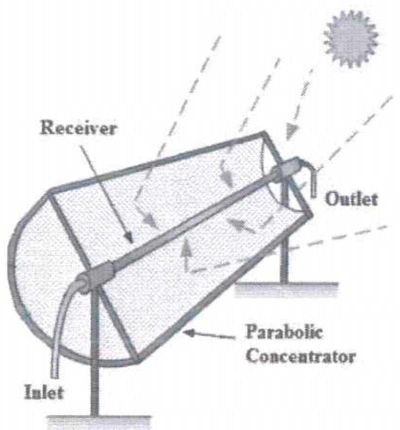
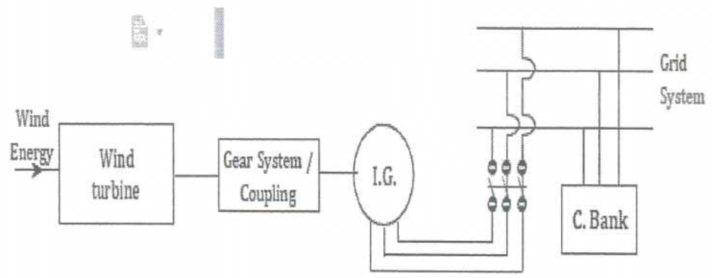
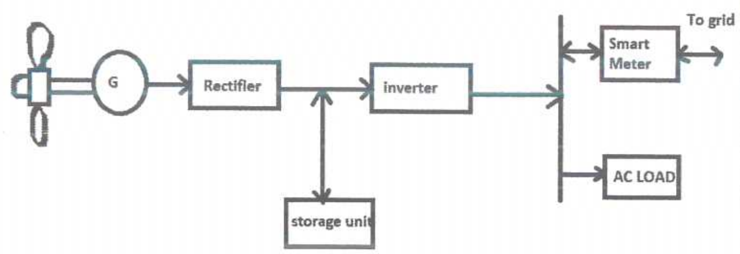
Scoring Indicators

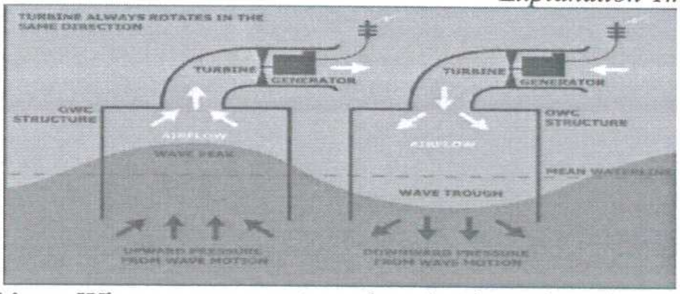
COURSE NAME : RENEWABLE ENERGY POWER PLANTS

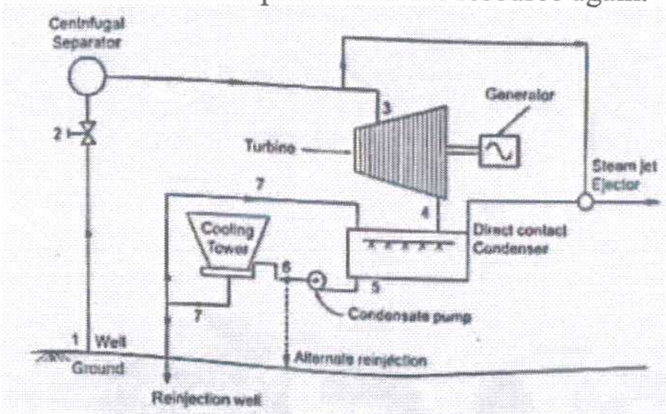
COURSE CODE : 5033A QID :**2109230058B**

