the specific heat capacity of the substance (in joules per kilogram per degree Celsius),
- ΔT\Delta TΔT is the change in temperature (in degrees Celsius).

This method of storage is straightforward and efficient, allowing for the direct use of the stored heat energy when required.

Latent Heat, in contrast, is the thermal energy absorbed or released by a substance during a phase change, such as melting, freezing, vaporization, or condensation, without any change in temperature. For instance, when ice melts to form water, it absorbs heat, known as the latent heat of fusion, but its temperature remains constant until all the ice has melted. In thermal energy storage systems, materials that undergo phase changes, known as phase change materials (PCMs), can store substantial amounts of energy. The energy stored during a phase change is calculated

JOIN WHATSAPP CHANNEL OR GROUP

vtucloud.in

		using the formula: Q=mLQ = mLQ=mL Where: • QQQ is the heat energy stored (in joules), • mmm is the mass of the substance (in kilograms), • LLL is the latent heat of the substance (in joules per kilogram). This method is particularly advantageous because it allows energy to be stored and released at a constant temperature, making it ideal for applications such as heating and cooling systems.			
	b	Explain the working principle and I-C Characteristics of Solar PV Cell  The working principle of a solar photovoltaic (PV) cell is based on the photovoltaic effect, which allows the conversion of solar energy directly into electrical energy. Here's a detailed breakdown of how it works: 1. Structure of the Solar Cell : A typical solar cell is made from semiconductor materials, most commonly silicon. Silicon has four valence electrons, which makes it a semiconductor. When impurities such as phosphorus or boron are added to silicon, it creates free electrons or holes, respectively, enhancing its conductivity. 2. Absorption of Solar Energy : When sunlight (photons) strikes the solar cell, it is absorbed by the semiconductor material. This energy excites the electrons, giving them enough energy to break free from their atomic bonds, creating free electrons. 3. Electric Field Creation : The solar cell is designed with a built-in electric field, typically created by the junction of p-type (positive) and n-type (negative) silicon. This electric field pushes the free electrons towards the n- type layer and the holes towards the p-type layer, creating a flow of electric current.	L2	CO 2, CO 3, CO4	10

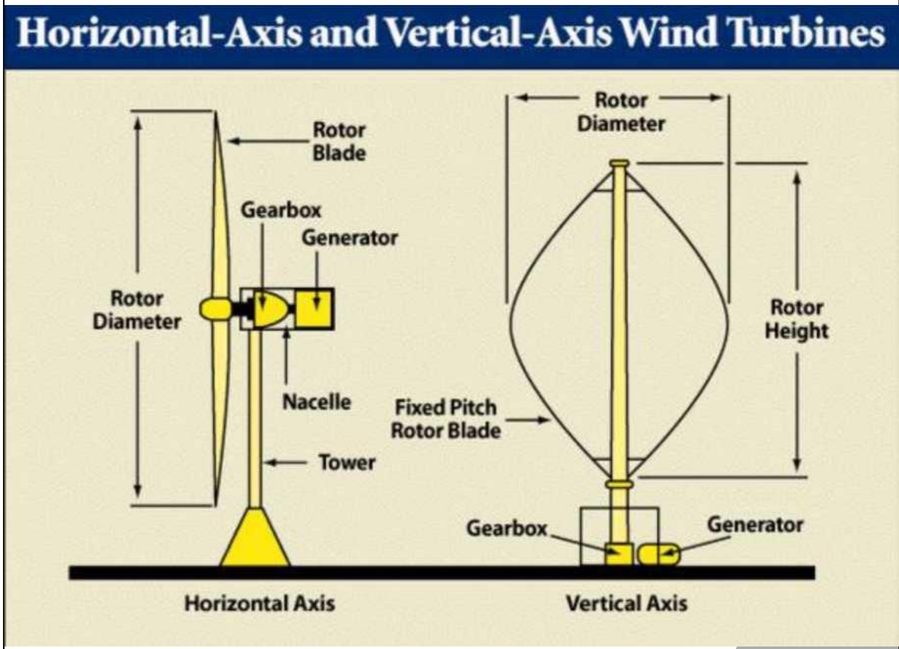
JOIN WHATSAPP CHANNEL OR GROUP

		4. Current Generation : The movement of these free electrons constitutes an electric current. When the solar cell is connected to an external load (like a battery or an inverter), this current can be harnessed to power electrical devices. 5. I-V Characteristics : The current-voltage (I-V) characteristics of a solar PV cell describe how the current output varies with the voltage across the cell. The key points on the I-V curve include: - Open Circuit Voltage (Voc) : The maximum voltage available from a solar cell when no current is flowing (the circuit is open). - Short Circuit Current (Isc) : The maximum current that flows when the output terminals are shorted (the voltage is zero). - Maximum Power Point (MPP) : The point on the I- V curve where the product of current and voltage is maximized, representing the optimal operating condition for the solar cell. The efficiency of a solar cell, which is typically between 10% to 20%, indicates how much of the solar energy is converted into usable electrical energy. Factors such as temperature, angle of sunlight, and shading can affect the performance and I-V characteristics of the solar cell.			
Module-3 **DOWNLOAD**					
Q. 05	a	List types of wind mills. Explain Horizontal Axis Wind Machine There are several types of wind turbines, commonly categorized into two main types: Horizontal Axis Wind Turbines (HAWTs) and Vertical Axis Wind Turbines (VAWTs). Let's focus on the Horizontal Axis Wind	L2	CO 2, CO 3, CO4	10

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

Machine.



