A Laboratory Manual for

Electric Power Generation (22327)

Semester- III

Diploma in Electrical Engineering

(EE)

Baharati Vidyapeeth Institute of Technology

Navi Mumbai

Baharati Vidyapeeth Institute of Technology

Navi Mumbai

Certificate

This is to certify that, Mr./ Ms. …….

Roll No. …… of Third Semester of Diploma in Electrical Engineering of Baharati Vidyapeeth Institute of Technology Navi Mumbai (Inst.code:0027) has satisfactorily completed the term work in the subject Electric Power Generation (22327) for the academic year 20…. to 20…. as prescribed in the MSBTE curriculum.

Place: ……... **Enrollment No. : ……**

Date:…… **Exam. Seat No. : …….**

Sign:

Name:

Subject Teacher **Head of the Department** **Principal**

Seal of Institution

List of experiments and progressive assessment for term work (TW) D-3

Academic Year: **Name of Faculty:**

Course code: EE3I **Subject Code:** ( )

Name of candidate: **Enroll no.** **Roll no.**

Semester: 3I **Marks:** Max : 25 Min :10

Sr. No.	Title	Date of performance	Date of submission	Marks	Sign of teacher
1	Identify the routine maintenance parts of gas fired thermal power plant after watching a video program.				
2	Draw schematic of a small diesel generator power plant.				
3	Identify the parts of nuclear fired thermal power plant after watching a video program.				
4	Identify the routine maintenance parts of a large hydro power plant after watching a video program.				
5	Draw the schematic of a micro hydro power plant.				
6	Draw the schematic of the parabolic trough concentrated solar power plant				
7	Draw the schematic of the parabolic dish CSP plant.				
8	Draw the schematic of the solar PV plant.				
9	Draw the schematic of small biogas plant to generate electric power.				
10	Identify the routine maintenance parts of large wind power plant after watching a video program.				
11	Draw schematic of a vertical axis small wind turbine.				
12	Identify the routine maintenance parts of the horizontal axis small wind turbine after watching a video program.				
			Total marks out of 300		
			Marks out of 25		

Name and Signature of student Name and Signature of staff

Experiment no. 1

Title: Identify the routine maintenance parts of gas fired thermal power plant after watching a video program.

Apparatus:

Watch videos at,

1. https://www.youtube.com/watch?v=Em1crnEt45Q
2. https://www.youtube.com/watch?v=IdPTuwKEfmA
3. https://www.youtube.com/watch?v=5UMiX6IHqO8

Theory:

In a gas fired power plant, natural gas is combusted in a gas turbine burner which drives a generator to produce electricity. The steam is directly sent to a turbine / generator unit to produce additional electricity, and then passed through a condenser to convert it into demineralized water again.

Natural gas power plants are cheap and quick to build. They also have very high thermodynamic efficiencies compared to other power plants. Burning of natural gas produces fewer pollutants like NOx, SOx and particulate matter than coal and oil. On the other hand, natural gas plants have significantly higher emissions than a nuclear power plant.

During maintenance, the technicians check every part of the gas turbine system. However, there are certain major components that demand special attention.

main parts of Gas Turbine system Components are,

- Turbine.
- Compressor.
- Air intake.
- Exhaust chimney.
- Gearbox.
- Combustor.
- Electric generator.

Maintenance Procedure:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 2

Title: Draw schematic of a small diesel generator power plant.

Apparatus:

Visit site,

1. https://www.electricalengineeringinfo.com/2014/12/diesel-power-station-or-diesel-power-plant-.html
2. https://www.slideshare.net/harshidpanchal7/diesel-power-plant-60227476

Theory:

A generating station in which diesel engine is used as the prime mover for the generation of electrical energy is known as Diesel power station or Diesel power plant. The diesel burns inside the engine and the products of this combustion act as the "working fluid" to produce mechanical energy. The diesel engine drives the generator which converts mechanical energy into electrical energy. The generation cost is considerable due to high price of diesel, therefore, such power stations are only used to produce small power. These plants are used as standby sets for continuity of supply to important points such as hospitals, radio stations, cinema houses and telephone exchanges.

