MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE
SEMESTER END EXAMINATION
B.Sc.(Hons) Agriculture
MODEL ANSWER SHEET

Semester : IV(New) Academic Year : 2023-2024
Course No. : ENGG-243 Title : Renewable Energy and Green Technology
Credits : 2 (1+1)
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 wherever necessary

SECTION "A"

Q. 1 Enlist various forms of energy. Give the advantages and disadvantages of solar energy and wind energy. (4)

Ans

i) Chemical energy
ii) Nuclear energy
iii) Stored mechanical energy
iv) Gravitational energy
v) Radiant energy
vi) Thermal energy
vii) Electrical energy
viii) Motion
ix) Sound
x) Light energy

Energy resource	Advantages	Disadvantages
Solar	1. Almost limitless source of energy. 2. Does not produce air pollution.	1. Expensive to use for large scale energy production. 2. Only practical in sunny areas.
Wind energy	1. Renewable 2.Relatively inexpensive to Generate 3. Does not produce air pollution	1. Only practicable in windy area

Q. 2 Describe in short the applications of biomass. Give the environmental benefits of biodiesel. (4)

Ans

Biomass applications:

Biofuel:

The production of biofuels such as ethanol and biodiesel has the potential to replace significant quantities of fossil fuels in many transport applications. The widespread use of ethanol in Brazil has shown that biofuels are technically feasible on a large scale. In the USA and Europe

biofuel production (ethanol and biodiesel) is increasing, with most of the products being marketed in fuel blend, e.g. E2O is 20 % ethanol and 80% petrol and has been found to be suitable for most spark ignition engines without any modifications. At present this production is supported by government incentives but in the future, with the increased growth of energy crops, and economics of scale, cost reduction may make biofuels competitive in their own right E10 is simply blending 10 % ethanol and 90 % petrol.

Electricity Generation:

There are number of conversion routes including external combustion and internal combustion suitable for electricity generation from biomass. Further internally combustion can produce producer gas, which can be successfully utilized for power generation. Electricity can be generated from a number of biomass sources and being a form of renewable energy can be marketed as **"Green power"**. The production of electricity from renewable biomass sources does not contribute to the greenhouse effect as the carbon dioxide released by the biomass when it is combusted (either directly or after a biofuel is produced) is equal to the carbon dioxide absorbed by the biomass material during its growth.

Heat and Steam:

The combustion of biomass or biogas can be used to generate heat and steam. Heat can be the main product in applications such as home heating and cooking, or it can be a byproduct of electricity generation in combined heat and power plants. Steam generated by biomass can be used to drive steam turbine for electricity generation, used for process heat in a manufacturing or processing plants.

Combustible Gas:

The biogas produced from anaerobic digestion or producer gas through gasification and pyrolysis has a number of uses. It can be used in internal combustion engine to drive turbines for electricity generation, to produce heat for commercial and domestic needs.

Environmental benefits:

There are number of environmental benefits through use of biodiesel, 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 hydrocarbon, 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 plantation would check soil erosion and retain moisture and soil nutrients.

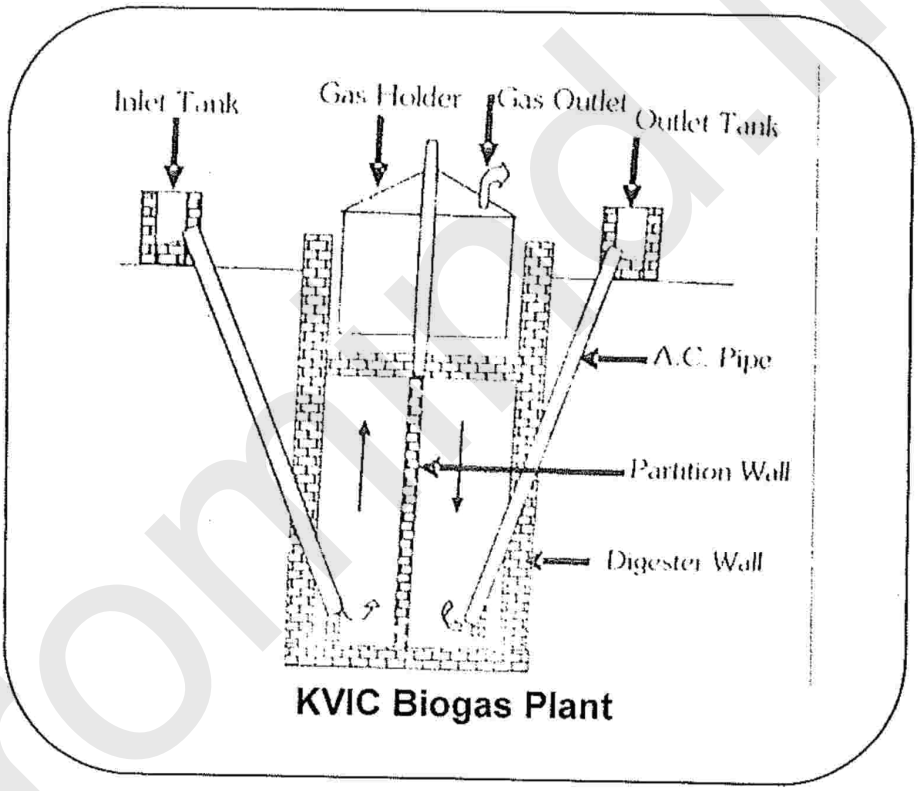
(6) Positive ecological benefits in terms of lending support to biodiversity, especially since degraded lands are required.