Horizontal Axis Wind Turbines (HAWTs)

Characteristics:

- Rotor Axis: The rotor axis is horizontal and parallel to the wind direction. This design is the most prevalent for large-scale wind turbines.
- Blades: HAWTs typically feature two or three blades mounted on a horizontal shaft. These blades are aerodynamically designed to optimize performance and efficiency, allowing them to capture wind energy effectively.
- Orientation: HAWTs are equipped with a yaw mechanism that enables the turbine to turn and face the wind direction, maximizing energy capture.

Advantages:

- Efficiency: HAWTs are known for their high efficiency in converting wind energy into electricity. On average, they can convert about 40% of the kinetic energy in the wind into electricity, with some advanced models achieving conversion rates of up to 50%.
- Power Generation: They are capable of generating significant amounts of power, making them suitable for large-scale wind farms and utility-scale power generation.
- Established Technology: HAWTs are well-established with a wealth of operational data and improvements over time, which contributes to their reliability.

Disadvantages:

- Complexity: The design of HAWTs requires a

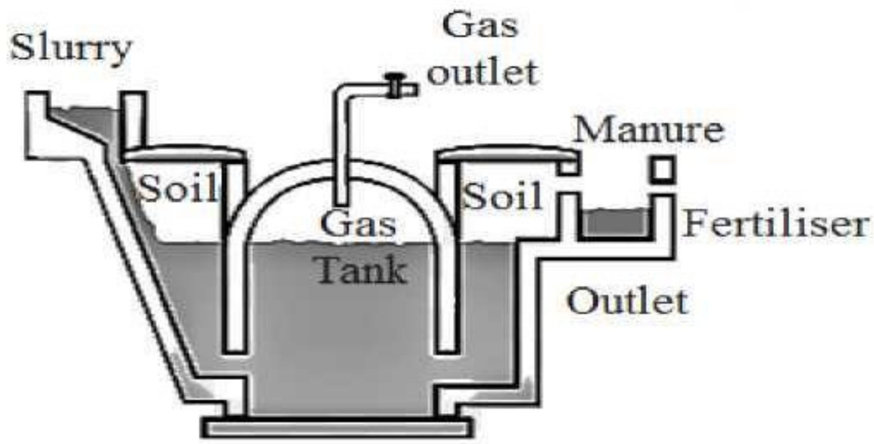
vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

		complex mechanical setup, including the yaw mechanism and a gearbox, which can complicate installation and operation. - Maintenance: Due to their height and mechanical complexity, maintenance and repairs can be challenging and costly.			
	b	List advantages, disadvantages and applications of Wind Energy Wind energy has several advantages, disadvantages, and applications that are important to consider: Advantages of Wind Energy: 1. Renewable Resource : Wind energy is a clean and renewable source of energy, meaning it won't deplete over time. 2. Cost-Effective : Once installed, wind turbines have low operational costs and can provide significant savings on energy bills. 3. Job Creation : The wind energy sector creates jobs in manufacturing, installation, and maintenance. 4. Scalability : Wind farms can be built on various scales , from small community projects to large utility-scale installations. 5. Reduced Greenhouse Gas Emissions : Utilizing wind energy helps reduce reliance on fossil fuels, leading to lower carbon emissions. Disadvantages of Wind Energy: 1. Intermittency and Variability : Wind power generation is dependent on wind speeds, which can fluctuate, making it less reliable during calm periods. 2. High Initial Costs : The capital investment for wind turbine installation and infrastructure can be significant, posing a barrier for new projects. 3. Land Use and Environmental Impact : Wind farms require substantial land, which can affect local ecosystems and wildlife habitats. 4. Noise and Aesthetic Concerns : Wind turbines can generate noise and may be considered visually unappealing by some communities, leading to opposition. 5. Maintenance and Operational Costs : Regular maintenance is necessary, and issues can arise, especially in offshore wind farms, leading to higher operational costs. Applications of Wind Energy: 1. Electricity Generation : Wind energy is primarily	L2	CO2, CO 3, CO 4	10

