MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE SEMESTER END THEORY EXAMINATION

B. Sc. (Agriculture)

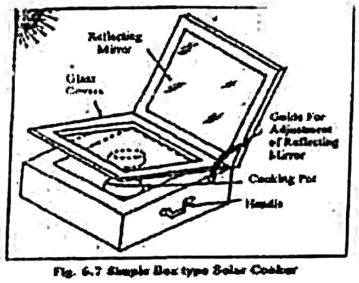
Semester	:	IV (New)	Academic Year	:	2018-19 Term-II		
Course No.	:	ENGG-243	Title	:	**Renewable Energy and Green Technology**		
Credits	:	1+1=2					
Day & date	:		Time	:	Total Marks	:	40

Note:

1. Solve ANY EIGHT questions from SECTION "A"
2. All questions from SECTION "B" are compulsory
3. All questions carry equal marks
4. Draw neat diagrams whenever necessary

Model Answer

SECTION-"A"

Q. No. 1	**Explain the working of Box Type Solar Cooker**
Ans.	**Box type Solar Cooker** Box type solar cooker is a typical example of solar energy devices, which demonstrate application of good reflector, absorber and transmitter. In this direct interception of solar radiation through glazing and indirect interception through plane mirror is made on the black body (insulated hot box) where raw material is placed for cooking. The insulated hot box may be square, rectangular or cylindrical in shape, which is painted black from inside with double-glazing for direct interception of solar radiation. The indirect entry of solar radiation through reflection is provided by single or multiple reflectors. Here the adjustment of cooker toward the sun is not so frequently required as in the case of direct type of solar cooker. It is slow cooker and takes long time for cooking and many of the dishes require roasting and baking cannot be prepared with this cooker. It has following important parts. A. **The outer box**: The outer box of a solar cooker may be made of wood, iron sheet or fiber reinforced plastic having suitable dimensions, which accommodate black body (inner box) and insulating pads.  Fig. 6.7 Simple Box type Solar Cooker **The inner box**: The inner box may be made from G. L. sheet or aluminum sheet. All the four sides and the bottom of the inner box, which are exposed to the sun, are coated with black board paint for absorbing maximum amount of solar radiations. In fact, it is acting as black body, which absorbs energy directly intercepting through glazing and secondary reflecting from the plane mirror. B. **Insulation**: The hot box must be thermally insulated so that heat gain through solar radiation be effectively used for cooking purpose. Therefore, the space between outer box and inner box must be filled with a quality insulating material such as glass wool, thermacol etc. A suitable thickness of good quality insulating materials maintained the temperature of inner box.

	C. **Double Glazing:** A double glass cover is provided on the top of the inner box. These covers have length and breadth slightly greater than the inner box and can be fixed in a wooden frame maintaining a small spacing between the two glasses. This air cavity between glazing act as a insulator, which prevent heat losses from the inside box to top of the surface. D. **Plane Mirror:** A plane mirror is attached to the cooker, so that it enhances the entry of solar radiation by about 50 per cent in the inner box. In fact plane mirror acts as reflector and it increases the radiation input on the absorbing surface. E. **Cooking containers:** These containers with covers are made of aluminum or stainless steel and having dull black paint on their outer surface so that maximum amount of radiation can directly absorbed.
Q. No. 2	**What are the uses of wind energy systems? Explain in details**
	The various uses of wind energy systems are- a) **Water pumping-** The wind has been used as a reliable and inexpensive power source for water pumping. b) **Remote communities-** In areas where diesel generators often supply electricity, the use of wind energy not only makes environment sense, it make economic sense as well. Larger wind energy systems can reduce reliance on expensive and greenhouse gas producing generators. c) **Recreation-**Using the wind as an energy source for your cottage or boat could be efficient and inexpensive when compared to fossil fuel generators. An environmentally friendly wind energy system could power lights, radios and small appliances and much other recreation purpose. d) **Farm and Ranch-**As they are ideal where remote, low voltage power is required, wind energy electrical generators are used for such farm systems as electric fences and yard lights and other on farm application. e) **Home use-** There are good potential to integrate wind energy uses for rural homes for meeting essential energy requirement such as lighting and power generation. Rural home owner who want to help to reduce the environmental impact of their use can reduce their reliance on grid power with a wind energy system. Even a mini wind energy system saves electricity generated from fossil fuels or nuclear energy. f) **Battery charger and other application-**There are several types of wind energy systems which can be used for charging batteries. There are stand-alone systems which provide power soley from the wind. A stand alone system may have a method for storing energy when conditions are not good.
Q. No. 3	**Write working principle of Cross Draft Gasifier**
	In cross drafft gasifiers insulation against these high temperatures is provided by the fuel i.e. charcoal itself. Charcoal gasification results in very high temperatures (1500°c and higher) in the oxidation zone which can lead to material problems. Gasification is a step forward to carbonization, where and product of carbonization is finally converted into gaseous mixture of combustible nature. This mixture is known as producer gas, which combustible in nature. This mixture is known as producer gas, which can be used for meeting domestic and motive power requirement. Design of gasifier depends upon type of fuel used and whether gasifier is portable or stationary. Gasifiers are classified according to air blast introduction in the fuel column and how producer gas travels in the reactor before its final use. Cross draft gasifier allow cross movement of fuel and gas. The air is allowed to enter perpendicular of fuel bed, where is Producer gas started generated in the same opposite live. The disadvantages of this design include their minimal tar-converting capabilities and the consequent need for high quality (low