Q. 3 Describe in short KVIC biogas plant. Give the advantages and disadvantages of KVIC biogas plant. (4)

Ans **KVIC Plant:**

In 1945 Scientist of Indian Agricultural Research Institute (IARI) New Delhi, worked on semi continuous flow digester and in the year 1961 Khadi and Village Industries Commission (KVIC) patented a design which is being popularized by various agencies in many countries.

This design consist of a deep well shaped underground digester connected with inlet and outlet pipes at its bottom, which are separated by a partition wall dividing the 3/4th of the total height into two parts. A mild steel gas storage drum is inverted over the slurry which goes up and down around the guide pipe with the accumulation and withdrawal of gas.



KVIC Biogas Plant

Advantages of KVIC Plant:

i) Constant gas pressure.
ii) Minimum gas leakage problem
iii) Higher gas production.
iv) Scum problem is minimum
v) Pressure is normally equalizes.
vi) No danger of mixing between biogas and external air. Hence no danger of explosion.

Disadvantages of KVIC Plant:

i) Higher cost
ii) Higher maintenance cost
iii) The outlet pipe should be flexible. It required regular attention.
iv) Heat is lost through gas holder.

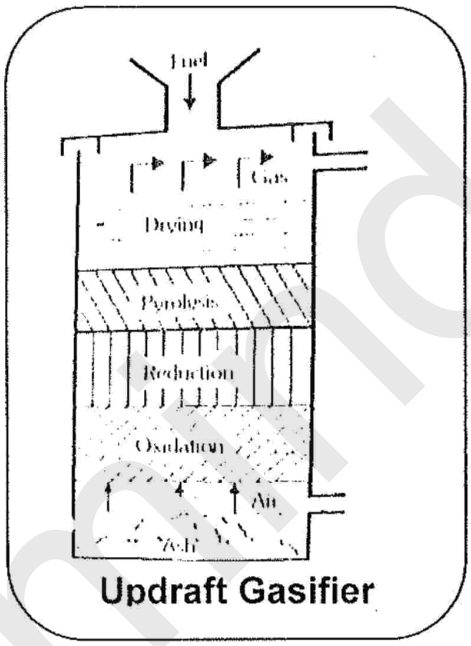
Q. 4 Enlist different types of gasifiers. Describe updraft gasifier in short. (4)

Ans

1) Updraft gasifier
2) Downdraft gasifier
3) Twin-fire gasifier
4) Cross draft gasifier
5) Fluidized bed gasifier
6) Other gasifier

Updraft gasifier:

An updraft gasifier is clearly defined zones for partial combustion, reduction and pyrolysis. As the name indicates, in this type of gasifier air is introduced at the bottom and act as counter current to fuel flow.



Updraft Gasifier

The gas is drawn at higher location. The updraft gasifier achieves the highest efficiency as the hot gas passes through fuel bed and leaves the gasifier at low temperature. The sensible heat given by gas is used to preheat and to dry fuel used.

Disadvantages of updraft gas producer are excessive amount of tar in raw gas and poor loading capability. Hence it is not suitable for running of vehicle. The updraft gasifier is suitable for low tar fuel such as charcoal and coke.