JOIN WHATSAPP CHANNEL OR GROUP

www.vtucloud.in

		used for generating electricity, contributing to the power grid and providing energy to homes and businesses. 2. Pumping Water : Historically, wind energy has been used to pump water for irrigation and livestock. 3. Hybrid Systems : Wind energy can be combined with other renewable sources, such as solar, to create hybrid systems that enhance energy reliability and efficiency. 4. Remote Power Supply : Wind turbines can be deployed in remote areas where extending the power grid is impractical, providing localized energy solutions.			
OR					
Q. 06	a	With neat explain Fixed dome biogas plant  A Fixed-Dome Biogas Plant is a type of biogas production facility designed to convert organic materials, such as animal manure and agricultural residues, into biogas through anaerobic digestion. Here's a detailed explanation of its components, features, advantages, and disadvantages: Advantages - Low Construction Cost : Compared to other biogas plant designs, the Fixed-Dome system is relatively inexpensive to build. - Minimal Maintenance : Once constructed, these plants require less ongoing maintenance, making them suitable for small-scale operations. Disadvantages - Limited Capacity for Gas Storage : The fixed structure means that it can only store a limited amount of gas, which may not be sufficient for larger operations. - Complexity in Operation : While the construction is simple, the operational management can be more complex, requiring careful monitoring of the digestion process.	L2	CO2, CO3, CO4	10

JOIN WHATSAPP CHANNEL OR GROUP

		Applications Fixed-Dome Biogas Plants are particularly beneficial for: - Agricultural Operations : Farms can utilize this technology to manage animal waste while generating energy for their operations. - Rural Communities : Small communities can benefit from self-sufficient energy systems, reducing reliance on external energy sources.			
	b	List the applications of biogas. What are the problems involved in production of biogas. Biogas has a variety of applications, including: 1. Electricity Generation : Biogas can be burned in engines or turbines to produce electricity, which can be fed into the power grid or used in standalone generators, especially in rural areas. 2. Heat Production : It can be utilized for heating purposes in industrial processes, residential heating, or combined heat and power (CHP) systems, where both heat and electricity are generated simultaneously. 3. Vehicle Fuel : Biogas can be processed into compressed biogas (CBG) and used as a renewable fuel for specially designed vehicles, such as buses and trucks. 4. Waste Treatment : Biogas production helps manage organic waste, reducing the need for landfills and providing a solution for municipal solid waste, agricultural waste, and wastewater treatment. 5. Fertilizer Production : The solid by-product from biogas production, known as digestate, is rich in nutrients and can be used as a natural fertilizer or soil conditioner, enhancing soil fertility. 6. Industrial Applications : Biogas can provide process heat for industries like food processing, brewing, and paper manufacturing, and can also serve as a feedstock for producing chemicals and other industrial products. However, there are several problems associated with the production of biogas: 1. Feedstock Variability and Quality : The quality and	L2	CO 2, CO 3, CO4	10

vtucloud.in

JOIN WHATSAPP CHANNEL OR GROUP

		composition of feedstock can vary significantly, which affects the efficiency of biogas production. 2. Initial Cost : The setup and operational costs for biogas plants can be high, posing a financial barrier to implementation. 3. Technical Complexity : Biogas production requires careful management and monitoring, which can be challenging and resource-intensive. 4. Space Requirements : Larger biogas plants need significant space for digesters and storage, which can be a limitation in certain areas. 5. Energy Loss : Some methods of biogas processing, such as compression and liquefaction, can involve energy losses, necessitating efficient storage solutions to minimize these losses. 6. Regulatory Compliance : Adhering to local and international safety and environmental regulations is essential, which can add to the complexity and cost of biogas production. 7. Public Education : Insufficient public education and awareness can hinder the adoption and support of biogas technologies, impacting community acceptance.			
Module-4 **DOWNLOAD**					
Q. 07	a	How are hydroelectric power plants classified ? Explain Hydroelectric power plants are classified based on several criteria, primarily focusing on the availability of water flow and the height of the water head. Here's a detailed breakdown: 1. According to the extent of water flow regulation : - Run-off River Power Plants without Pondage : These plants do not have any storage facility. They generate electricity only when water is available from the river, making them unsuitable for constant, steady loads. - Run-off River Power Plants with Pondage : These plants include a storage pond that allows for some regulation of water flow. They can handle fluctuating loads and are more reliable than those without pondage, suitable	L2	CO 2, CO 3, CO4	10