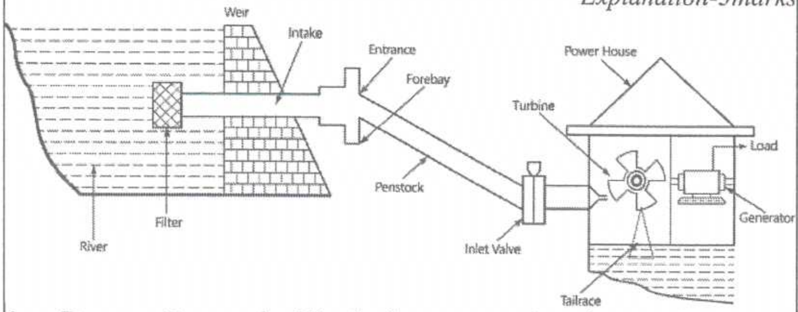
Q No	Scoring Indicators	Split score	Sub Total	Total score
	PART A			**9**
I. 1	Pelton wheel turbine		1	
I. 2	Plant or animal material used as fuel to produce electricity or heat.		1	
I. 3	it is a measure of the amount of solar power received per unit area on a surface at a given location and time.(w/m2)		1	
I. 4	*(Any one)* Charge controller prevents over charging of battery. It prevent reverse power flow from battery to panel.		1	
I. 5	**Cell:** A solar cell, also known as a photovoltaic cell, is the basic unit that converts sunlight into electricity using the photovoltaic effect. **Module:** A solar module, also called a module, is a collection of interconnected solar cells. Modules are designed to generate electricity from sunlight.	0.5x2	1	
I. 6	*(Any one)* Induction generator/synchronous generator		1	
I. 7	(A) Generator — b. mechanical energy to electrical energy (B) Turbine — a. Kinetic energy to mechanical energy	0.5x2	1	
I. 8	*(Any two)* Wave energy conversion, tidal energy conversion, OTEC	0.5x2	1	
I. 9	At the anode $2H_2 \longrightarrow 4H^+ + 4e^-$		1	
	PART B			24
II. 1	*Definition- 1.5marks* *Constituent listing-1.5marks* A renewable fuel that's produced when organic matter, such as food or animal waste, is broken down by microorganisms in the absence of oxygen. Methane (55-60)% Carbon dioxide (30-40)% and small percentages of hydrogen,nitrogen and hydrogen sulphide.	1.5x2	3	
II. 2	1. **Building-Integrated Solar Systems**: Building-integrated solar systems refer to the integration of solar technology into the design and structure of a building. Instead of adding solar panels as an external feature, building-integrated systems seamlessly incorporate	1.5x2	3	

	solar elements into the building's architecture. This can include solar facades, solar roofing materials, solar windows, and other innovative solutions 2. **Solar Power Satellite:** A solar power satellite, also known as a space solar power system, is a concept that involves the construction of large solar energy arrays in space. These satellites would collect solar energy in space, where there is no atmospheric interference, and then transmit the captured energy to Earth in the form of microwaves or other wireless transmission methods.			
II. 3	*Figure-2marks* *Explanation-1marks*  A parabolic trough comprises a linear parabolic reflector that concentrates sunlight on a receiver that is positioned along the focal line of the reflector. The receiver is a tube placed directly over the middle of the parabolic mirror and filled with a working fluid. The heat absorbed by the working fluid transfers to water for producing steam. The focus of solar radiation changes with the change in the Sun's elevation. The reflector keeps following the sun during the day by tracking along a single axis. A working fluid (e.g., molten salt is heated between 150 and 350 °C (302–662 °F) as it flows through the receiver.	2+1	3	
II. 4	*(Any three)* 1. Availability of potential amount of wind energy. 2. Choose the site with consistent wind speed of 5.5 to 6.5 meter per second. 3. The installation will not create any environmental issues. 4. Availability of proper land area. 5. The plant should be easily acessible to the grid system. 6. The plant should be economical and profitable.	1x3	3	

II. 5	*Equation-1marks* *Calculation-2marks* Power output = $1/2*\rho*\pi*r^2*V^3 = 1/2 * 1.226*3.14*30*30*5.4^3$ = 272780.871 W	1.5x2	3	
II. 6	*Figure-2marks* *Labelling-1marks*  	2+1	3	
II. 7	*Figure-2marks* *Labelling-1marks* *Similar block diagrams can be accepted*  	2+1	3	

II. 8	*Figure-2marks* *Explanation-1marks*  **working:** When a wave enters the chamber, the air pressure increases, forcing air out through the turbine. As the wave recedes, the air pressure decreases, causing air to be drawn back into the chamber through the turbine. This back-and-forth flow of air drives the turbine, which is connected to a generator to produce electricity.	2+1	3	
II.9	Due to the solar radiation their is a temperature difference between the ocean surface and ocean depth. This temperature difference is utilized for the energy conversion. The warm water on the surface is used to production of steam from the working fluid. And the cold water at the bottom surface is used for the condensation of working fluid. The steam generated is used to drive the turbo generator to the production of electrical energy. OTEC is differentiated into two types based on the working fluid used 1. Open cycle OTEC (Claude cycle) 2. Closed cycle OTEC (Anderson cycle)	3	3	
II.10	*Advantages-1.5marks* *Disadvantages-1.5marks* **Advantages of tidal power (any 3)** ● Renewable and predictable ● Environmentally friendly ● Long life span and low operating cost ● Reduced land use ● High energy density **Disadvantages of tidal power (any 3)** ● Limited location suitability ● Environmental impact	1.5x2	3	