volatile content) charcoal with high exit gas temperature, poor CO_2 reduction and high gas velocity. Unlike downdraft and updraft gasifiers, the ash bin fire and reduction zone is crossdraft gasifiers are separated. This design characteristic limit the type of fuel for operation to low ash fuels such as wood, charcoal and coke. The load following ability of crossdraft gasifier is quite good due to concentrated partial zone which operate at temperatures up to 2000° C. Start up time (5-10 minutes) is much faster than that of downdraft and updraft units. The relatively higher temperature in cross draft gas producer has an obvious effect on gas composition such as high carbon monoxide, and low hydrogen and methane content when dry fuel such as charcoal is used. Crossdraft gasifier operates well on dry air blast and dry fuel.

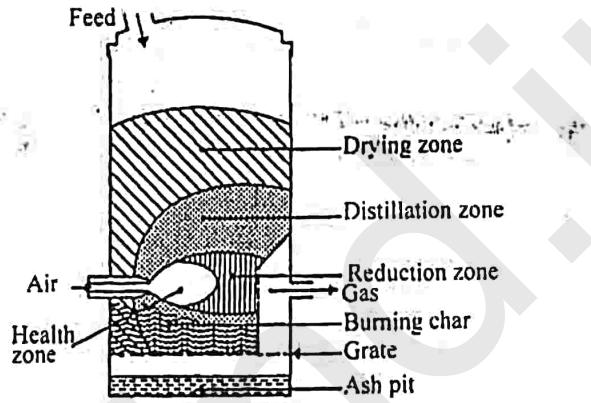


Fig. 11.3: Cross-draught Gasifier

Q. No. 4 **Write environmental benefits of biofuels**

Environmental benefits.

There are number of environmental benefits through use of diesel, which are given as below:

1) The use of bio-fuel avoids fossil fuel use and hence avoids CO_2/CO emission in atmosphere. It is one of environmental friendly option.
2) It is a promising alternative fuels source for future especially for automobiles.
3) Substantial reduction of unburned hydrocarbons, carbon monoxide and particulate matter hence no pollution.
4) Decrease the solid carbon fraction of particulate matter.
5) Increase in the green cover as result of plantations would check soil erosion and retain moisture and soil nutrients.
6) Positive ecological benefits in terms of lending support to biodiversity, especially since degraded lands are involved.

Biofuels also help the environment because the plants grown to the fuels take greenhouse gases such as carbon dioxide out the of the air and fix it in their roots, stems and leaves. Much of this carbon dioxide gets sequestered in the soil, reducing the overall level of carbon dioxide in the atmosphere.

