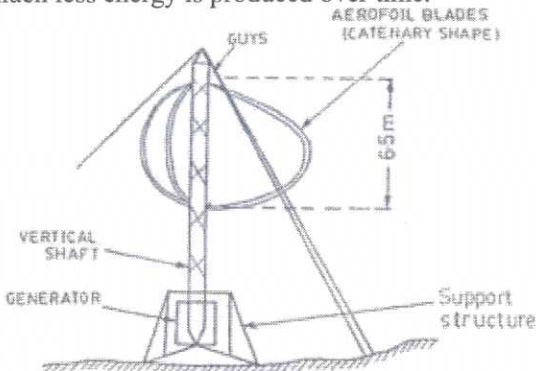


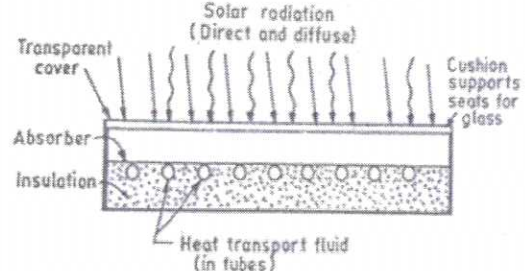
SCHEME OF VALUATION

(Scoring Indicators)

Revision : 2015 Course Title : Alternative Energy Sources & Management		Course Code: (15) 5024 QID: 1505230099		
Qn. No.	Scoring Indicator	Split up score	Sub total	Total
Part A				
I (1)	Primary sources: Fossil fuels, solar, wind, biomass Secondary sources: Electricity, syngas, hydrogen	1 x 2	2	10
I (2)	The amount of radiant energy received from sun in unit time on a unit area perpendicular to the sun's direction at the mean distance of the earth from the sun is called solar constant. Its value is 1353 W/m ² .	1 x 2	2	
I (3)	Renewable organic materials such as wood, agricultural crops or residues, municipal wastes etc. used as source of energy. It can be burned directly or processed into biofuels such as ethanol and methane.	1 x 2	2	
I (4)	1.Can be used directly for heating and drying without any specialized equipment. 2.Heat is not produced by burning fuels, hence pollution-free . 1.Located remotely and in areas with high seismic activity. 2.Large scale power production is not economical.	1 x 2	2	
I (5)	The vast majority of world's accessible geothermal energy is found in rocks that are hot but essentially dry. They are called hot dry rock resources.	1 x 2	2	
Part B				
II (1)	An energy audit is an inspection, survey and analysis of energy flows for energy conservation in a building, process or system, to reduce the amount of energy into the system without negatively affecting the output. a) <u>Walk-through energy audit</u> : Involves walking through the premises where the auditor inspects the energy related systems. Energy data, if available, for one or more years would be required for analysis. b) <u>Comprehensive energy audit</u> : Standard energy audit. Involves more detailed investigation. Energy data for three or more years required for analysis. c) <u>Investment grade energy audit</u> : Most sophisticated energy audit requiring detailed energy modeling and analysis of the facility.	2 2 2	6	42
II (2)		6	6	
	A simple gas turbine cycle, consisting of air compressor, combustion chamber and gas turbine is used with the turbine exhaust gas going to a heat-recovery boiler to generate superheated steam. This steam is used in a standard steam cycle, which	3		

