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# CMR Institute of Technology, Bangalore
## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING /INFORMATION SCIENCE AND ENGINEERING /CIVIL ENGINEERING
## III - INTERNAL ASSESSMENT

Semester: 6-CBCS 2018
Subject: NON CONVENTIONAL ENERGY SOURCES (18ME651)
Faculty: Mr Harish Babu

Date: 2 Aug 2021
Time: 01:00 PM - 02:30 PM
Max Marks: 50

**Instructions to Students :**

Answer all questions

*Answer All Questions*

| Q.No | | Marks | CO | PO | BT/CL |
|---|---|---|---|---|---|
| 1 | With a neat sketch, explain single basin tidal power plant. | 10 | CO7 | PO1 | L2 |
| 2 | What are the major problems associated with wind power? Explain horizontal axis wind mill with sketch. | 10 | CO6 | PO1 | L2 |
| 3 | With a sketch, explain the working of “Hot dry rock” geothermal plant. | 10 | CO7 | PO1 | L2 |
| 4 | Explain the constructional details and working of KVIC digester. | 10 | CO6 | PO1 | L2 |
| 5 | With a neat sketch, explain the closed cycle OTEC system (Anderson cycle). | 10 | CO7 | PO1 | L2 |

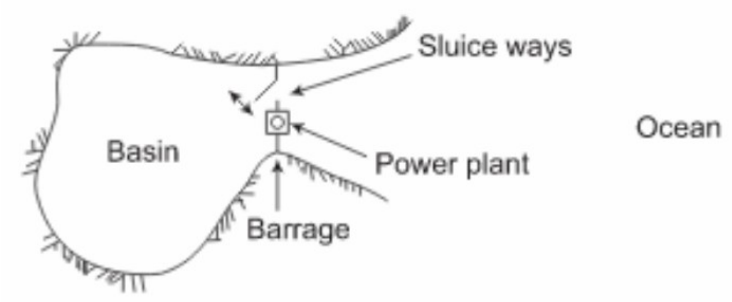
# NON CONVENTIONAL ENERGY SOURCES

(18ME651)

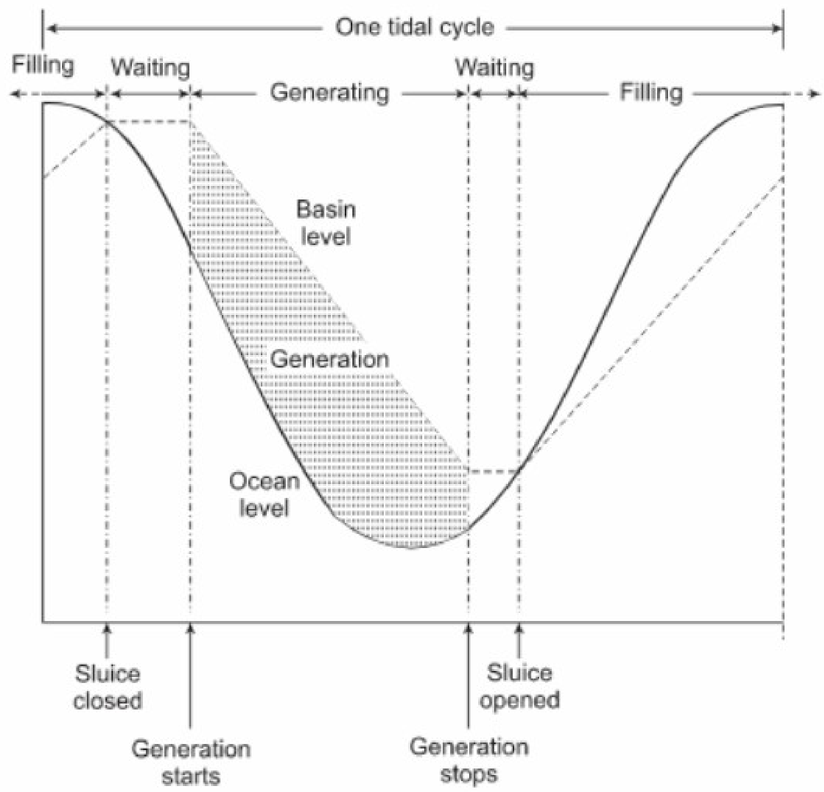
IAT 03 Solutions

1) Single Basin Tidal Power plant:

Single basin scheme has only one basin as shown in Figure. In single effect scheme, power is generated during either filling or emptying the basin. Two types of operation cycles are possible. In ebb generation cycle operation, the sluice way is opened to fill the basin during high tide. Once filled the impounded water is held till the receding cycle creates a suitable head. Water is now allowed to flow through the turbine coupled to generator till the rising tide reduces the head to the minimum operating point. The flow is held till the next generating cycle.




