



Important suggestions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more importance. (Not applicable for subject English and communication skills)
- 4) While assessing figures, examiner may give credit for principle components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case some questions credit may be given by judgment on part of examiner of relevant answer based on candidate understands.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q.1	Attempt any FIVE of the following	10 Marks
a)	Classify the hydro-electric plants according to the head and load basis.	
Ans:	Classification the hydro-electric plants According to availability of Head of Water: 1. Very high head power plant 2. High head power plant 3. Medium head power plant 4. Low head power plant Classification the hydro-electric plants According to Load basis: 1. Base load power plant 2. Peak load power plant	(1 Mark) (1 Mark)
b)	List the types of turbine used in hydro power plant.	
Ans:	Following types of turbine used in hydro power plant: 1. Pelton wheel 2. Francis Turbine 3. Kaplan Turbine 4. Propeller Turbine	(2 Mark)



c)	Describe the term 'Nuclear shielding' in Nuclear Power Plant.
Ans:	Explanation of 'Nuclear shielding' in Nuclear Power Plant: (2 Marks) <p>Shielding is provided to absorb alpha, beta particles and gamma rays which are produced during nuclear chain reaction (fission process)</p> <p>The function of shielding is to protect environment, humans and animals from the harmful radioactive radiation (pollution), before they are emitted to atmosphere.</p> <p>Shielding is made from:-</p> <ol style="list-style-type: none">1. Thick layer of Paper are provided to stop the alpha particles2. Thick layer of metal or Aluminum are provided to stop the beta particles3. Thick layer of lead or concrete wall are provided all around the reactor vessel (3-m thick concrete shield) for stopping gamma rays4. Thick layer of Water or concrete wall are provided all around the reactor vessel for stopping neutrons.
d)	Enlist the nuclear fuels.
Ans:	Following nuclear fuel are used in nuclear power plant:- (Any Two Name of fuels expected: 1 Mark each) <ol style="list-style-type: none">1. Natural Uranium2. Low-enriched Uranium3. Highly-enriched Uranium4. Fertile Material:-U238 / Th232
e)	Why concentrating collectors are used in solar power plant.
Ans:	Because of following advantages concentrating type collector are used in solar power plant: - (Any two points are expected: 2 Marks) <ol style="list-style-type: none">1. Temperature: Temperature obtained is high because absorber area is less and collector/reflector area is more.2. Heat Losses: Losses are less as absorber area is small3. Efficiency: Efficiency is high4. Heat insulation: Heat insulation required is less as absorber area is small.5. Anti-freeze protection: Little or no anti-freeze protection is required to protect the absorber.6. Used to generate steam electricity: Can be used to generate electricity with the help



	<p>of steam turbine.</p> <p>7. Due to tracking better results: As tracking system is used better results are obtain than flat type collector.</p>										
f)	Explain the concept of following terms : (i) Connected load (ii) Maximum demand										
Ans:	<p>1. Connected Load: (1 Mark)</p> <p>It is the sum of load of all equipment's connected to supply system which are in use or not in use of each consumer. OR</p> <p>The sum of connected load of all consumers is the connected to the power station or power system.</p> <p>2. Maximum Demand: (1 Mark)</p> <p>It is the maximum load which a consumer uses at a particular time period out of his total connected load.</p>										
g)	What is a meaning of load duration curve.										
Ans:	<p>Load duration curve: (2 Mark)</p> <p>It is drawn from load curve. It is graph of load (MW/KW) arranged in descending order of magnitude with respect to time. OR</p> <div style="text-align: center;"><table border="1"><caption>Load Duration Curve Data</caption><thead><tr><th>Time (hours)</th><th>Load (MW)</th></tr></thead><tbody><tr><td>0 - 3</td><td>80</td></tr><tr><td>3 - 7</td><td>35</td></tr><tr><td>7 - 12</td><td>20</td></tr><tr><td>12 - 24</td><td>5</td></tr></tbody></table></div> <p style="text-align: center;">Load Duration Curve</p> <p style="text-align: right;">OR Equivalent Figure</p>	Time (hours)	Load (MW)	0 - 3	80	3 - 7	35	7 - 12	20	12 - 24	5
Time (hours)	Load (MW)										
0 - 3	80										
3 - 7	35										
7 - 12	20										
12 - 24	5										