	consists of turbine, condenser, pump, closed feed water heaters and deaerating heater. The HRB consists of an economizer, boiler, steam drum and superheater. The gas leaves the HRB to the stack. Both gas and steam turbines drive electric generators.			
II (3)	<ul style="list-style-type: none"> a) Saves resources b) Saves energy c) Helps protect the environment d) Reduces incineration 	Any 3 x 2	6	
II (4)	<ul style="list-style-type: none"> a) Hydrothermal or hydro-geothermal:- vapour/dry steam, liquid/wet steam, hot water b) Petro-thermal or petro-geothermal c) Geopressure d) Magma e) Volcanoes 	1 x 6	6	
II (5)	<p>Vertical axis wind turbines have the main rotor shaft installed vertically. The turbine need not be pointed into the wind to be effective and can be installed on a building. The generator and gearbox can be placed near the ground, making maintenance easier. However, much less energy is produced over time.</p> 	3	6	Fig-3
II (6)	<ul style="list-style-type: none"> a) The size of the plant is much smaller than conventional fossil fuel plants b) Can be started and put online with a few seconds c) High thermal efficiency d) Provides instantaneous power. e) Can be used most economically as peak load plant f) Closed cycle produces pollution free power. 	1x6	6	
II (7)	<ul style="list-style-type: none"> a) Very expensive and large in size b) Storage and delivery constraints of hydrogen c) Still undergoing research and cannot be implemented right away. 	3x2	6	
III (a)	<p style="text-align: center;"><u>Part-C</u></p> <p>Energy management is the process of monitoring, controlling and conserving energy in a building or industry. The main objectives are resource conservation, climate protection and cost savings, without compromising work processes. It focuses on best utilization of energy, improvement in energy efficiencies and optimum management of energy resources. Some of the energy management techniques are:</p> <ul style="list-style-type: none"> a) Analysis of input: Input-output based energy intensities consider energy inputs from all sources, direct and indirect, in determining total energy requirement for producing commodities. It is useful in determining expected changes in energy demand for changes in composition of industrial output. b) Reuse and recycling of waste: Reuse means using the waste of one process as the raw material for another process. Recycling is the process of converting waste materials into new materials and objects. c) Energy education: Awareness and education on proper use of energy resources and need for conservation. d) Conservation and energy audit: Conservation is the process of reducing demand on a limited supply and enabling steady supply of the resource over a longer period of time. 	2	8	1.5 x 4

<p>III (b)</p>	<p>a) Most of the conventional energy sources such as fossil fuels are non-renewable and are depleting at an alarming rate.</p> <p>b) The energy demand of the world is increasing rapidly due to increase in population and consumption.</p> <p>c) Excessive use of conventional energy sources lead to many adverse environmental impacts such as pollution, global warming, climate change etc.</p> <p>d) Cost and efficiency must be considered while selecting suitable energy source. Therefore alternative energy sources such as wind, solar, biomass etc. must be utilized since they are renewable, sustainable and does not possess adverse environmental impacts.</p>	<p>1.5x4</p> <p>1</p>		<p>15</p>
<p>IV (a)</p>	<p>All the human activities require energy which is obtained from many different sources. The major sources of energy are petroleum, natural gas, coal, nuclear, hydroelectric, biomass, biofuels, wind, geothermal, solar energy.</p> <p><u>Non-renewable energy</u>:- It is the conventional fuels such as coal, oil and gas, which are likely to deplete with time. Coal, petroleum, and natural gas are together called fossil fuels.</p> <p>(i) Coal:- Coal is one of the most important sources of energy and is being used for various purposes such as heating, fuel for boilers and steam engines, and generation of electricity by thermal plants. Coal has also become a precious source of production of many chemicals of industrial importance. Coal is and will continue to be the major fuel in thermo-electric power generation in India.</p> <p>(ii) Petroleum:- Petroleum is also derived from plants and also from dead animals that lived in remote past. Almost 40% of the energy needs of the world are fed by petroleum.</p> <p>(iii) Natural gas:- Natural gas is produced in the Earth's crust by the similar process as petroleum and this is also a combustible fuel. Natural gas is also emerging as an important source of energy in India's commercial energy scene in view of large reserves of gas that have been established in the country, particularly, in South Basin off west coast of India. Natural gas is also making significant contribution to the household sector.</p> <p>(iv) Nuclear Energy:- Nuclear power is the use of nuclear reactions that release nuclear energy to generate heat, which most frequently is then used in steam turbines to produce electricity in a nuclear power plant.</p> <p><u>Renewable energy</u>:- Energy generated by using wind, tides, solar, geothermal heat, and biomass including farm and animal waste as well as human excreta is known as non-conventional energy. All these sources are renewable or inexhaustible and do not cause much environmental pollution. Moreover most of the time they do not require heavy expenditure.</p> <p>(i) Wind Energy:- Wind power is harnessed by setting up a windmill which is used for pumping water, grinding grain and generating electricity. Areas with constantly high speed preferably above 20 km per hour are well-suited for harnessing wind energy.</p> <p>(ii) Tidal Energy:- Sea water keeps on rising and falling alternatively twice a day under the influence of gravitational pull of moon and sun. This phenomenon is known as tides.</p> <p>(iii) Solar Energy:- Sun is the source of all energy on the earth. It is most abundant, inexhaustible and universal source of energy. All other sources of energy draw their strength from the sun. India has developed technology to use solar energy for cooking, water heating, water desalination, space heating, crop drying etc.</p> <p>(iv) Geo-Thermal Energy:- Geo-thermal energy is the heat of the earth's interior. This energy is manifested in the hot springs.</p> <p>(v) Energy from Biomass:- Biomass refers to all plant material and animal excreta when considered as an energy source. Some important kinds of biomass are inferior wood, urban waste, biogas, farm animal and human waste.</p> <p>(vi) Hydroelectric Energy:- Potential energy of water is converted into mechanical energy by using prime movers called hydraulic turbine. The mechanical energy is then converted into electrical energy.</p>	<p>7</p> <p>1x8</p> <p>8</p>		