	• High initial cost • Can't be used as a dependent power source • Maintenance difficulty			
	PART C			42
III.	*Figure-4marks* *Explanation-3marks* *Similar blockdiagrams can be accepted* Vapour dominated type ✓ In vapour dominated system instead of hot water steam generated in resource is collected. ✓ The steam collected is pressurised and passed through the turbine. ✓ Turbine rotates the generator and produce electrical energy. ✓ The steam after process is de pressurised and passed through the cooling tower. ✓ The cooled wated is passed into the resource again.	3	7	7
	 *Dry steam or vapour-dominated geothermal power plant*	4		

IV.	*Figure-4marks* *Explanation-3marks*  1. Dam or Reservoir: The hydro power plant is usually located near a river or constructed with a dam to create a reservoir. The dam helps in storing water, creating a height difference, and controlling the flow of water. 2. Intake and Pen stock: Water is drawn from the reservoir or river through an intake structure and directed into a large pipe called a pen stock. The pen stock is designed to withstand high water pressure and transport water to the turbine. 3. Turbine: The high-pressure water from the pen stock is directed onto the blades of a turbine, causing the turbine to rotate. The turbine converts the kinetic energy of the moving water into mechanical energy. 4. Generator: The rotating turbine is connected to a generator. As the turbine spins, it drives the rotor of the generator, which is equipped with electromagnets. The rotation of the rotor within a stationary magnetic field induces the generation of electricity through electromagnetic induction. 5. Transformer and Power Transmission: The electrical energy produced by the generator is in the form of alternating current (AC). It is then transmitted through a transformer, which steps up the voltage to facilitate efficient long-distance transmission. High-voltage transmission lines carry the electricity to distribution networks and eventually to homes, businesses, and industries. 6. Tail race: After passing through the turbine, the water is discharged into a lower river or tail race. It rejoins the natural watercourse downstream of the power plant.	4+3	7	7

<table>
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<td>V.</td>
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Listing-2marks
Pyrolysis explanation-2.5marks
Gassification explanation-2.5marks
1. Pyrolysis 2. Gassification

1. Pyrolysis :Pyrolysis is the heating of an organic material, such as biomass, in the absence of oxygen. Biomass pyrolysis is usually conducted at or above 500 °C, providing enough heat to deconstruct the strong bio-polymers mentioned above. Because no oxygen is present combustion does not occur, rather the biomass thermally decomposes into combustible gases and bio-char. Most of these combustible gases can be condensed into a combustible liquid, called pyrolysis oil (bio-oil), though there are some permanent gases (CO_2, CO, H_2, light hydrocarbons), some of which can be combusted to provide the heat for the process. Thus, pyrolysis of biomass produces three products: one liquid, bio-oil, one solid, bio-char and one gaseous, syngas.
2. Gassification :Gasification is a technology that converts material containing carbon, such as coal, biomass, and waste, into synthetic gas. Gasification uses little or no air or oxygen in a closed reactor to directly convert carbon-based materials into synthetic gas or syngas, and it does not involve combustion.
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<td>2+5</td>
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<td>VI.</td>
<td>
Any five comparison-5marks
Listing of examples-2marks
<table>
<tr><th>Conventional energy sources</th><th>Non convensional energy sources</th></tr>
<tr><td>These source are limited in amount.</td><td>Resources are abundent in nature</td></tr>
<tr><td>The energy sources non renewable.</td><td>These sources are renewable type.</td></tr>
<tr><td>They are used for large power applications.</td><td>They are used for small power applications.</td></tr>
<tr><td>They are reliable source of energy.</td><td>They are not continous in nature.</td></tr>
<tr><td>Energy conversion rate is high.</td><td>Energy conversion rate is very low</td></tr>
<tr><td>They pollute environment by emitting harmful gases.</td><td>They are environmental friendly.</td></tr>
<tr><td>Eg: coal, petroleum products, Nuclear resources</td><td>Eg: solar energy,Wind energy, Oceanenergy, Geothermal energy</td></tr>
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<td>5+2</td>
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<td>VII.</td>
<td>
Figure-3
Construction-2marks
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<td>3+2+2</td>
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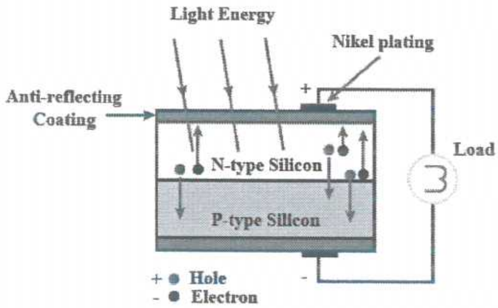
Working-2marks