The plant has the following auxiliaries

1. Fuel supply system
2. Air intake system
3. Exhaust system
4. Cooling system
5. Lubricating system
6. Engine starting system

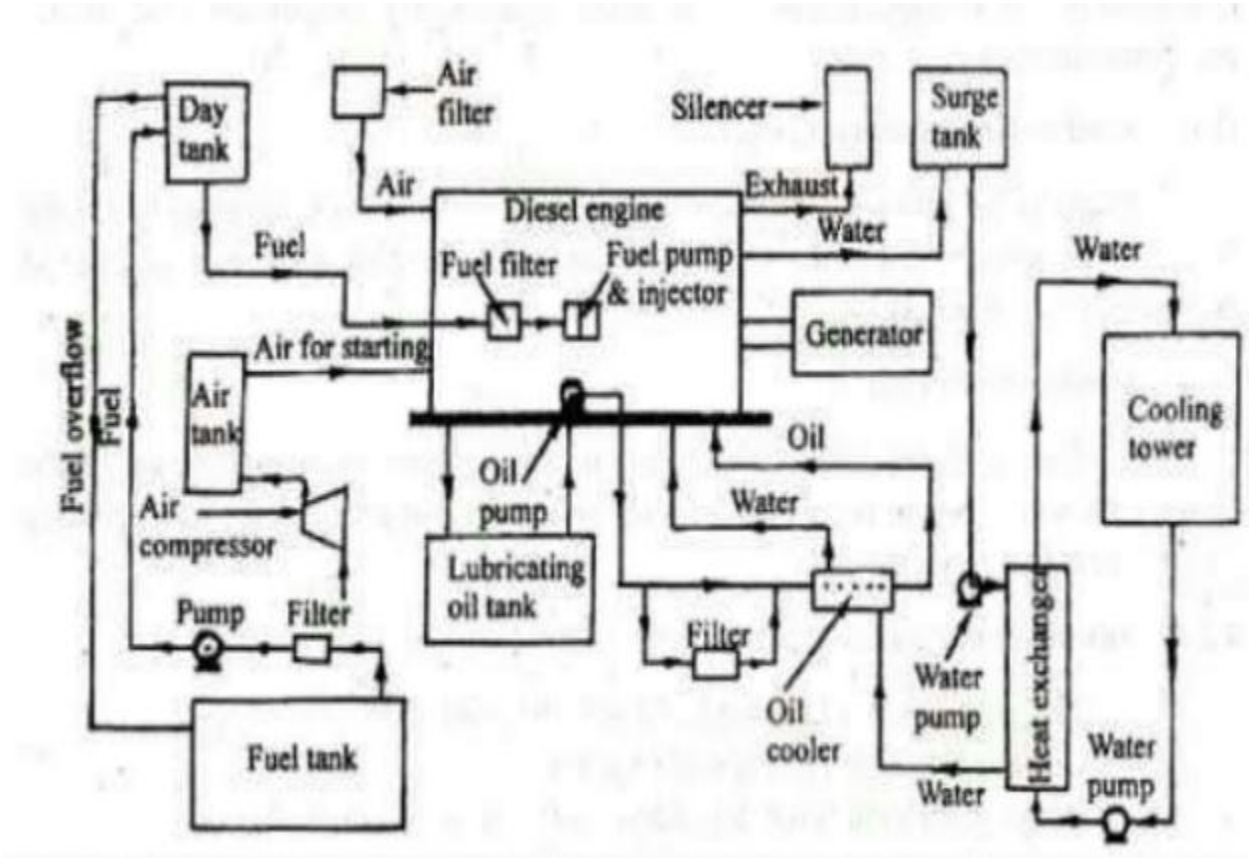

Fig. Schematic diagram of Diesel power plant

Schematic diagram of Diesel power plant (to be drawn by the student)

Parts description:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 3

Title: Identify the parts of nuclear fired thermal power plant after watching a video program.

Apparatus:

Watch videos at,

1. https://www.explainthatstuff.com/how-nuclear-power-plants-work.html
2. https://www.explainthatstuff.com/how-nuclear-power-plants-work.html

Theory:

Nuclear power plants are a type of power plant that use the process of nuclear fission in order to generate electricity. They do this by using nuclear reactors in combination with the Rankine cycle, where the heat generated by the reactor converts water into steam, which spins a turbine and a generator. Nuclear power provides the world with around 11% of its total electricity, with the largest producers being the United States and France.