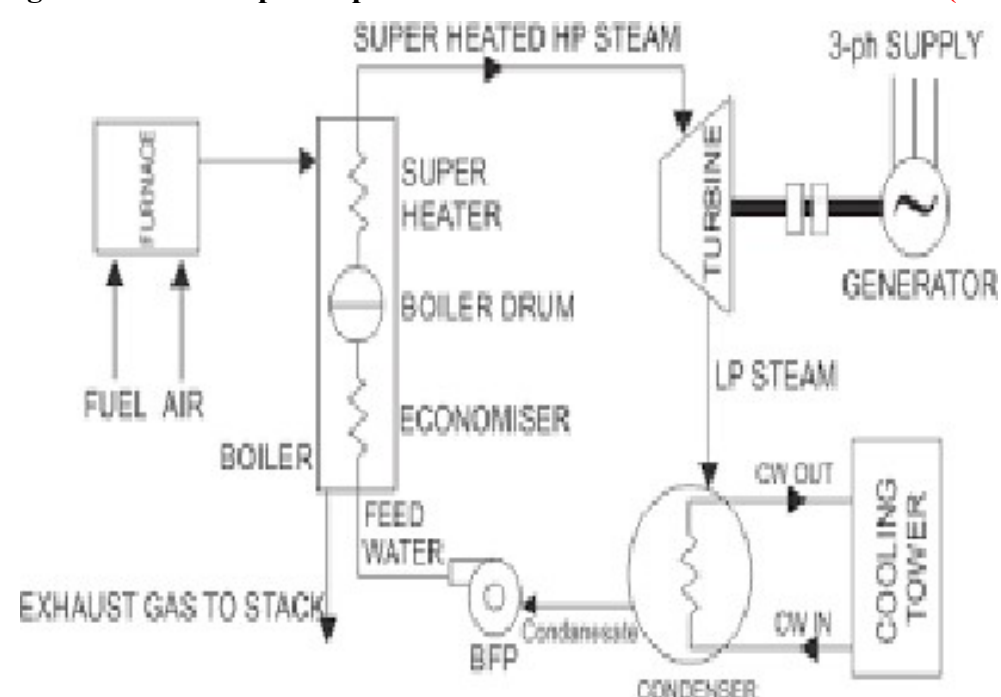
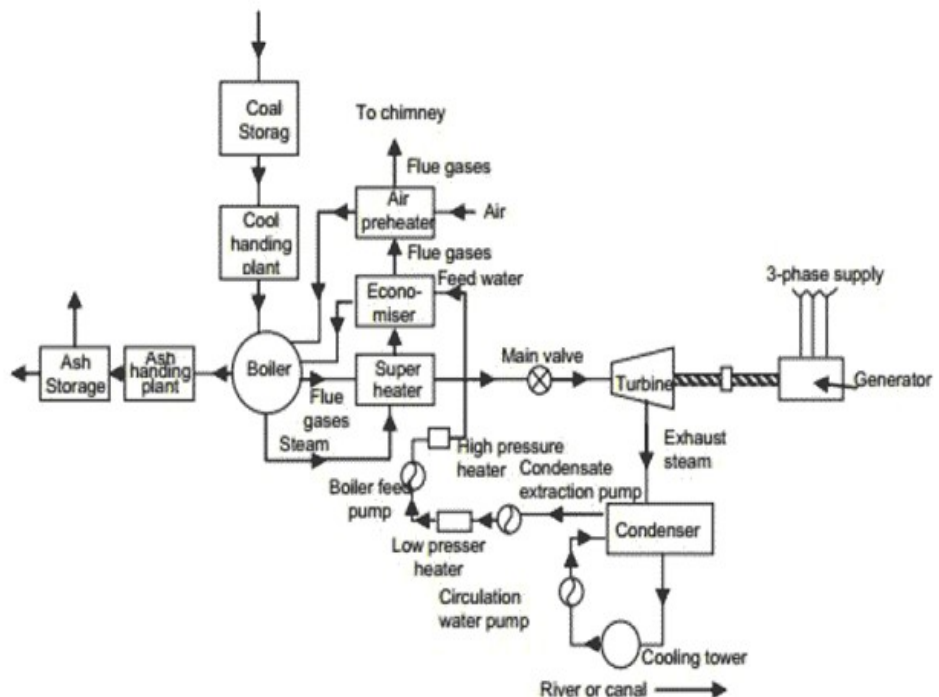