Construction

A solar cell is basically a junction diode, although its construction it is little bit different from conventional p-n junction diodes. A very thin layer of n-type semiconductor is grown on a relatively thicker p-type semiconductor. We then apply a few finer electrodes on the top of the p-type semiconductor layer.

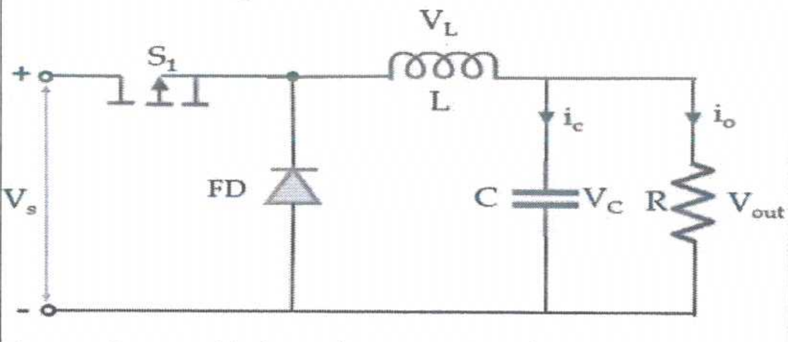


These electrodes do not obstruct light to reach the thin p-type layer. Just below the n-type layer there is a p-n junction. We also provide a current collecting electrode at the bottom of the p-type layer. We encapsulate the entire assembly by thin glass to protect the **solar cell** from any mechanical shock.

Working principle

When light reaches the p-n junction, the light photons can easily enter in the junction, through very thin n-type layer. The light energy, in the form of photons, supplies sufficient energy to the junction to create a number of electron-hole pairs. The incident light breaks the thermal equilibrium condition of the junction. The free electrons in the depletion region can quickly come to the n-type side of the junction.

Similarly, the holes in the depletion can quickly come to the p-type side of the junction. Once, the newly created free electrons come to the n-type side, cannot further cross the

	junction because of barrier potential of the junction. Similarly, the newly created holes once come to the p-type side cannot further cross the junction became of same barrier potential of the junction. As the concentration of electrons becomes higher in one side, i.e. n-type side of the junction and concentration of holes becomes more in another side, i.e. the p-type side of the junction, the p-n junction will behave like a small battery cell. A voltage is set up which is known as photo voltage. If we connect a small load across the junction, there will be a tiny current flowing through it.			
VIII.	*Circuit diagram-4marks* *Explanation-3marks* **BUCK CONVERTER (step down chopper)** When the chopper is on state the current flow from source to load through the inductor L. Inductor charges during the on time of chopper. When chopper is turned off the polarity of inductor reverses and diode D become forward biased condition. The inductor discharges the stored energy through the load. Thus current through the load is continuous in nature.  From volt second balance law average voltage across inductor is zero (Vs -Vo) DT = Vo (1-D) T (Vs -Vo) D = Vo (1-D) Vo / Vs = D From the equation it is clear that the output voltage is less than the input.	4+3	7	7
IX.	i) Total power required = (10*40) +(80*4) = 720 W. Inveter capacity required = 25% more than rated load = 720*125/100 = 900 W ii) Back up energy requirement = 720*10 = 7200 Wh	2	7	7
	Ampere hour rating of battery = 7200 / 12 = 600 Ahour	3		

	Input Wh rating of battery = 7200/0.8*0.9 =10000 Wh ii) Solar watt power requirement = 10000 / 4 = 2500 Wp No of panels required = 2500/200 = 12.5=13 nos	2		
X.	A. Watt hour rating of battery = 12*150 = 1800 Whr Output energy available from battery = 1800 whr Backup period available from battery = 1800 /1000 = 1.8 hours	4	7	7
	B. Required Power output from solar panel = 12 * 20 = 240 W So the system requires one solar panel of 250Wp rating.	3		
XI.	*(Any five points)*	7	7	7

Horizontal axis wind turbine	Vertical axis wind turbine
Axis of rotation parallel to the ground	Axis of rotation perpendicular to ground
All the blades works at a time	Only one blade works at a time
Works only for a specific wind direction	Works in all wind directions
More ground area needed	Less ground area needed
Can be located in remote area due to lagre area requirement	Can be installed in urban areas
Height is more	Height is less
Power transmisssion cost is large	Power transmission cost is less
Maintenance cost is high	Maintenance cost is less.