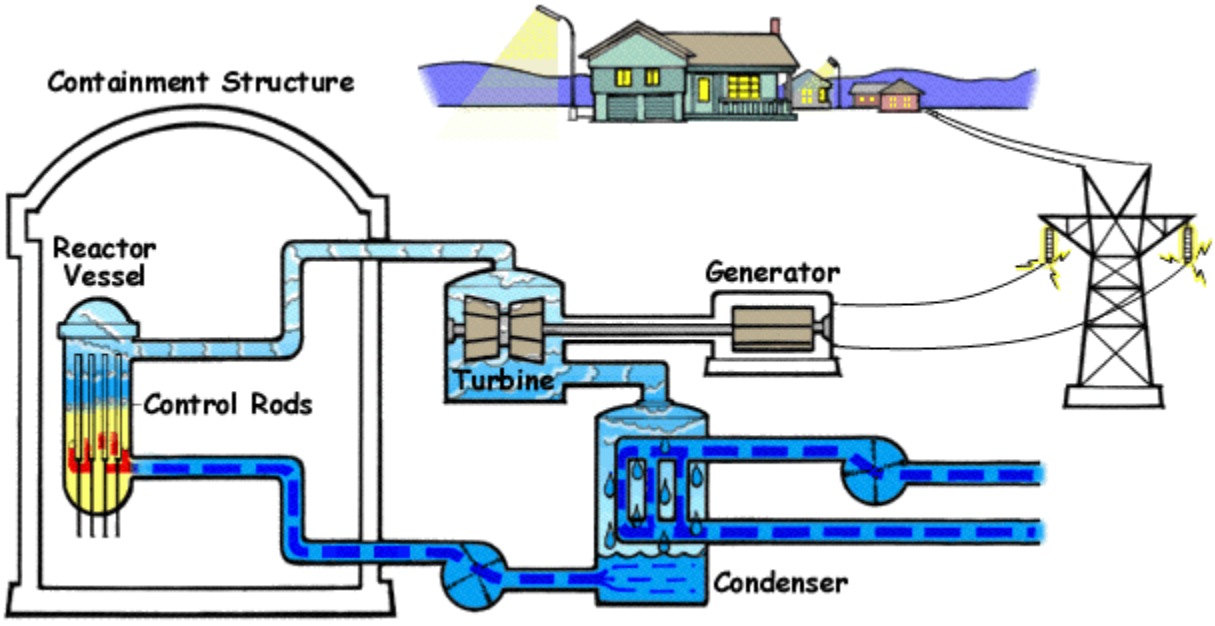

Fig. **A boiling water nuclear reactor in combination with the Rankine cycle**

Schematic of a nuclear powered thermal power plant (to be drawn by student)

Components & Operation:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 4

Title: Identify the routine maintenance parts of a large hydro power plant after watching a video program.

Apparatus:

Watch videos at,

1.https://www.renewablesfirst.co.uk/hydropower/hydropower-operation-maintenance-services/

2. https://www.youtube.com/watch?v=Uhjhufhg3Xk

Theory:

Hydropower plants capture the energy of falling water to generate electricity. A turbine converts the kinetic energy of falling water into mechanical energy. Then a generator converts the mechanical energy from the turbine into electrical energy. It works on the principle that the potential energy of the water stored at great heights in the dam is converted in to kinetic energy by allowing the water to flow at high speed. Then the kinetic energy of flowing water used to generate electricity. Routine service and maintenance required are,

1. Turbine functional checks and inspection.
2. Turbine bearing lubrication and inspection.
3. Gearbox inspection.
4. Gearbox oil condition analysis and oil changes.
5. Gearbox bearing inspection and lubrication.
6. Drive belt inspection and replacement.
7. Drive coupling inspection.
8. Generator inspection.
9. Generator bearing inspection and lubrication.
10. Hydraulic system inspection.
11. Hydraulic system oil condition analysis and oil changes.
12. Check all sensors operate correctly.
13. Check controller functions correctly.
14. Inspection of intake area, impounding structures, pipeline, sluice(s).

Routine maintenance Procedure:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 5

Title: Draw the schematic of a micro hydro power plant.

Apparatus:

Theory:

Micro hydro is a type of hydroelectric power that typically produces from 5 kW to 100 kW of electricity using the natural flow of water. These installations can provide power to an isolated home or small community, or are sometimes connected to electric power networks, particularly where net metering is offered. There are many of these installations around the world, particularly in developing nations as they can provide an economical source of energy without the purchase of fuel. Micro hydro systems complement solar PV power systems because in many areas, water flow, and thus available hydro power, is highest in the winter when solar energy is at a minimum.