Q. No. 5 **What are the applications of Solar Pond? Describe briefly.**

1. **Heating and cooling of Buildings.** Because of the large heat storage capability in the lower convective zone of the solar pond it has ideal use for heating even at high latitude stations and for several cloudy days. Many scientists have attempted and sized the solar pond for a particular required heating load for house heating. Calculations have shown that a solar pond with a 100 m diameter and 1 m deep lower convective zone is sufficient to drive either an absorption system or chillier capable of meeting 100 percent of typical cooling load of a 50 house community in Fort worth (U.S. A).
2. **Production of Power.** A solar pond can be used to generate electricity by

	driving a thermo-electric device or an organic Rankine cycle engine- a turbine powered by evaporating an organic fluid with great promise in those areas where there is sufficient insolation and terrain, and soil conditions allow for construction and operation of large solar ponds necessary to generate meaningful quantities of electrician be converted into electric power. The conversion efficiency is limited due to its low operating temperatures (70-100 C). Because of low which have low boiling points such as halo-carbons (like Freons) or hydrocarbons (such as propane). 3. **Industrial Process Heat.** Industrial process heat is the thermal energy used directly in the preparation and of treatment of materials and goods manufactured by industry. Several scientists have determined the economics of solar pond for supply of process hear in industries. According to them the solar pond can play a significant role supplying the process heat to industries thereby saving oil, natural gas, electricity, and coal. From the calculations it was concluded that for crop drying and for a paper industry, for which economics have been determined, the heat form solar pond is highly competitive with oils and natural gas. 4. **Desalination.** The low cost thermal energy can used to desalt or otherwise purify water for drinking or irrigation. Multi – flash desalination units along with a solar pond is an attractive proposition for getting distilled water because the multi-flash desalination plant below 100° C which can well be achieved by a solar pond. This system will be suitable at places where portable water is in short supply and brackish water is available. The cost of distilled water appears to be high for industrialized countries but can be used in developing countries where there is a shortage of potable water Moreover this type of desalination plant produces five times more distilled water than the conventional basin type solar still. 5. **Heating animal housing and drying crops on farms.** Low grade heat can be used in many ways on farms, which have enough land for solar ponds. Several small demonstration ponds in Ohio. Lowa and Illinois have been used to heat green houses and hogbarns. 6. **Heat for biomass conversion.** Site built solar ponds could provide heat to convert biomass to alcohol or methane. While no solar ponds have been used for this purpose, it is an ideal coupling of two renewable-energy technologies.
Q. No.6	**Write in detail about hydro-electric power station**
	Electricity generation through hydro-electric power station includes. i.e. conversion of potential energy into kinetic energy, conversion of kinetic energy into mechanical energy and finally mechanical energy into electrical energy through conventional generator. The amount of electrical energy that can be generated from a water source depends primarily on two things i.e. the distance the water has to fall and how much water is flowing. Hydro-electric power station are therefore situated where they can take advantage of the greatest fall of a large quantity of water at the bottom of a deep and steep-sided valley or gorge or near the base of a dam. Water is collected and stored in the dam above the station for use at high elevation when it is, required. Some dams create big reservoirs to store water by raising the levels of rivers to increase their capacity. Other dams simply arrest the flow of rivers and diverts the water down to the power station through pipelines.