Winter- 2018 Examinations

Subject Code: 22327

Model Answer

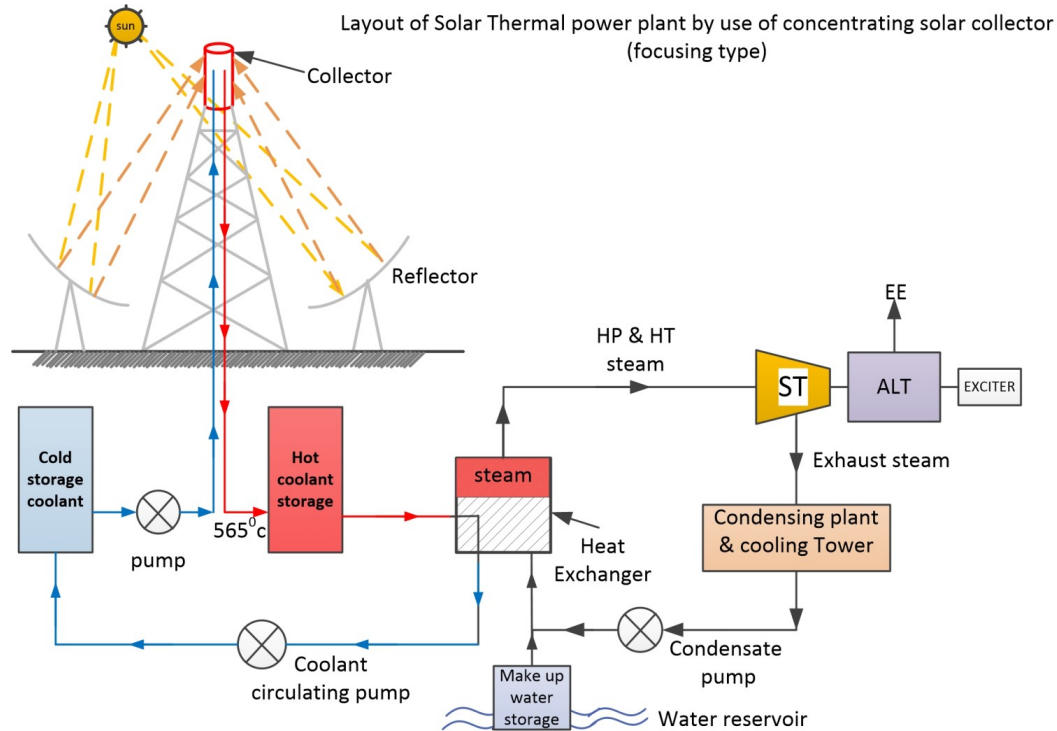
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Q. 2	Attempt any THREE of the following	12 Marks
a)	Draw a block diagram of thermal power plant.	
Ans:	<p>Block diagram of thermal power plant :</p> <p style="text-align: right;">(4 Marks)</p>  <p style="text-align: center;">OR Equivalent Figure</p> 	

b) With a neat diagram explain solar power tower.