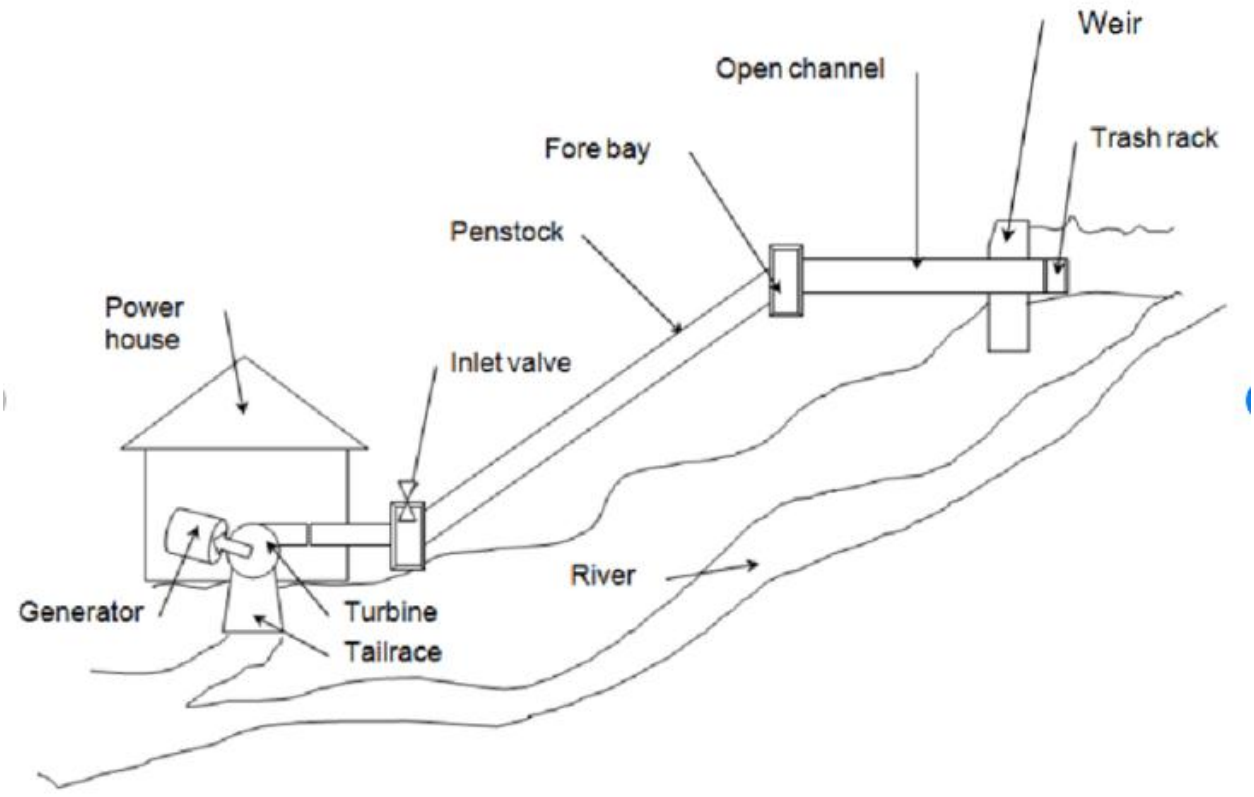

Fig. Schematic diagram of micro-hydro power plant

Schematic diagram of micro-hydro power plant (to be drawn by the student)

Description:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 6

Title: Draw the schematic of the parabolic trough concentrated solar power plant.

Apparatus:

Watch videos at,

1. https://www.youtube.com/watch?v=ZAJeDVLO1_w&app=desktop
2. https://www.youtube.com/watch?v=VdL6C_O9ywU

Theory:

A parabolic trough concentrated solar power plant is a solar based thermal power generating system, using a type of solar thermal collector that is straight in one dimension and curved as a parabola in the other two, lined with a polished metal mirror. The sunlight which enters the mirror parallel to its plane of symmetry is focused along the focal line. A tube containing a fluid runs the length of the trough at its focal line. The sunlight is concentrated on the tube and the fluid heated to a high temperature by the energy of the sunlight. The hot fluid can be piped to a heat engine, the heat transfer fluid is then used to heat steam in a standard turbine generator to generate electricity.