Q. 5 Give the detail classification of solar cookers and enlist applications of the direct solar energy. (4)

Ans

Classification of solar cooker:

(A) Direct or focusing type:

(i) Point focusing type
(ii) Conical reflector type
(iii) Paraboloidal reflector type
(iv) Step reflector
(v) Spherical reflection (umbrella) type.
(vi) Multi faced spherical reflector type
(vii) Cylindro-parabolic reflector type
(viii) Spherical parabolic type

(B) Indirect or box type solar cooker:

(i) Single reflector type (Box type)
(ii) Multi reflection type (Solar oven)
(iii) Flat plate collector with plane side reflector
(iv) Flat plate collector with compound side reflector.

(C) Advanced type or Separate collector and cooking chamber type solar cooker:

(i) Heat transfer system type solar cooker.
(ii) Energy storage type solar cooker
(iii) Combination of heat transfer and energy storage.

Direct Solar Energy Applications:

(1) Solar water heating
(2) Space heating
(3) Space cooling
(4) Solar energy - Thermal electric conversion
(5) Solar energy - photovoltaic electric conversion.
(6) Solar distillation
(7) Solar pumping
(8) Agriculture and industrial process heat
(9) Solar furnace
(10) Solar cooking
(11) Solar production of hydrogen and
(12) Solar green houses.

Q. 6. What are the advantages of solar water heaters? Describe in short box type of solar cooker. (4)

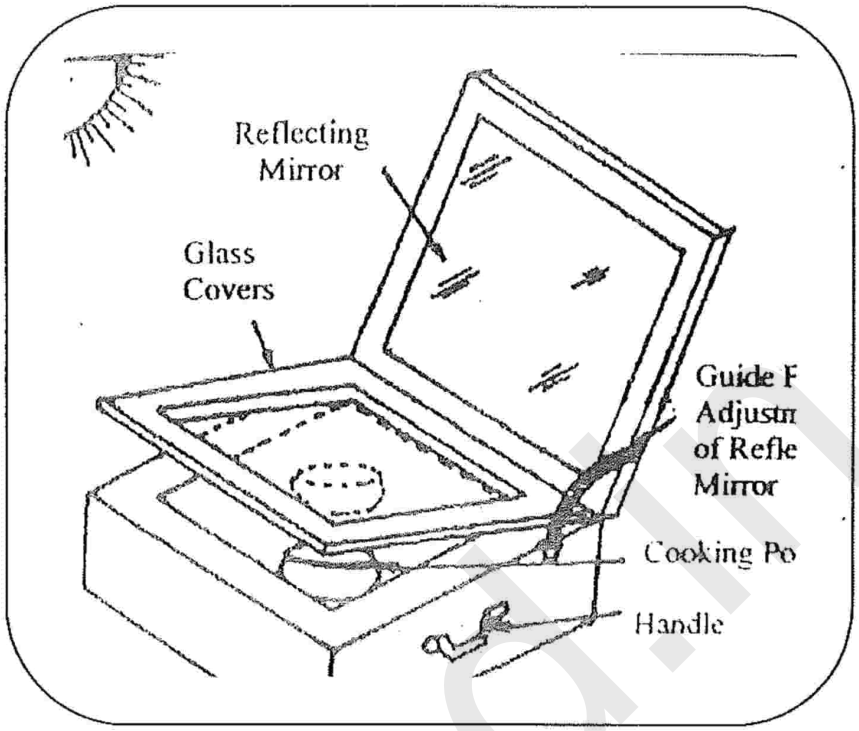
Ans

Advantages of Solar Water Heater:

(1) Simple in construction and installation.
(2) Almost no maintenance and operating cost.
(3) It saves time and energy for heating water.
(4) Easily retro-fittable to existing houses as per requirement.
(5) Economically viable as compared to electric water heater.
(6) Moderate temperature required, domestic affairs could easily achieved.

Box type solar cooker:

It is a good reflector, absorber and transmitter. In this type of solar cooker there is direct interception of solar radiation through glazing. There is indirect interception through reflection from plane mirror is made on the black body 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. It is slow cooker and take long time for cooking. Roasting and baking can not be prepared with this cooker.



Parts of Box type Solar cooker:

(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.

(B) The inner box:

The inner box may be made from G.T. sheet or alluminum sheet. All the four sides and the bottom are coated with black board paint for absorbing maximum amount of solar radiations.

(C) Insulator:

The hot box must be thermally insulated so that heat gained 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, thermocole etc.