vtucloud.in

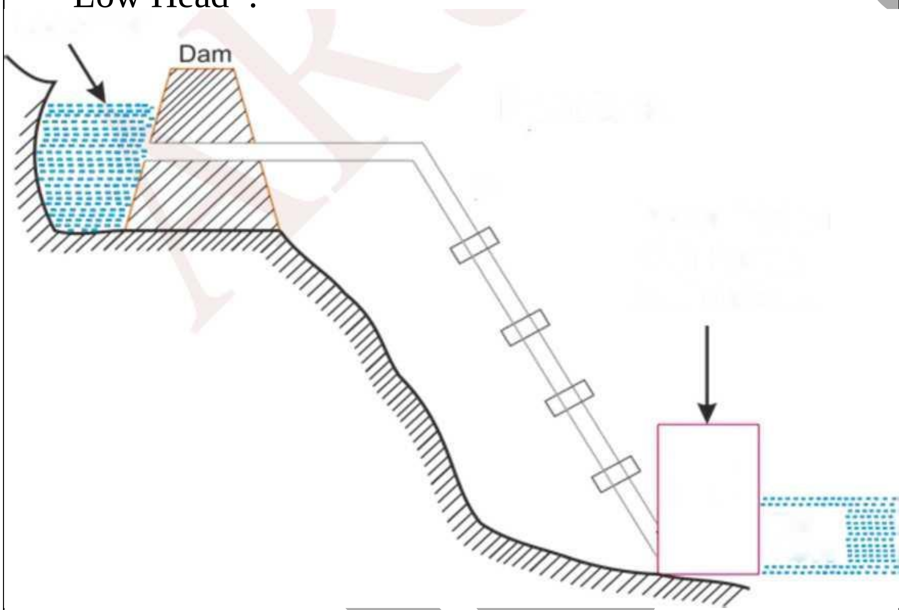
JOIN WHATSAPP CHANNEL OR GROUP

for both base and peak load periods.

- Reservoir Power Plants : These are the most common type of hydroelectric plants. They store water behind a dam, ensuring a consistent water supply throughout the year, even during dry seasons. This type is highly efficient and can meet both base and peak load demands.

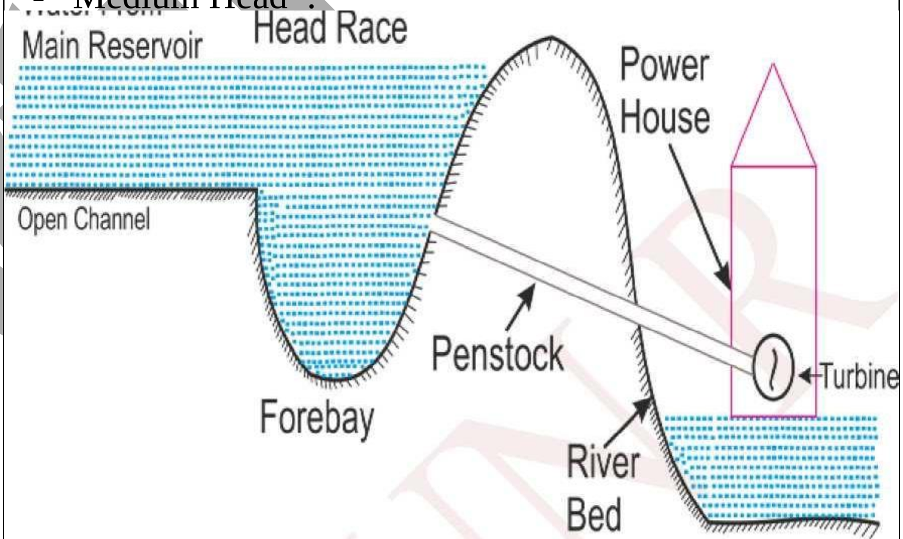
2. According to the availability of water flow (water head) :

- Low Head :



Defined as having a water head of less than 30 meters. These plants typically use Francis, Kaplan, or propeller turbines and require dam construction to create the necessary water head.

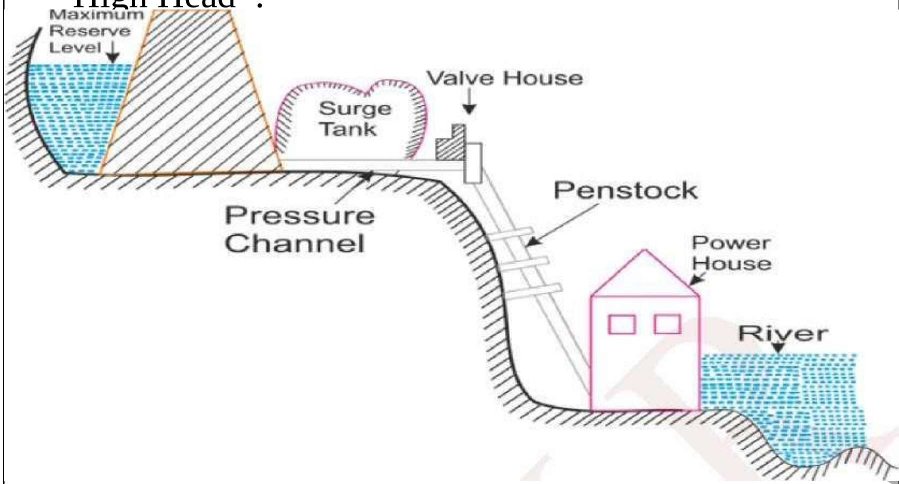
- Medium Head :



This category includes plants with a water head between 30 meters and 300 meters. They can utilize similar turbine types as low head plants but are designed to operate efficiently at higher elevations.