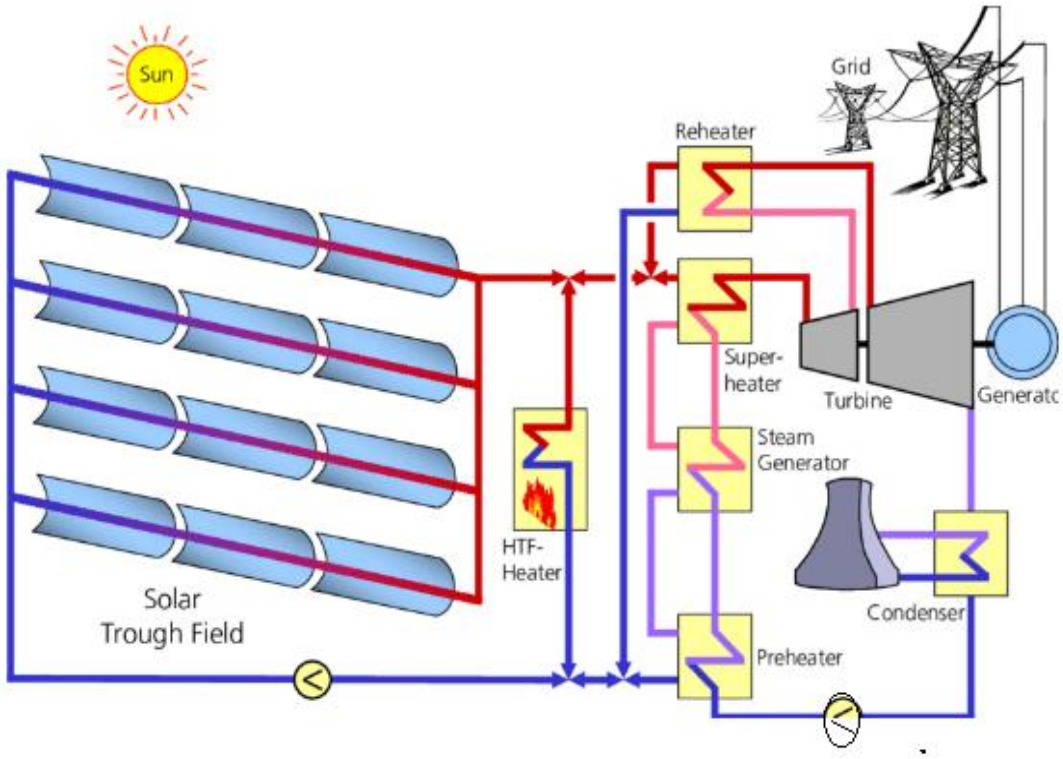

Fig. Schematic of parabolic trough concentrated solar power plant

Schematic of parabolic trough concentrated solar power plant (to be drawn by the student)

Description of the plant:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 7

Title: Draw the schematic of the parabolic dish CSP plant.

Apparatus:

Read at,

1. https://www.researchgate.net/figure/Fig-8-Schematic-diagram-of-a-parabolic-dish-collector_fig6_228343933.
2. https://www.solarpaces.org/how-csp-works/.

Theory:

A Parabolic dish system consists of a parabolic-shaped point focus concentrator in the form of a dish that reflects solar radiation onto a receiver mounted at the focal point. These concentrators are mounted on a structure with a two-axis tracking system to follow the sun. The collected heat is typically utilized directly by a heat engine mounted on the receiver moving with the dish structure.

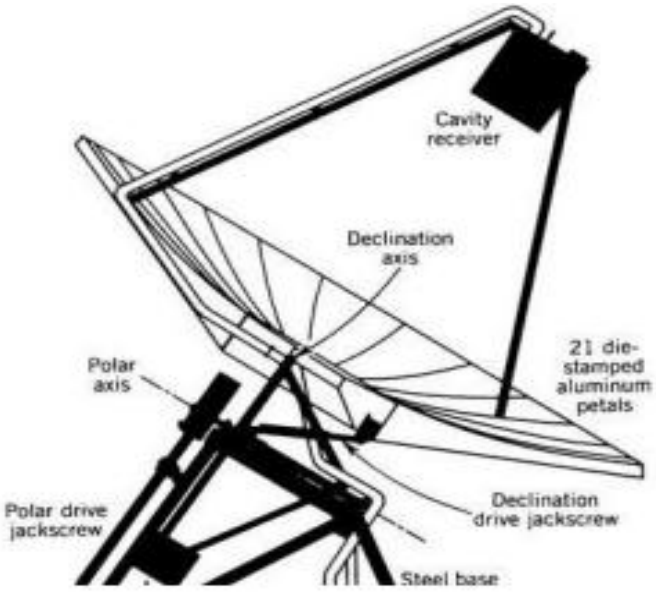

Fig. Schematic of the parabolic dish

Fig. Schematic of the parabolic dish CSP plant

Schematic of the parabolic dish (to be drawn by the student)

Description:

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Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 8

Title: Draw the schematic of the solar PV plant.

Apparatus:

Read at,

1. https://www.mechanicalbooster.com/2017/12/solar-power-plant.html
2. https://www.mpoweruk.com/solar_power.htm
3. https://www.pinterest.com/pin/429812358163614582/

Theory:

A **solar power plant** is based on the conversion of sunlight into electricity, either directly using photovoltaics (PV), or indirectly using *concentrated solar power* (CSP). Concentrated solar power systems use lenses, mirrors, and tracking systems to focus a large area of sunlight into a small beam. Photovoltaics converts light into electric current using the photoelectric effect. Solar PV technology is generally employed on a panel (hence solar panels). PV cells are typically found connected to each other and mounted on a frame called a module. Multiple modules can be wired together to form an array, which can be scaled up or down to produce the amount of power needed.