(D) Double glazing:

A double glass cover is provided on the top of the inner box. These covers have length and breath slightly greater than the inner box. Covers are fixed in a wooden frame maintaining a small space between the two glasses. This air cavity between glazing act as a insulator, which prevent heat looses from the inside box.

(E) 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.

(F) Cooking container:

These containers with covers are made of alluminum or stainless steel and having dull black paint on their outer surface so that maximum amount of radiation can be directly absorbed.

Q.7 Give the detail classification of solar dryers. (4)

Ans **Different types of solar dryers:**

(1) Natural Convection type
(2) Forced circulation type.

(1) Natural Convection type:

(a) Direct Solar dryer
(b) Indirect Solar dryer
(c) Direct cum indirect type dryer

(a) Direct Solar dryers:

(i) Rack type solar dryer
(ii) Solar cabinet type
(iii) Greenhouse type solar tunnel dryer

(b) Indirect solar dryers:

(i) Chimney type
(ii) Fruit and vegetable dryer
(iii) Wing ventilated type

(c) Direct cum Indirect type dryer:

(i) Chimney type having both provision.

(2) Forced circulation type dryer:

(a) Bin type grain dryer
(b) Tunnel or Belt dryer
(c) Solar assisted or hybrid type
(d) Solar Timber dryer or Solar Kiln.

(a) Bin type grain dryer:

(i) Recirculating type bin dryer
(ii) Non recirculating type bin dryer
(iii) Continues cross flow dryer
(iv) Continues parallel flow bin dryer.

Q.8 What are the merits of solar photovoltaic system? Describe in short the working of photovoltaic cells. (4)

Ans **Merits of PV System:**

(i) PV system can be designed for a variety of applications and Operational requirements.
(ii) PV system have no moving parts, are modular, easily expandable and even transportable in some cases.
(iii) Energy independence and environmental compatibility.
(iv) The fuel (sunlight) is free.
(v) No noise or pollution is created from operating PV system.
(vi) It requires minimal maintenance and have long service life.

Working of PV Cells:

A typical silicon PV cell is composed of a thin wafer consisting of an ultra-thin layer of phosphorus -doped (N-type) silicon on top of a 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 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.

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 and is proportional to the intensity of sunlight striking the surface of the cell.

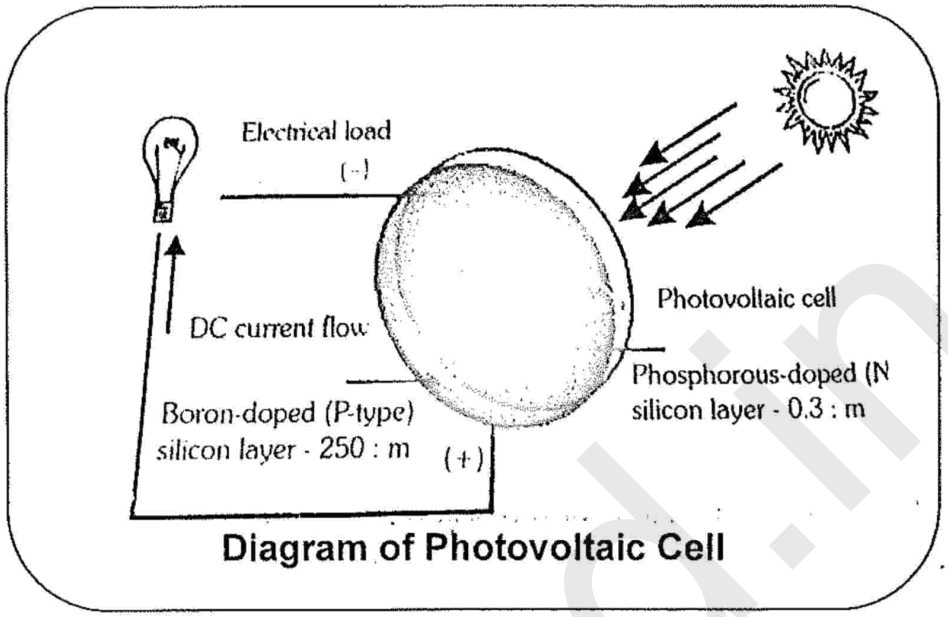


Diagram of Photovoltaic Cell

Under peak sunlight conditions a typical commercial PV cell with a surface area of 160 cm^2 will produce about 2 watt peak power. If the sunlight intensity were 40 per cent of peak, this cell would produce about 0.8 watt.