JOIN WHATSAPP CHANNEL
OR GROUP

- High Head :



These plants have a water head greater than 300 meters. They are often more efficient due to the greater potential energy available from the higher elevation.

3. According to the types of load supply
a. Base Load
b. Peak Load
c. Pumped storage plants for the peak load

a. Base load hydroelectric power plant
This is a large capacity power plant. This plant work as a base portion of load curve of power system, that's why it is called base load plants. Base load plant is suitable for constant load. Load factor of this plant is high and it is performed as a block load. Run off river plants without pondage and reservoir plants are used as base load plants.

b. Peak load hydroelectric power plant
This plant is suitable for peak load curve of power system. When demand is high, this type of plant does their job very well. Run off river plants with pondage can be employed as peak load plants. If water supply is available, it generates large portion of load at a peak load period. It needs huge storage area. Reservoir plants can be used as peak load plants. This type of plant can serve power throughout the year.

c. Pumped storage hydroelectric power plant for the peak load
This is unique design of peak load plants. Here two types of water pond is used, called upper head water pond and tail water pond. Two water ponds are connected each other by a penstock. Main generating pumping plant is lower end. During the off load period, surplus energy of this plant is utilized to pumping the lower head pond water to upper head pond water. This extra water is used to generate

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

		energy at pick load periods. By doing this arrangement, same water is used again and again. Extra water is required only to take care of evaporation and seepage.			
	b	Explain the following	L2	CO 2,	10

vtucloud.in

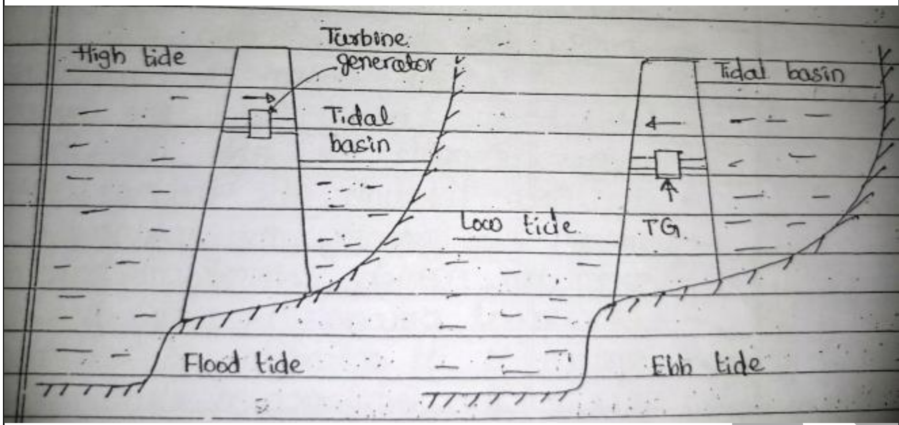
JOIN WHATSAPP CHANNEL OR GROUP

		(i) Hydrograph (ii) Flow Duration Curve (iii) Surge Tank (iv) Spill way (v) Draft tube (i) Hydrograph : A hydrograph is a graphical representation that shows the flow of water in a river or stream over a specific period of time. It typically plots discharge (the volume of water flowing per unit of time) against time. Hydrographs are essential for understanding the variability of water flow, which is crucial for managing water resources, designing dams, and planning for flood control. (ii) Flow Duration Curve : The flow duration curve is a graphical representation that shows the relationship between the flow rate of a river and the percentage of time that flow is equaled or exceeded over a specified period. This curve helps in assessing the availability of water for hydroelectric power generation, as it indicates how often certain flow rates occur, which is vital for optimizing the operation of a hydroelectric plant. (iii) Surge Tank : A surge tank is a small reservoir located near a hydroelectric power plant, designed to absorb sudden changes in water pressure within the penstock. When there is a sudden reduction in load on the turbine, the surge tank helps to prevent pressure surges (water hammer) that could damage the penstock. It also provides additional water when there is an increase in demand, ensuring a stable flow to the turbines . (iv) Spillway : A spillway is a structure built into a dam that allows excess water to flow out of the reservoir safely. It is crucial for preventing overflow and potential damage to the dam during periods of heavy rainfall or snowmelt. Spillways can be designed as open channels or gates that can be controlled to manage water levels in the reservoir. (v) Draft Tube : A draft tube is a conduit that connects the turbine to the tailrace (the area where water exits the turbine). Its primary function is to recover some of the kinetic energy of the water exiting the turbine, converting it back into pressure energy. This helps to improve the overall efficiency of the hydroelectric power plant by		CO 3, CO 4	

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

		allowing the water to flow smoothly back into the river or reservoir.			
OR					
Q. 08	a	With a neat sketch explain single basin and double basin tidal power plant	L2	CO 2, CO 3, CO 4	10



A tidal power plant can be designed in various configurations, with single basin and double basin systems being two common types. Let me explain both in detail:

Single Basin Tidal Power Plant

A single basin tidal power plant typically consists of a dam-like structure built across an estuary or bay. This design captures the potential energy created by the difference in water height (head) between high and low tides within a single enclosed area. Here's how it works:

1. Mechanism : The plant has sluice gates that open and close to allow water to flow in and out of the basin during high and low tides. When the tide rises, water flows into the basin, and when it recedes, the water is released back into the sea, turning turbines to generate electricity during both phases.