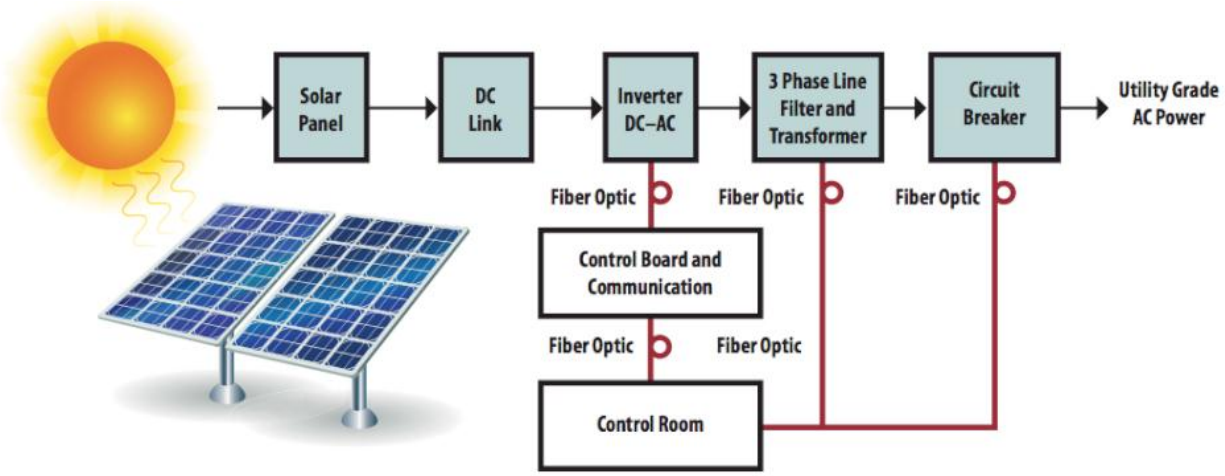


Fig. Schematic of the solar PV plant

Schematic of the solar PV plant (to be drawn by the student)

Description:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 9

Title: Draw the schematic of small biogas plant to generate electric power.

Apparatus:

Read at,

1. https://www.youtube.com/watch?v=24Zxr2KHW6s
2. https://www.ecomena.org/working-of-a-commercial-biogas-plant/
3. https://www.slideshare.net/asertseminar/biogas-ppt

Theory:

The components of a modern biogas (or anaerobic digestion) plant includes manure collection, anaerobic digester, effluent treatment plant, gas storage, and Co-Generation Plant(CHP) or electricity generating equipment. Biogas (methane) can be converted directly into electricity by using a fuel cell. However, this process requires very clean gas and expensive fuel cells. Therefore, this option is still a matter for research and is not currently a practical option. Biogas contain significant amount of hydrogen sulfide (H_2S) gas which needs to be stripped off due to its highly corrosive nature. The removal of H_2S takes place in a biological desulphurization unit in which a limited quantity of air is added to biogas in the presence of specialized aerobic bacteria which oxidizes H_2S into elemental sulfur.