XII.	*Block diagram-4marks* *Explanation-3marks* *Similar block diagrams can be accepted*	4+3	7	7

STAND ALONE WIND ENERGY SYSTEM.

- In stand alone type wind energy system the whole energy to drive the load is derived from the wind turbine itself.
- Since the wind turbine is coupled with the AC generator it develop AC power. So it can directly drive the AC load connected to it.
- For maintaining frequency at load side the generated AC is converted into DC and it is converted into AC by using inverter by suitable switching of inverter circuit is utilized to develop a constant frequency AC output.

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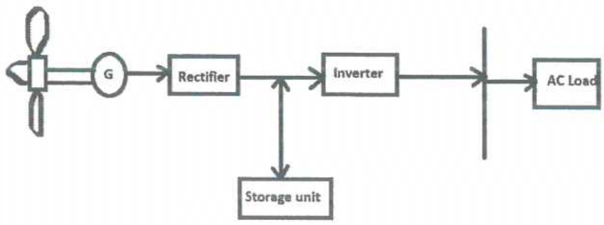
<tr><td></td><td>
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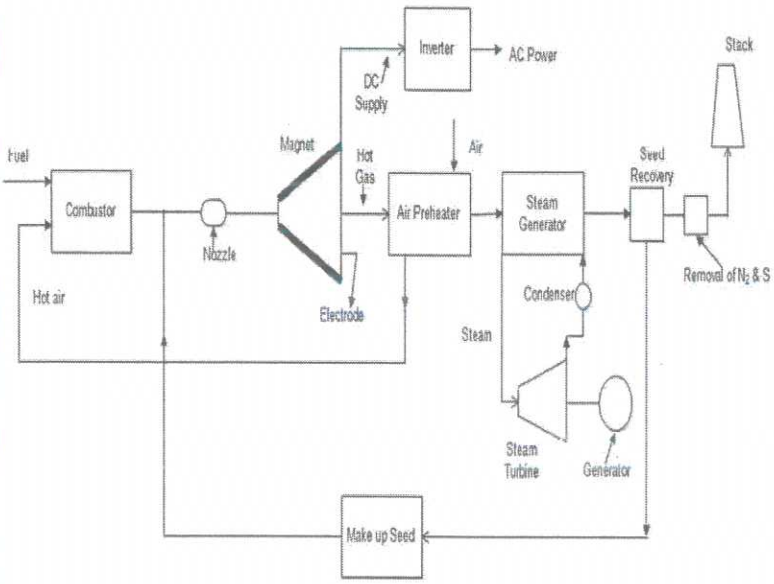
<tr><td>XIII.</td><td>

Block diagram-4marks

Explanation-3marks



- MHD system need high temperature gas source. The atmospheric air is treated in a combuster to raise the temperature level.
- To increase the conductivity of air alkaline metals are seeded into the working fluid before entering into the MHD system.
- After the generation the high temperature air is used to generate steam from water to drive the turbine.
- The seeding metals are recovered from the air after the steam generation.

After the operation the air is removed through the exhaust systems.

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<td>XIV.</td>
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(Any five points)
<table>
<tr><th>Aspect</th><th>Battery</th><th>Fuel cell</th></tr>
<tr><td>Energy source</td><td>Chemical enrgy stored in battery</td><td>Chemical energy from external fuel source</td></tr>
<tr><td>Fuel</td><td>Consumes stored chemicals</td><td>Requires continous supply of fuel</td></tr>
<tr><td>Power generation</td><td>Limited by stored capacity</td><td>Continous as long as fuels supplied</td></tr>
<tr><td>Cost</td><td>Varies with battery type and capacity</td><td>Expensive than batteries</td></tr>
<tr><td>Weight and size</td><td>Generally lighter and small</td><td>Bulkier and heavier</td></tr>
<tr><td>Start up time</td><td>instantaneous</td><td>Require warm up period</td></tr>
<tr><td>Environmental impact</td><td>Depends on battery chemistry</td><td>Low emissions</td></tr>
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