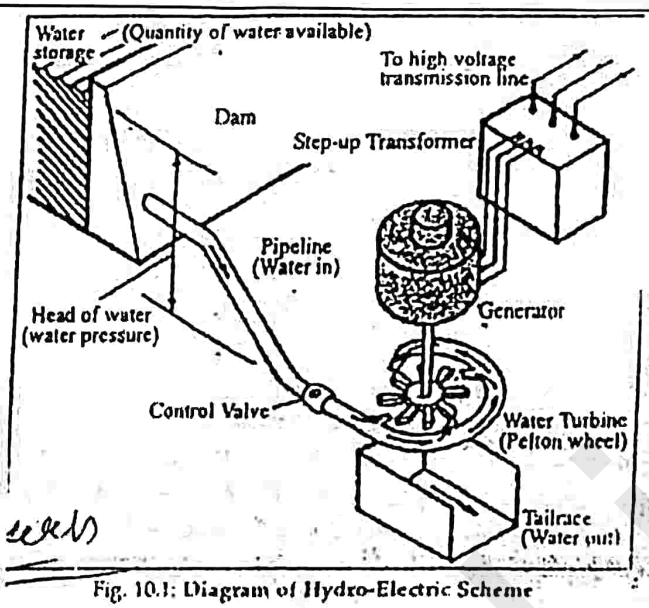


Fig. 10.1: Diagram of Hydro-Electric Scheme

Q. No. 7 **Explain the thermosyphon type solar water heater.**

Water heating is one of the simplest applications of solar energy. Hot water is requirement of domestic activities as well as industrial activities. Here heat from solar collectors through natural convection. Collector coupled to storage tank type of water heater is used as domestic solar water heater where the maximum temp. required is not more than 700 c. A system consist of solar collector, metallic absorber, back insulation and collector box, insulated tank with or without heat exchanger, piping controls and pump.Heating is accomplished by collection of solar radiation with flat plate collector mounted on south facing roof or walls. The collector is usually placed below the storage tank, cold water from the storage tank flows down to the inlet of the collector, gets heated in the collector and rises to the tank by thermosyphonic effect. A density difference created by the temperature gradient causes the fluid to flow up in the collector by the thermosyhonic effect. The collectors are usually oriented south with an inclination angle equal to latitude of the place.

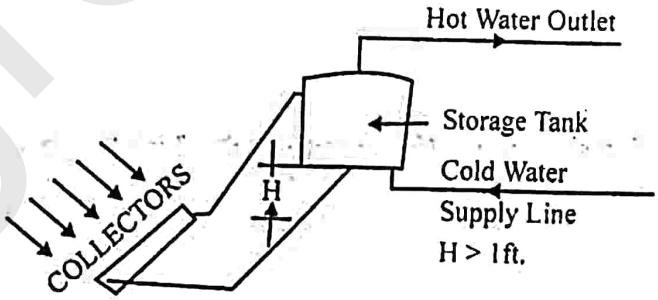


Fig. 6.4: Thermosyphon type Solar Water Heater
(Direct Natural Circulation type)

Q. No. 8 **Write working principle of Photo Voltaic cells with proper diagram**

A typical silicon PV cell is composed of a thin water consisting and ultra-thin layer of phosphorus-doped (N-type) silicon on top of thicker layer of boron-doped (P-type) silicon. An electrical field is created near the top surface of the cell where these two materials are in contact, called the P-N junction. When sunlight strikes the surface of a PV cell, this electrical field provides momentum and direction to light-stimulated electrons, resulting in a flow of current when the solar cell is connected to an electrical load.

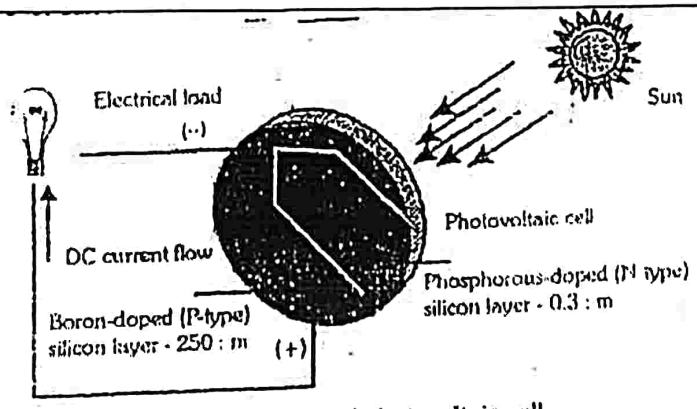


Fig 7.1 Diagram of photovoltaic cell.

Regardless of size, a typical silicon PV cell produces about 0.5-0.6 volt DC under open-circuit, no-load conditions. The current (and power) output of a PV cell depends on its efficiency and size (surface area), and is proportional to the intensity of sunlight striking the surface of the cell.