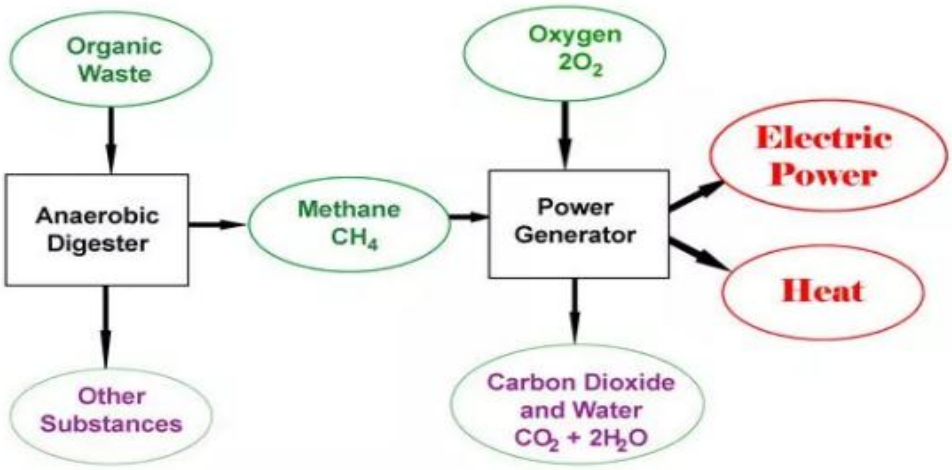


Fig. Biogas power generation flow chart

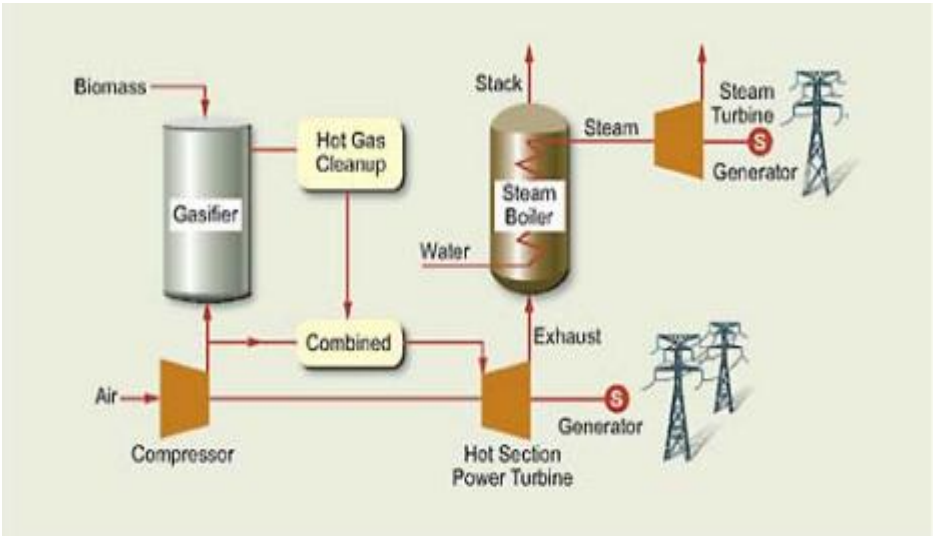


Fig. Schematic of a bio power IGCC(Integrated Gasifier combined cycle) power plant

Schematic of biogas plant (to be drawn by the student)

Description:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 10

Title: Identify the routine maintenance parts of large wind power plant after watching a video program.

Apparatus:

Watch at,

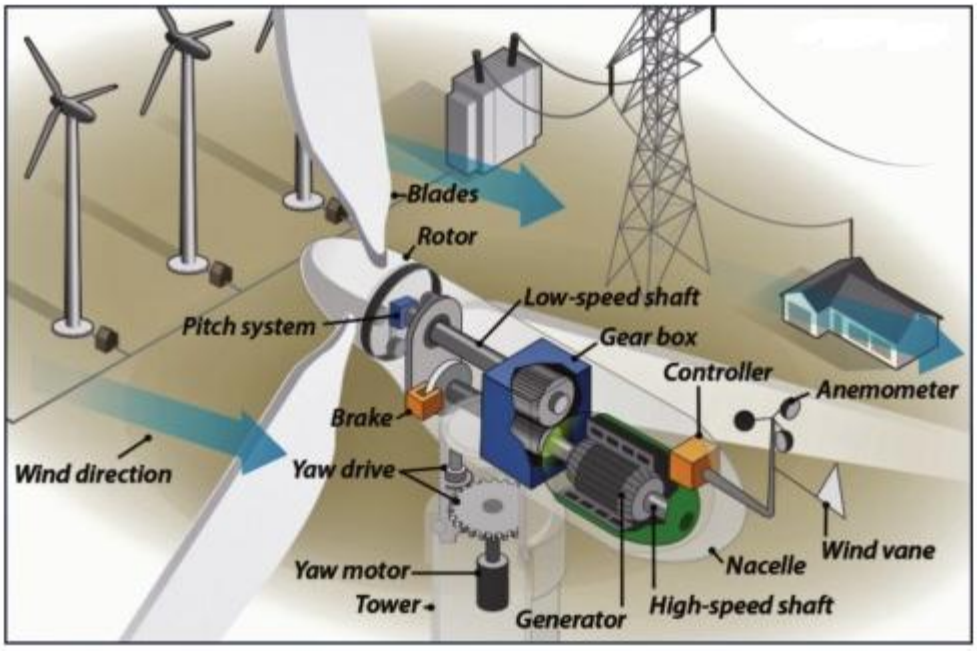
1. https://www.energy.gov/eere/wind/inside-wind-turbine
2. https://www.intechopen.com/books/advances-in-wind-power/wind-turbine-generator-technologies

Theory:

A wind turbine is a machine that transforms kinetic power in the wind into electricity. The main parts are rotor and hub, several bearings, gearbox, generator, brakes, control system and a part that balance the electricity. Design of the wind turbine when it comes to rotor and hub can vary, but the most common is that the axis is horizontal. That is the axis of rotation rotate parallel with the ground with two or three blades. The gearbox task is to speed up the rotation from a low speed to a speed that can operate the generator. Some turbines use special generators that work at a low speed and then do not need a gearbox.

Nearly all wind turbines use induction or synchronous generators that demand a constant or close to constant speed. Because the generator should not be too warm a cooling system is needed. The generator can be cooled in two ways either with air or with water. There are two brakes in a wind

turbine; one brakes the rotor and the other is placed between the gearbox and generator and is used as an emergency brake or when the wind turbine is being repaired to avoid that the rotor starts spinning. The task of the control system is to put an upper limit on the torque and to maximize the energy production. There is also a small motor that runs a gearwheel so that the nacelle can be turned so that it always is in the wind direction. The nacelle also contains a controller that controls the different parts of the wind turbine.



Maintenance procedure:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 11

Title: Draw schematic of a vertical axis small wind turbine.