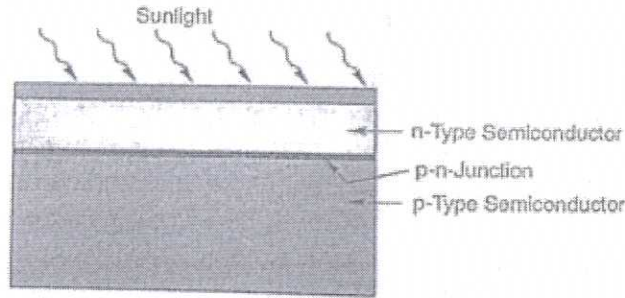
<p>IV (b)</p>	<p>India is the second top coal consumer in the world after China. India ranks third in oil consumption after US and China. The primary energy consumption in India has been the third highest in the world after China and the US, of which it imports nearly 45%.</p> <p><u>Coal</u>: About 80% of power production is through coal based thermal power plants. India is the third largest producer of coal.</p> <p><u>Oil and Natural gas</u>: India is the fourth top crude oil importer and ranks 4th globally in oil refinery capacity.</p> <p><u>LPG</u>: More than 215 million domestic LPG connections are for cooking alone.</p> <p><u>Biomass and charcoal</u>: Only 40% of households in India use biomass and charcoal for cooking purposes and is decreasing rapidly due to smoke and soot.</p> <p><u>Nuclear power</u>: It contributes about 2.4% of electricity generated in India, with 22 nuclear power reactors at 8 power stations. More reactors are being constructed.</p> <p><u>Hydro power</u>: India ranks 7th globally in hydropower generation. Only 15% of potential has been harnessed so far.</p> <p><u>Wind power</u>: Total installed capacity is more than 40 GW, 4th largest installed capacity in the world.</p> <p><u>Solar power</u>: Solar PV and solar thermal power plants are installed with focus on becoming carbon neutral by 2030. 4th rank globally with 40 GW installed capacity.</p>	<p>2</p>	<p>7</p>	<p>15</p>
<p>V (a)</p>	<p>a) Available only during day time b) Solar collectors are expensive c) During cloudy climate and on rainy days energy production is minimal d) Low efficiency e) Solar batteries require large space and are expensive f) Replacing solar panels is difficult. g) Direct use of energy from panel is not feasible as it does not provide consistent power supply. h) Air pollution and dust can degrade the efficiency of photovoltaic cells.</p>	<p>1x8</p>	<p>8</p>	
<p>V (b)</p>	<p>By supplying heat as hot water, hot air or steam for agricultural and industrial purposes, solar energy has the potential for replacing substantial amounts of fossil fuels.</p> <p>1. Low temperature applications: Based on flat plate collectors and can be used for space and water heating upto 100 °C. Heating and cooling of green houses, space heating of livestock shelters, poultry houses etc.</p> <p>2. Intermediate temperature applications: Food processing, textile, laundry and other industries require both hot water and low pressure steam. Water is heated in flat plate collectors first and then passed through an array of parabolic trough concentrating collectors, raising the temperature to 100-175 °C at moderate pressure.</p> <p>3. High temperature applications: Steam above 175 °C is used in many industries, especially for power generation and pumping water for irrigation.</p>	<p>2</p> <p>2</p> <p>2</p> <p>2</p>	<p>7</p>	<p>15</p>
<p>VI (a)</p>	 <p>Flat plate collector is a metal box with a glass or plastic cover on top and a dark</p>	<p>Fig-4</p>		

coloured absorber plate at the bottom. Sunlight passes through the transparent cover and strikes the absorber plate, which heats up by converting solar energy to thermal energy. This heat is transferred to the liquid passing through pipes attached to the absorber plate. Absorber plates are painted with selective coatings which absorb and retain heat better than ordinary black paint. Flat plate collectors are used when the required temperatures are below 90°C, such as for water and space heating.