Ans: Diagram explain solar power tower :

(Diagram : 2 Mark & Explanation : 2 Marks Total 4 Marks)



OR Equivalent Figure

All concentrating solar thermal power (STP) basic elements:

- Concentrator
- Receiver
- Transport-storage (a portion of the thermal energy is stored for later use)
- Steam generator (Heat exchanger)
- Condenser
- Steam turbine
- Alternator

Explanation (Operation):

- The concentrator captures and reflect solar radiation towards collector (absorber)
- The receiver absorbs the concentrated sunlight rays and gets heated.
- The secondary fuel (coolant or working fluid) is passed through collector.
- Transferring its heat energy to a working fluid.



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Model Answer

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	<ul style="list-style-type: none"> ➤ This coolant gets heated to a very high temperature. ➤ This hot coolant is stored in transport-storage system (a portion of the thermal energy is stored for later use). Thus solar energy can be used even when sun rays are not available ➤ Then hot coolant is passed through heat exchanger (steam generator) where steam at high temperature and high pressure is generated. ➤ This secondary fuel (coolant or working fluid) is re-circulated again and again. ➤ This steam at high temperature and high pressure is used to run the steam turbine. ➤ Steam turbine is coupled with alternator which converts mechanical power to electrical energy ➤ Exhaust steam is condensate in condenser
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c) Give the four advantages of vertical axis wind mills.

Ans: **Advantages of vertical axis wind mills:** (1 Mark each Advantage: Total 4 Marks)

1. Simple blade design
2. Low cost of fabrication.
3. No yaw controller required.
4. Easy maintenance because ground mounted generator and gear box.

d) Compare base load plant with peak load plant. (any four)

Ans: (Any Four Point expected : 1 Mark each point Total 4 Marks)

Sr.No.	Points	Base load plant	Peak load plant
1	Definition	The power plant which supplies base load of load curve is known as base load plant	The power plant which supplies peak load of load curve is known as peak load plant
2	Generating capacity	High	Low
3	Firm capacity	High	Low
4	Working Hours	24 hours	Only during peak load hours
5	Cost of generation/ unit	Generally low cost of generation per unit are selected as base load plant	Generally high cost of generation per unit are selected as peak load plant
6	Starting time	Both quick & more starting time power plant can be selected as a base load plant	Quick starting time power plant are selected as a peak load plant

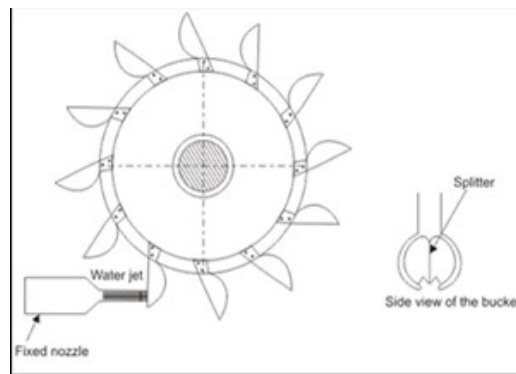


7	Load factor	High	Low
8	Capacity Factor	High	Low
9	Plant use factor	High	Low
11	Examples	Large capacity hydro, thermal, nuclear power station	Small capacity storage hydro, pumped storage hydro, gas, diesel power station.

Q.3 Attempt any **THREE** of the following **12 Marks**

a) **With a neat diagram explain pelton wheel turbine.**

Ans: **Diagram of Pelton Wheel:- (Diagram : 2 Marks & Explanation : 2 Marks)**



OR Equivalent Figure

Explanation (Working):

The water stored at high head is made to flow through the penstock and reaches the nozzle of the Pelton turbine.

The nozzle increases the K.E. of the water and directs the water in the form of jet.