Q. No. 9 **Enlist different types of Solar Dryers**

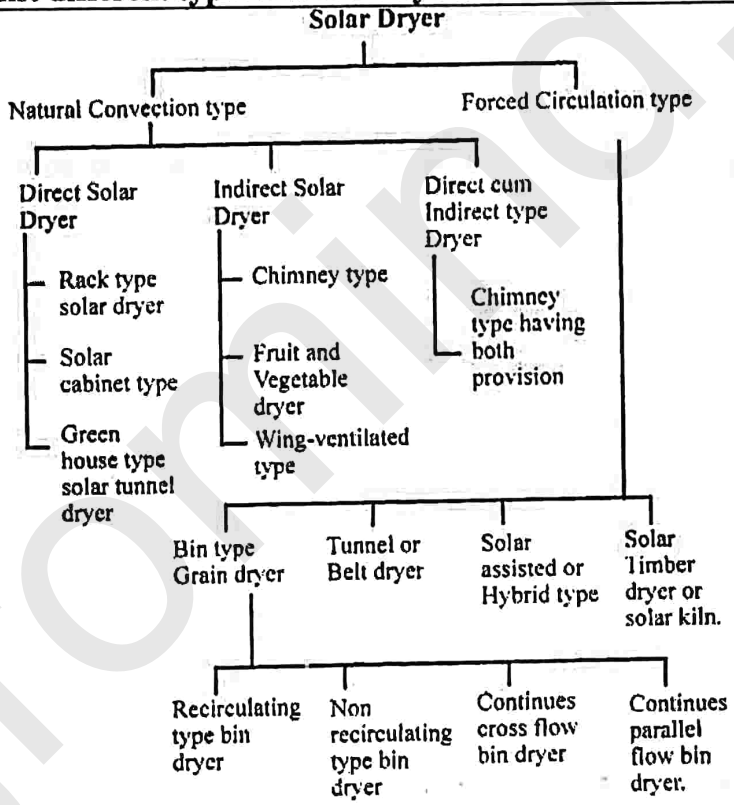


Fig. 6.10: Different type of Solar Dryer

Q. No. 10 **Write short note on classification of energy**

The energy sources can be classified on the basis of three features

1. Conventional and Non conventional Energy Sources
2. Renewable and Non-renewable energy sources
3. Commercial and non-commercial energy sources

1. Conventional sources of energy- These are non-renewable sources of energy which if exhausted cannot be regenerate in a short time. These are not long lasting. Their availability quantity wise is limited and is considered very precious. For eg-coal, petroleum and natural gas
2. Non conventional sources of energy- These are obtained from the entire atmosphere and have no shortage as far their quantum is concerns. For eg solar, wind, biomass, tidal, geothermal, hydro and ocean energy.
3. Renewable energy sources-The sources of energy which are continuously and

	freely produced in nature and not exhaustible are called as renewable sources of energy. For eg.-Biomass, wood energy, geothermal energy, wind energy, ocean energy and ocean energy. 4. Non renewable sources of energy-The sources which are nature gifted which once consumed cannot be replaced are called as non-renewable sources of energy. For eg-coal, petroleum, natural gas, other fossil fuels. 5. Commercial energy sources- The sources of energy which are available in the market on the recurring basis are known as commercial energy sources.For eg.-Fossil fuel, petroleum, natural gas. 6. Non-commercial sources of energy-The sources which are nature gift and available freely in the vicinity are by virtue is called non-commercial sources of energy. For eg.-solar energy, wind energy, bio-energy.

Section "B"

Q. No. 11.	Define the following terms
1.	**Tidal Energy-**It is a form of hydropower that converts the energy obtained from tides into useful forms of power, mainly electricity.
2.	**Geothermal Energy-**It is form of energy conversion in which heat energy from within Earth is captured and harnessed for cooking, bathing, space heating, electrical power generation
3.	**Pyrolysis-**It is the basic thermochemical process for converting solid biomass to a more useful fuel.
4.	**Biomass-** It is the solar energy stored in chemical form in plant and animal materials.

Q. No. 12	Fill in the blanks
1.	A 100 litre solar water heater can saves about **2000 units** of electricity.
2.	The calorific value of biogas is **4713Kcal/m^3**
3.	**Hydraulic Retention Time** is the number of days the feed material is required to remain in the digester to begin gas production.
4.	The power of wind is proportional to the **cube** of its velocity.