Aim:

Apparatus:

Theory:

A vertical axis wind turbine has its axis perpendicular to the wind streamlines and vertical to the ground. A more general term that includes this option is "transverse axis wind turbine" or "cross-flow wind turbine. In vertical-axis wind turbines (VAWT), the main rotor shaft is set transverse to the wind (but not necessarily vertically) while the main components are located at the base of the turbine. This arrangement allows the generator and gearbox to be located close to the ground, facilitating service and repair. VAWTs do not need to be pointed into the wind, which removes the need for wind-sensing and orientation mechanisms. Major drawbacks for the early designs (Savonius, Darrieus and giromill) included the significant torque variation or "ripple" during each revolution, and the large bending moments on the blades. Later designs addressed the torque ripple issue by sweeping the blades helically (Gorlov type).

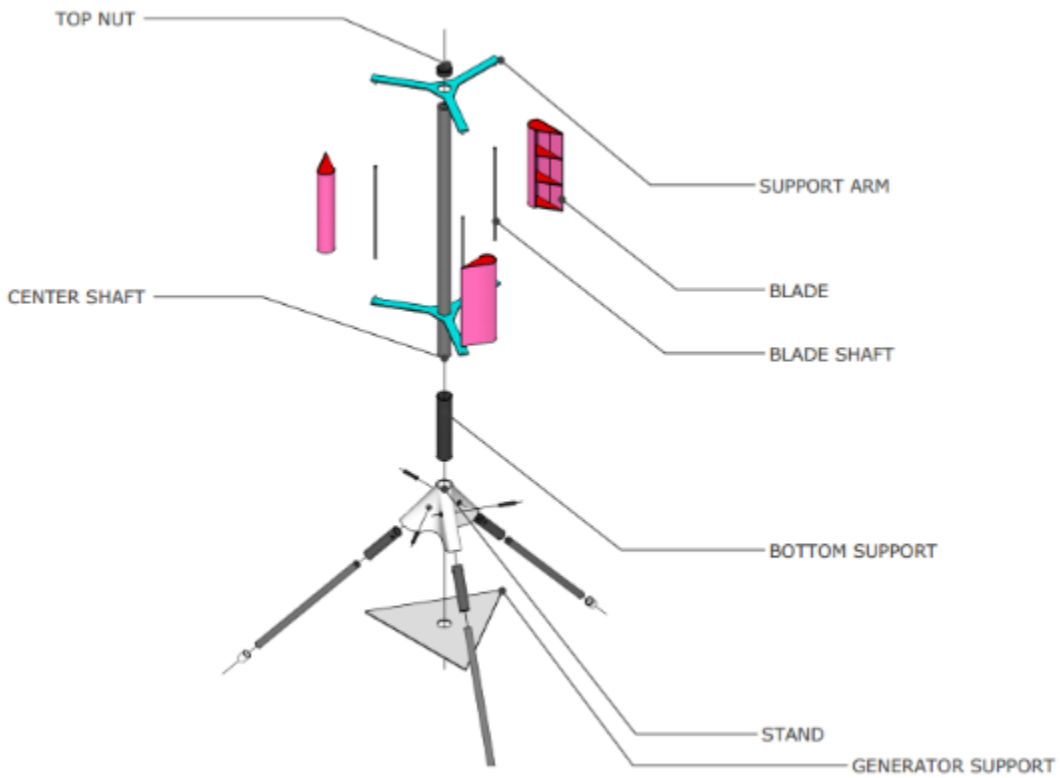

TOP NUT
SUPPORT ARM
BLADE
CENTER SHAFT
BLADE SHAFT
BOTTOM SUPPORT
STAND
GENERATOR SUPPORT

Fig. Exploded View of VAWT

Schematic of VAWT:

Description:

Conclusion:

Marks out of (25)	Dated signature of staff

Experiment no. 12

Title: Identify the routine maintenance parts of the horizontal axis small wind turbine after watching a video program.

Apparatus:

Watch at,

1. http://www.bluechipsolarandwind.com/Wind-turbine-maintenance.html
2. https://www.youtube.com/watch?v=oPhNQ35_Dwo
3. http://www.archiexpo.com/prod/sonkyo-energy/product-62299-160248.html

Theory:

Horizontal-axis wind turbines (HAWT) have the main rotor shaft and electrical generator at the top of a tower, and must be pointed into the wind. Small turbines are pointed by a simple wind vane, while large turbines generally use a wind sensor coupled with a servo motor. Most have a gearbox, which turns the slow rotation of the blades into a quicker rotation that is more suitable to drive an electrical generator. Since a tower produces turbulence behind it, the turbine is usually positioned upwind of its supporting tower. Turbine blades are made stiff to prevent the blades from being pushed into the tower by high winds. Additionally, the blades are placed a considerable distance in front of the tower and are sometimes tilted forward into the wind a small amount.

Routine maintenance:

Conclusion:

Marks out of (25)	Dated signature of staff