3

VI
(b)

Solar cells are composed of various semiconductor materials, mostly silicon. Silicon solar cell consists of a thin slice of crystal p-type silicon into which a very thin layer of n-type material is diffused.



4

8

Fig-3

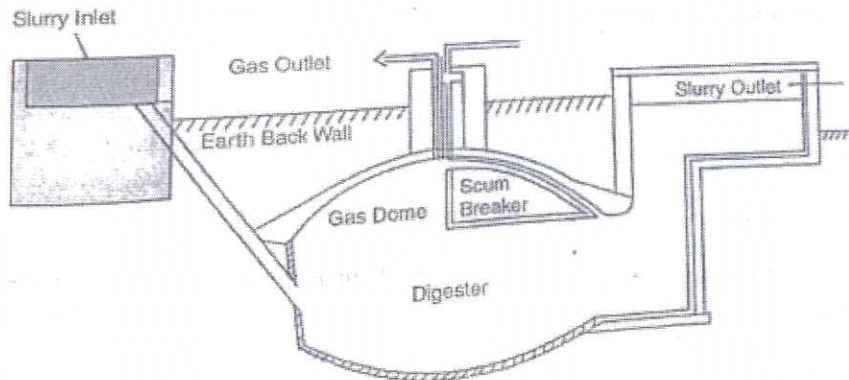
The solar cell works on the photovoltaic effect, which is a process of generating an e.m.f as a result of absorption of ionizing radiation. In a p-n junction after the photons are absorbed, the free electrons of n-regions will tend to flow to the p-region and the holes of p-side will tend to flow to the n-region to compensate for their respective deficiencies. This diffusion will create an electric field from the n-region to p-region.

VII
(a)

In fixed dome type biogas plants, gas is stored in upper part of the digester. There is no separate gas holder. Inlet and outlets are connected at the middle of the digester. The upper portion above the liquid surface acts as storage space for biogas. When gas is produced, level of digester liquid drops whereas that in outlet rises with height difference between the two varying according to gas pressure. This difference in height helps in self-regulating the gas pressure.

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15



7

Fig-4

VII
(b)

- a) Inexhaustible source of energy
- b) No pollution
- c) Can be directly used as mechanical energy
- d) Can be used in remote areas with wind potential
- e) Can be used along with solar energy
- f) Both low-speed and high speed winds can be used for generating power
- g) Unlike solar energy, available during night time also.

1x7

VIII
(a)

- a) Superior wind speed
- b) Good road access to sites
- c) Low population density
- d) Proximity to suitable electrical grid
- e) Good industrial support for construction
- f) Minimum risk of agro-forestry operations (Explain any four)

2x4

VIII
(b)

Fuel Wood in Crop Production and Biological Wastes

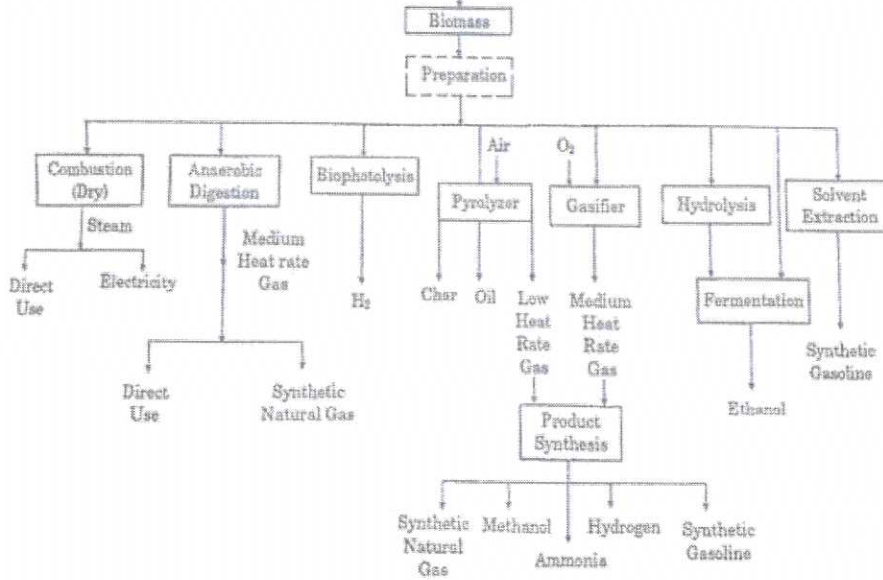


Fig-4

Exp.3

15

IX
(a)