Q.9 What are the uses of wind energy systems? (4)

Ans **Uses of Wind Energy Systems:**

(a) Water pumping: The wind has been used as a reliable and inexpensive power source for water pumping.

(b) Remote communities: In remote communities where diesel generators often supply electricity, the use of wind energy not only makes environmental sense, it makes economic sense as well. Large 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. Wind energy stem could power lights, radios and small appliances and many other recreations purpose.

(d) Farm and Ranch:

Wind energy can be ideal where remote, low voltage is required. Wind energy electrical generators are used for such farm systems as electric fences and yard lights.

(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.

(f) Battery charger and other applications:

Wind energy systems which can be used for charging batteries. There are stand-alone systems which provides power solely from the wind. There are hybrid systems which use another source of power, perhaps solar panels or a diesel generator, to supplement the energy provided from the

wind. These can be used to aerate ponds or pumping water for livestock, irrigation or household water supplies.

Q. 10 Write short notes on (any two) (4)

i) Operation of simple solar still:

In the solar still the incident solar radiation is transmitted through the glass cover and is absorbed as heat by a black surface in contact with the water to be distilled.

The water is thus heated and gives off water vapour. The vapour condenses on the glass cover, which is at a lower temperature because it is in contact with the ambient air and runs down into a gutter from where it is fed to a storage tank. Here condensation is not drop wise, whereas it is film wise, therefore, condensed water along the glass cover is allowed to trap in a channel fixed at its bottom.

ii) Ocean thermal energy conversion:

This is also an indirect method of utilizing solar energy. A large amount of solar energy is collected and stored in tropical oceans. The surface of the water acts as the collector for solar heat, while the upper layer of the sea constitutes infinite heat storage reservoir. The heat contained in the oceans could be converted into electricity by utilizing the fact that the temperature difference between the warm surface waters of the tropical oceans and the colder water in the depths is about 20-25 ^{0}K. The surface water which is at higher temperature could be used to heat some low boiling organic fluid, the vapours of which would run a heat engine. The exit vapour would be condensed by pumping cold water from the deeper regions. Several such plants are built in France after World War II (the largest of which has a capacity of 7.5 MW). All the systems for OTEC method work on a closed Rankine cycle and use low boiling organic fluids like ammonia, propane, R-12, R-22 etc.

The warm surface water is used for supplying the heat input in boiler, while the cold water brought up from the ocean depths is used for extracting the heat in the condenser.

iii) Fuel cells:

It may be defined as an electro-chemical device for the continuous conversion of the portion of the free energy change in a chemical reaction to electrical energy.

Main components of a cell are (i) a fuel electrode (ii) an oxidant or air electrode and (iii) an electrolyde.

Hydrogen as a fuel so far gives the most promising results. Cells consuming coal, oil or natural gas would be economically much more useful for large scale applications.

Some of the cells are hydrogen, Oxygen (H_2, O_2), Hydrazine, Oxygen (N_2H_4, O_2), Carbon / coal, oxygen (C, O_2), methane, oxygen (CH_4, O_2).

Hydrogen oxygen fuel cells (Hydrox) are efficient and the most highly developed cell. Two porous carbon or nickel electrodes are immersed in an electrolyte. Catalyst is embedded in Nickel electrode. The electrolyte is typically 30 % KOH.

SECTION "B"

Q. 11 Define the following terms (4)

i) Solar pond ii) Gasification

iii) Bio-energy iv) Chemical energy

i) Solar pond: A natural or artificial body of water for collecting and absorbing solar radiation energy and storing it as heat

ii) **Gasification**: Gasification is a step forward to carbonization where end product of carbonization is finally converted into gaseous mixture of combustible nature.

iii) **Bio-energy**: The chemical energy that is stored in plants and animals, or in the wastes that they produce, is called 'bio energy'

iv) **Chemical energy**: Chemical energy is the energy stored in the bonds of atoms and molecules

Q. 12 Fill in the blanks (4)

i) About 70 % of India's energy generation capacity is from fossil fuels.

ii) For solar water heater collector, the required collector area for 100 liter hot water demand at 50^0C is about 2 m^2.

iii) In wind energy conversion system, the horizontal axis machines are those in which the axis of rotation is **parallel** to the direction of wind.

iv) Biogas contains 60 percent of methane.

Signature of Course Instructor

Signature of Head of the Department

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