2. Advantages :
   - Predictable Energy Generation : The energy output is highly predictable due to the regular tidal patterns.
   - Flood Protection : It can provide flood protection to the surrounding areas.
   - High Energy Output : It can generate a significant amount of electricity.

3. Challenges :
   - High Initial Costs : The construction of the barrage and associated infrastructure can be expensive.

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

		- Environmental Impact : There can be significant ecological disruptions in the estuarine ecosystems, affecting local wildlife and communities. Double Basin Tidal Power Plant A double basin tidal power plant, often referred to as a tidal lagoon, involves two separate basins (high lagoon and low lagoon) that work together to harness tidal energy more efficiently. Here's how it operates: 1. Mechanism : Similar to the single basin system, but it creates two distinct areas. Water flows between the two lagoons through turbines, generating power from both incoming and outgoing tides. The design allows for more controlled water flow and energy generation. 2. Advantages : - Less Environmental Impact : Compared to single basin systems, double basin plants can have a reduced ecological footprint. - Scalability : They can be built to scale, allowing for larger energy outputs. - Recreational and Conservation Benefits : The lagoons can provide recreational areas and support local biodiversity . 3. Challenges : - High Construction Costs : Like single basin systems, the initial investment can be substantial. - Site-Specific Feasibility : The effectiveness of a double basin system is highly dependent on the geographical location and tidal range.			
	b	List advantages and disadvantages of Tidal energy Advantages of Tidal Energy: 1. Predictability : Tidal patterns are highly predictable, providing a reliable source of energy. 2. Longevity : Tidal energy systems can have long operational lifespans, often exceeding 100 years. 3. Low Operating Costs : Once installed, the operating and maintenance costs are relatively low. 4. Significant Power Generation : Tidal barrages can generate a substantial amount of power and also provide flood protection and act as bridges. 5. Less Intrusive to Marine Life : Compared to other energy methods, tidal energy installations are generally less intrusive to marine ecosystems.	L2	CO 2, CO 3, CO4	10