In a Hydrogen Fuel cell, hydrogen is the fuel and oxygen is the oxidant. Hydrogen is supplied to the negative electrode and oxygen to the positive electrode. Porous Nickel or Carbon electrodes are used. Usually a catalyst such as finely divided platinum is included in the electrode to enhance the rate of reaction. An electrolyte is placed between the electrodes. The electrolyte is typically 40% KOH solution. The electrodes have large number of porous sites where the gases, electrode and electrolyte are in contact. Electro-chemical reactions occur at these sites, where hydrogen and oxygen combine to form water and release electrons.

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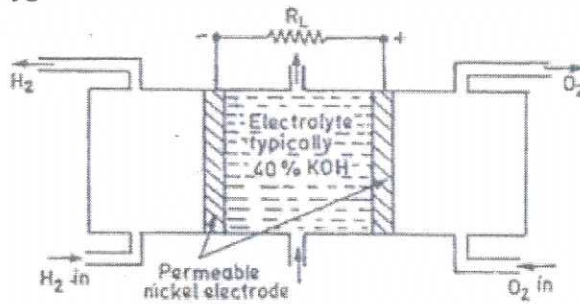


Fig-4

IX
(b)

- 1) It has very high conversion efficiencies, since it is a direct conversion process and does not involve a thermal process.
- 2) Fuel cells can be installed near the use point, thus reducing electrical transmission requirements and accompanying losses.
- 3) They have few mechanical components; hence, they operate fairly quietly and require little attention and less maintenance. They can be readily applied in residential areas.
- 4) Atmospheric pollution is small. If the primary energy source is hydrogen, the only waste product is water. If the source is hydrocarbon, carbon dioxide is also produced. Some heat is generated by a fuel cell, but it can be dissipated to the atmosphere or used locally.
- 5) There is no requirement for large volumes of cooling water such as are necessary to condense exhaust system from a turbine in the conventional power plant.
- 6) The fuel cell takes little time to go into operation.
- 7) The space requirement for fuel cell power plant is considerably less as compared to conventional power plants.
- 8) Unlike batteries, fuel cells have no "memory effect" when they are getting refueled.
- 9) Low temperature fuel cells (PEMFC, DMFC) have low heat transmission which makes them ideal for military applications.

1x7

8

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7

<p>X (a)</p>	<p>Magneto hydrodynamics is the physical-mathematical framework that concerns the dynamics of magnetic fields in electrically conducting fluids eg. in plasma and liquid metals.</p> <ol style="list-style-type: none"> 1. Geophysics: The eddies created by the liquid outer core of the earth can be studied using MHD equations. 2. Earthquakes: They are sometimes preceded by a spike in ultra-low frequency activity. 3. Magnetic drug targeting: MHD equations and finite element analysis is used to study the interaction between magnetic fluid particles in the blood stream and the external magnetic field in cancer research. 4. Engineering: Plasma confinement, liquid metal cooling of nuclear reactors and electromagnetic casting is related to MHD. 5. Sensors: Used for precision measurement of angular velocities in inertial navigation systems. 6. Astrophysics 7. MHD power plants 	<p>1 1.5x4</p>	<p>8</p>	<p>15</p>
<p>X (b)</p>	<p>A geothermal field is a place where geothermal energy is available in sufficient quantities and a geothermal power plant can operate economically.</p> <p>The hot magma near the surface A solidifies into igneous rock B. The heat of the magma is conducted upward to this igneous rock. Ground water that finds its way down this rock will be heated and it rises upward into a porous reservoir C above the igneous rock and is trapped by solid rock D above with fissures E that act as vents. The vents show up at the surface as geysers and fumaroles F or hot springs G. A well H taps steam from the fissures for use in geothermal power plant.</p>	<p>4</p>	<p>7</p>	<p>Fig-3</p>