The sequence of events is illustrated in Figure below. This cycle is repeated and power is generated intermittently. In flood generation cycle operation, the sequences are altered to generate power during filling operation of the basin. However, the sloping nature of the basin shores usually makes ebb generation the more productive method.



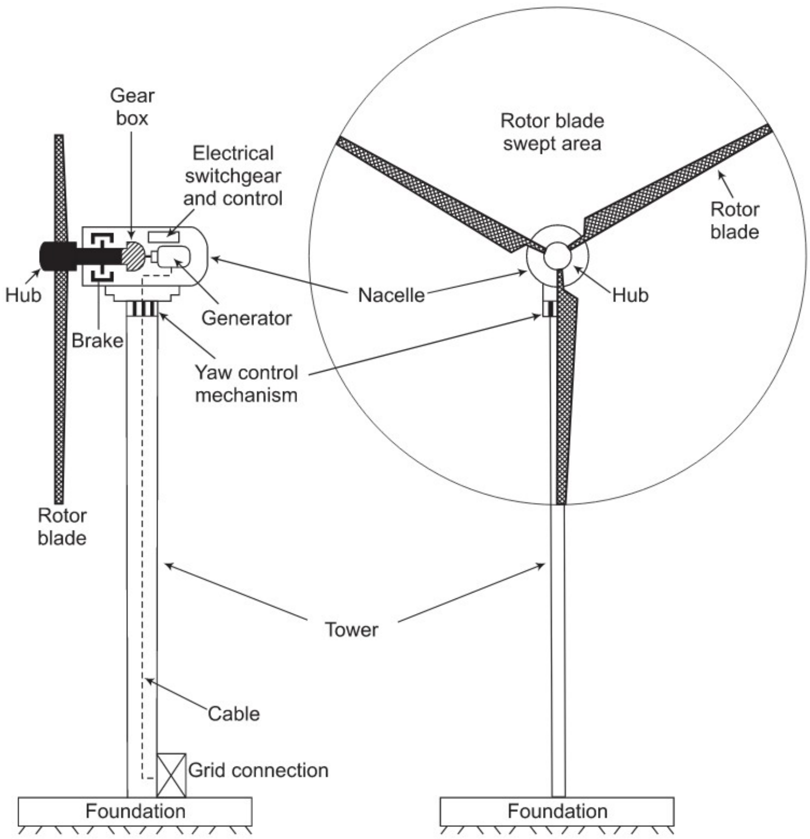
2) In general, the use of energy in any form, affects the environment in one-way or the other at different levels. Wind energy is no exception. Main environmental concerns are discussed below:

(a) Indirect Energy Use and Emissions: Energy is required to produce materials used to construct the wind turbine and in its installation. Some pollution (emission of CO,, etc.) is caused due to use of energy during construction.

(b) Bird Life: Large wind turbines pose a threat to bird life as a result of collision with tower or blades. Their resting and breeding patterns are also affected.

(c) Noise: The disturbance caused by the noise produced by wind turbine is one of the important factors that prevent its siting close to inhabited areas. The acoustic noise is composed of (i) mechanical noise due to movement of mechanical parts in the nacelle and (ii) aerodynamic noise , which is a function of wind speed and which cannot be avoided. Some of this noise is of infra sound, at frequencies below the audible range. This infrasound may cause houses and other structures to vibrate.

(d) Telecommunication Interference: Wind turbines present an obstacle for incident electromagnetic waves (i.e. TV or microwave signals). These waves can be reflected, scattered and dithered. Thus they interfere with telecommunication links and badly affect the quality of radio and TV reception.




Main Components: The constructional details of most common, three-blade rotor, horizontal axis wind turbine are shown in figure above.