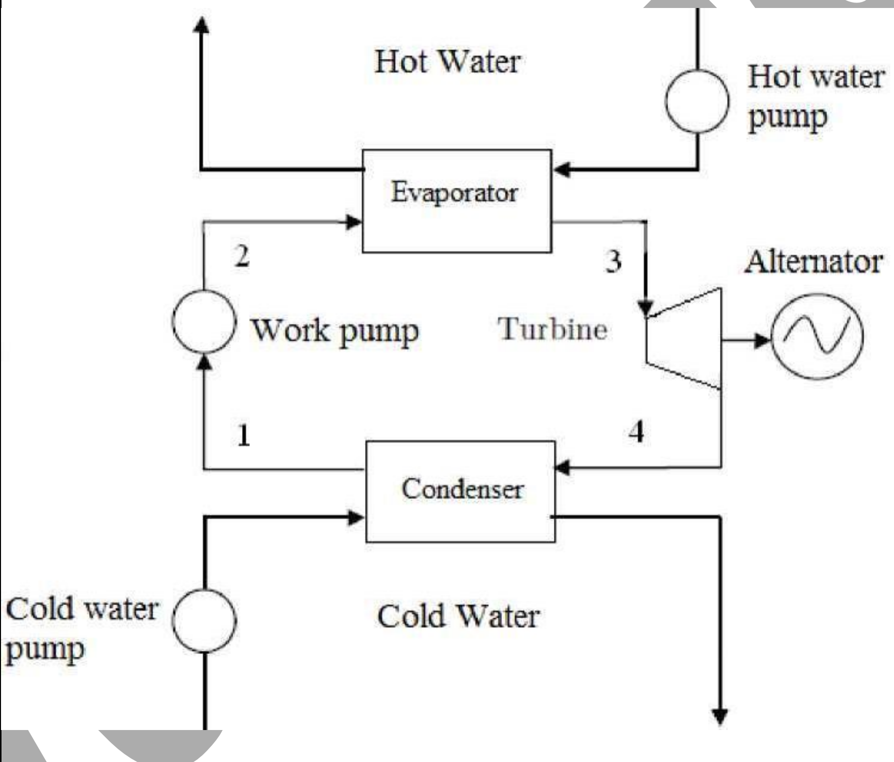
JOIN WHATSAPP CHANNEL
OR GROUP

vtucloud.in

		6. Bilateral Energy Production : Tidal systems can generate electricity during both rising and falling tides, providing two periods of energy production each day. 7. Environmental Benefits : Tidal energy has negligible greenhouse gas emissions during operation. Disadvantages of Tidal Energy: 1. High Initial Costs : The construction of tidal energy systems, particularly barrages, requires substantial capital investment. 2. Site Specificity : Tidal energy can only be economically recovered in locations where the tidal range is 5 meters or more. 3. Variable Energy Availability : The availability of tidal energy is variable, leading to fluctuating power generation. 4. Environmental Impact : Tidal installations can affect marine ecosystems, fish migration patterns, and sediment transport, necessitating careful site selection and environmental impact assessments. 5. Maintenance Challenges : Marine environments are harsh, leading to higher maintenance costs due to corrosion and biofouling. 6. Geographical Limitations : Suitable locations for tidal power installations are limited to regions with significant tidal ranges and strong tidal currents.			
		Module-5 **DOWNLOAD**			
Q. 09	a	What is the basic principle of OTEC Ocean Thermal Energy Conversion (OTEC) is based on harnessing the temperature difference between the warm surface water of the ocean and the cold water from the depths. This temperature gradient results from solar energy heating the ocean's surface. The OTEC process unfolds in several stages: 1. Warm Surface Water : Warm water, typically between 25°C and 30°C, is pumped from the surface through a heat exchanger. Here, it heats a working fluid with a low boiling point, such as ammonia or a refrigerant. 2. Evaporation : The working fluid evaporates into gas due to the heat from the warm water. This gas expands and drives a turbine connected to a generator, producing	L2	CO 2, CO 3, CO4	10

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP

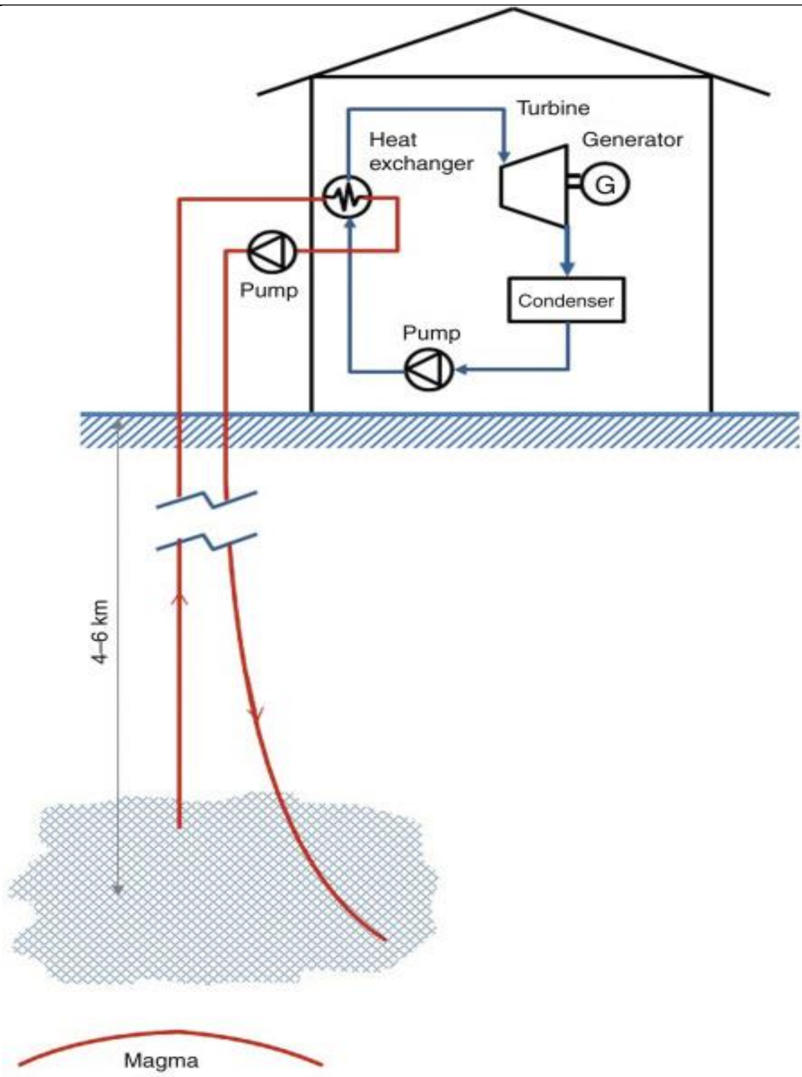
		electricity. 3. Cold Deep Water : Cold water is drawn from depths of about 1000 meters, where the temperature is around 4°C to 5°C. This cold water is used to cool and condense the vapor of the working fluid back into a liquid. 4. Recirculation : The condensed working fluid is recirculated back to the evaporator to repeat the cycle. This system allows for continuous and stable energy generation, making it a base-load energy source, unlike other renewable sources that depend on weather conditions. However, OTEC faces challenges such as high initial costs, technical complexities, and environmental concerns.			
	b	Explain with a sketch, the Open Rankine Cycle OTEC System  The Open Rankine Cycle OTEC (Ocean Thermal Energy Conversion) system is an innovative technology that utilizes the temperature difference between warm surface seawater and cold deep seawater to generate electricity. Here's a detailed explanation along with a sketch description: Open Rankine Cycle OTEC System 1. Warm Surface Seawater : The process begins with warm seawater, typically around 25°C to 30°C, being	L2	CO2, CO 3, CO 4	10