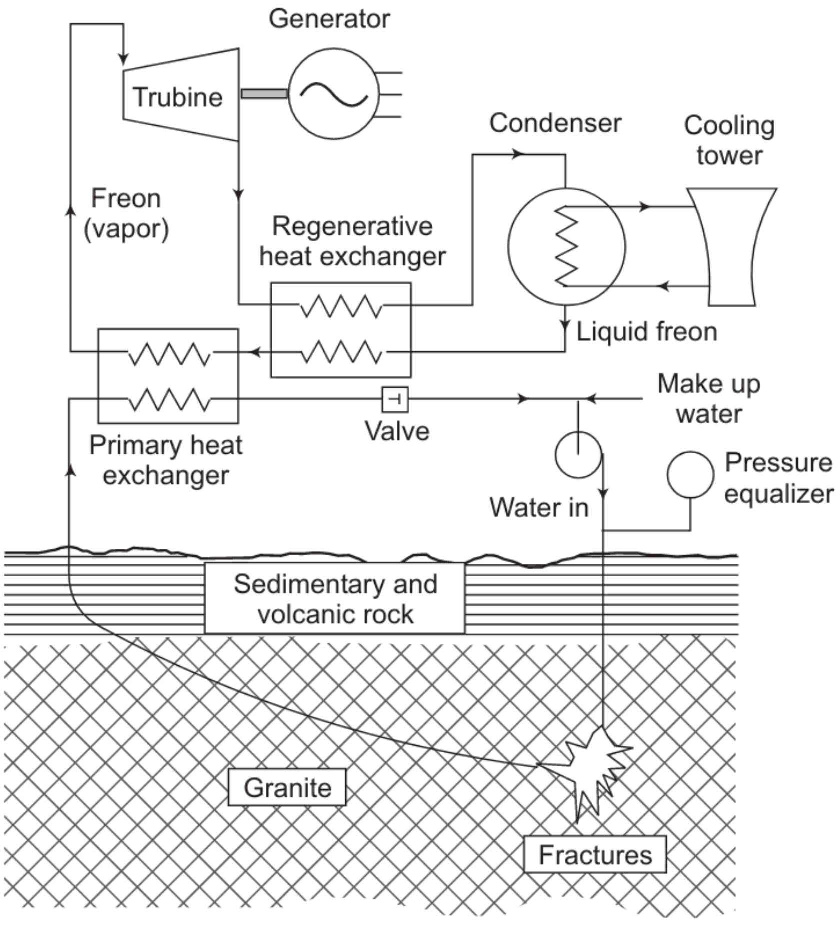
(a) Turbine Blades: Turbine blades are made of high-density wood or glass fiber and epoxy composites. They have airfoil type cross-section. Diameter of a typical, MW range, modern rotor may be of the order of 100 m.

(b) Hub: The central solid portion of the rotor wheel is known as hub. All blades ate attached to the hub. Mechanism for pitch angle control is also provided inside the hub.

(c) Nacelle: The rotor is attached to nacelle, mounted at the top of a tower. It contains rotor brakes, gearbox, generator and electrical switch-gear and control. Brakes are used to stop the rotor when power generation is not desired. Gearbox steps up the shaft rpm to suit the generator. Protection and control functions are provided by switch-gear and control block. The generated electrical power is conducted to ground terminals through a cable.
(d) Yaw Control Mechanism: The mechanism to adjust the nacelle around vertical axis to keep it facing the wind is provided at the base of nacelle.

(e) Tower: Tower supports nacelle and rotor. For medium and large sized turbines, the tower is slightly taller than the rotor diameter. In case of small sized turbine, the tower is much larger than the rotor diameter as the air is erratic at lower heights.

3) Hot Dry Rock Resources

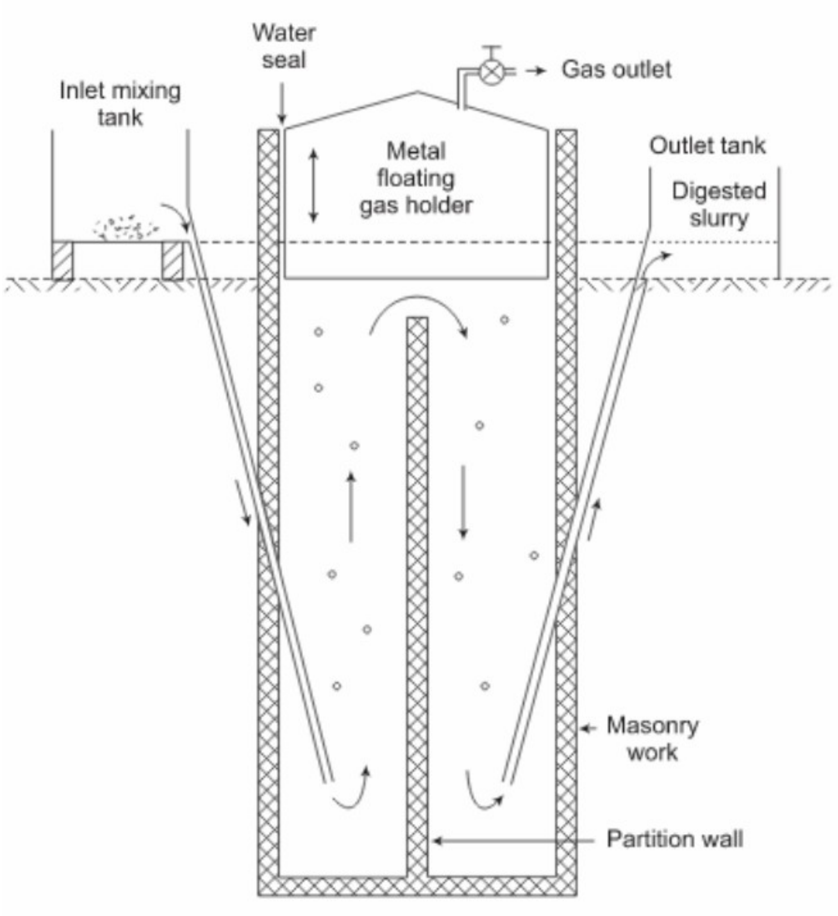



There are regions underground at temperatures exceeding 200 °C, with little or no water. The rocks are impermeable and/or there is no surface water in the vicinity. Such resources up to a depth of 5 km are estimated to be significant and worthy of development as a source of energy. Hot dry rocks

are much more common than hydrothermal reservoirs and more accessible, so their potential is quite high.
The recovery of heat from HDR involves forming a man-made reservoir by drilling deep into the hot rocks and then cracking it to form cavity or fractures. Such a system is known as “Enhanced Geothermal Systems” (EGS), also sometimes called engineered geothermal systems. This can be achieved by (i) detonating high explosive at the bottom of the well, (ii) nuclear explosion or (iii) hydraulic fracturing. Hydraulic fracturing, which is performed by pumping of water at high pressure into the rock formation, is commonly used in oil and gas fields to improve the flow.

To recover heat, water is pumped into the cracks from the surface, and withdrawn by another well at a distance. Injection and production wells are joined to form a circulating loop through this man-made reservoir to achieve a steady flow of high temperature water (or water—steam mixture). Electricity can be generated by binary fluid system as shown.

4)




KVIC Biogas Plant: It has an inverted mild steel drum to work as gasholder. This is the most expensive component of the plant. The drum floats either direct on fermentation slurry or in a water jacket of its own. Most Indian plants now have a pair of central guide pipes.
The gasholder is free to rise or fall depending on the production and use of gas. It is also free to rotate on its axis. Gasholder rotation will also be useful as a device to break the scum in the digester. A flexible hosepipe is attached at the top of the gasholder for gas dispersion. The gas passes through a moisture trap before supplying to the utility/house.

The digester is a deep circular pit or a well, built of bricks, mortar and plaster, with a partition wall. The bifurcation of digestion chamber through partitioning wall provides optimum conditions for growth of acid formers and methane formers as the requirement of pH values for these bacteria are different. Therefore, this plant operates very well with good biogas yield. The underground structure helps minimize the heat loss from the plant and the cylindrical shape has better structural strength.

5) Ocean thermal energy exists in the form of temperature difference between the warm surface water and the colder deep water. A heat engine generates power utilizing well established thermodynamic principle, where heat flows from high temperature source to low temperature sink through engine, converting a part of the heat into work. In the present case the surface water works as heat source and deep water as heat sink to convert part of the heat to mechanical energy and hence into electrical energy.

In closed cycle (also known as Anderson cycle) plant, warm surface water is used to evaporate a low boiling point working fluid such as ammonia, freon or propane. The vapor flows through the turbine and is then cooled and condensed by cold water pumped from the ocean depths. Because of low quality heat a large surface areas of heat exchangers (evaporator and condenser) are required to transfer significant amount of heat and large amount of water need to be circulated. The schematic diagram of closed loop OTEC plant is shown in Figure below. The operating pressures of the working fluid at the boiler/evaporator and condenser are much higher and its specific volume is much lower as compared to water in open cycle system. Such pressures and specific volumes result in turbine that is much smaller in size and hence less costly as compared to that in open cycle system.