JOIN WHATSAPP CHANNEL OR GROUP

		pumped into a vacuum chamber. This chamber is crucial as it allows the seawater to vaporize at lower temperatures due to the reduced pressure. 2. Vaporization : In the vacuum chamber, the warm seawater is vaporized, creating steam. This steam is the working fluid that will drive the turbine. 3. Turbine : The generated steam expands and drives a turbine connected to a generator. As the turbine spins, it converts the thermal energy of the steam into mechanical energy, which is then transformed into electrical energy by the generator. 4. Condensation : After passing through the turbine, the steam enters a condenser where it is cooled by cold deep seawater, typically drawn from depths of around 1000 meters, where the temperature is about 4°C to 5°C. The cold seawater absorbs heat from the steam, causing it to condense back into liquid water. 5. Recirculation : The condensed working fluid (now liquid seawater) is then pumped back into the vacuum chamber to repeat the cycle. This pump increases the pressure of the liquid, preparing it to absorb heat again in the next cycle. Advantages of Open Rankine Cycle OTEC - Desalination : One of the significant benefits of this system is that it can produce fresh water as a byproduct, which is particularly beneficial for arid regions. - Sustainability : It generates clean energy without burning fossil fuels, contributing to reduced greenhouse gas emissions.			
OR					
Q. 10	a	With a neat sketch explain Geothermal Energy System by Hot Dry Rock (HDR)	L2	CO2, CO 3, CO 4	10

JOIN WHATSAPP CHANNEL
OR GROUP

vtucloud.in



Geothermal Energy System using Hot Dry Rock (HDR) is an innovative approach to harnessing geothermal energy from the Earth's interior. Here’s a detailed explanation along with a description of a neat sketch you can visualize:

Explanation of the Geothermal Energy System:

1. Heat Source : The system relies on the heat stored in the Earth's crust, specifically in the HDR, which is heated by the Earth's internal processes.

2. Hydraulic Fracturing : To utilize HDR, hydraulic fracturing is employed to create pathways for water to flow through the rock. This process enhances the permeability of the rock, allowing for efficient heat exchange.

3. Heat Extraction : Water is injected into the HDR, where it absorbs heat from the surrounding rock. The heated water then rises through the production well to the surface.

4. Electricity Generation : At the surface, the hot water or steam is used to drive a turbine connected to a generator, converting thermal energy into electrical energy.

JOIN WHATSAPP CHANNEL OR GROUP

		5. Sustainability : The cooled water is then reinjected back into the HDR layer through the reinjection well, ensuring that the system remains sustainable and can continuously produce energy. Advantages - Advantages : HDR systems can provide a continuous and reliable source of renewable energy, reducing dependence on fossil fuels and lowering greenhouse gas emissions.			
	b	List and explain the problems associated with Geothermal System operations The problems associated with geothermal system operations are diverse and can impact both the economic viability and environmental sustainability of these projects. Here are some of the main challenges: 1. High Initial Costs : The development of geothermal power plants requires significant investment in exploration, drilling, and construction of the plant. These high upfront costs can be a barrier to entry for new projects and limit investment in this technology. 2. Site Specificity : Geothermal resources are geographically specific, meaning that not all locations have accessible and economically viable geothermal resources. This limits the applicability of geothermal energy to certain regions, typically those with high geothermal activity, such as volcanic areas or tectonic plate boundaries. 3. Environmental and Structural Risks : The extraction of geothermal energy can lead to issues such as land subsidence, induced seismicity (earthquakes), and the release of trace gases from geothermal reservoirs. These risks must be carefully managed to minimize their environmental impact. 4. Resource Depletion : If not managed properly, geothermal resources can become depleted or experience a decline in productivity over time. It is crucial to implement sustainable management practices to prevent the overexploitation of these resources. 5. Geographical Limitations : Effective geothermal energy production is often restricted to regions with high	L2	CO 2, CO 3, CO4	10

JOIN WHATSAPP CHANNEL OR GROUP

		geothermal activity. This means that many areas, especially those not near volcanoes or tectonic plate boundaries, may not be viable for geothermal energy development.			

Bloom's Taxonomy Level: Indicate as L1, L2, L3, L4, etc. It is also desirable to indicate the COs and POs to be attained by every bit of questions.

vtucloud.in

JOIN WHATSAPP CHANNEL
OR GROUP