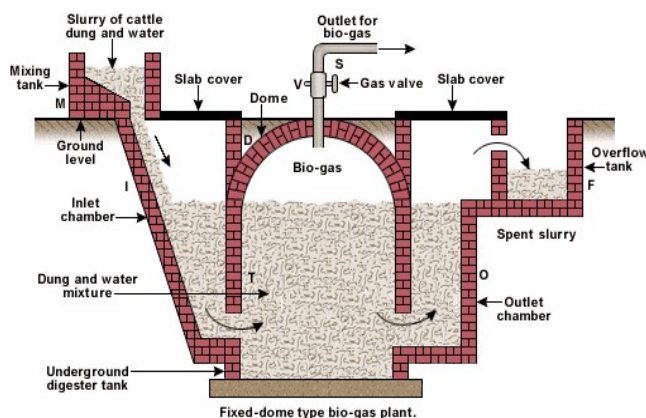
The jet of water from the nozzle strikes the buckets (vanes) of the runner. This made the runner to rotate at very high speed.

The quantity of water striking the vanes or buckets is controlled by the needle valve present inside the nozzle.

The generator is attached to the shaft of the runner which converts the mechanical energy (i.e. rotational energy) of the runner into electrical energy.

b) Draw and explain fixed dome type biogas plant.

Ans: Diagram of fixed dome type biogas plant: (Diagram : 1 Marks & Explanation : 3 Marks)



OR Equivalent Figure

Explanation of layout of biogas plant by the method of fermentation conversion

1. Foundation :

Biomass plant consists of pit excavated to desire size & depth, The foundation is nothing but the base of digester. It is made with the help of cement, concrete.

2. Digester:

- It is container made up of bricks, sand & cement. Digester tank is undergrounded to increase the efficiency.
- In the digester, decomposition of biomass takes place due to anaerobic bacteria to produce biogas.
- Quantity of gas produced is depend open type of waste & temperature.

3. Dome (Balancing Tank) :

It is the roof of digester in which biogas is collected.

4. Mixing Tank:

It is the tank placed on the top of inlet chamber in which animal, sanitary waste & water are mixed properly to make slurry.

5. Inlet Chamber:

It is to admit slurry into digesteor chamber through pipe due to gravity.

6. Outlet Chambers:

When generated biogas is high then it increases pressure downwards to slurry.

Due to pressure of gas, slurry comes upward automatically through pipe which is



collected in outlet chamber.

The residue (slum) left is used as fertilizer (valuable)

7. Gas Outlet pipe:

It is an outlet pipe fitted at the top of the dome of the digester to take the biogas for utilization.

The valve is provided to control the flow of biogas.

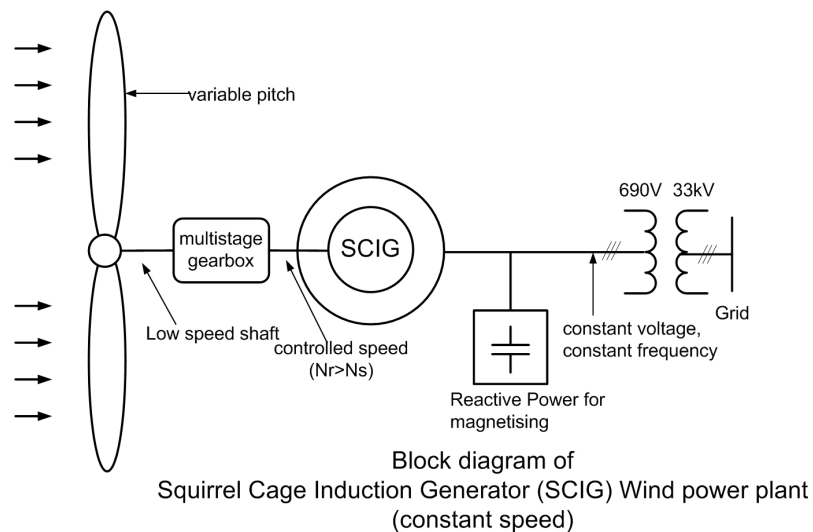
8. Mixing or Stirring:

The decomposition process can be speed up by stirring the slurry from the top of the dome with the help of stirrer which is at digester chamber.

c) Explain Squirrel Cage Induction Generator (SCIG) and also draw a diagram.

Ans: Diagram of Squirrel Cage Induction Generator (SCIG):

(Diagram : 2 Marks & Explanation : 2 Marks)



OR Equivalent Figure

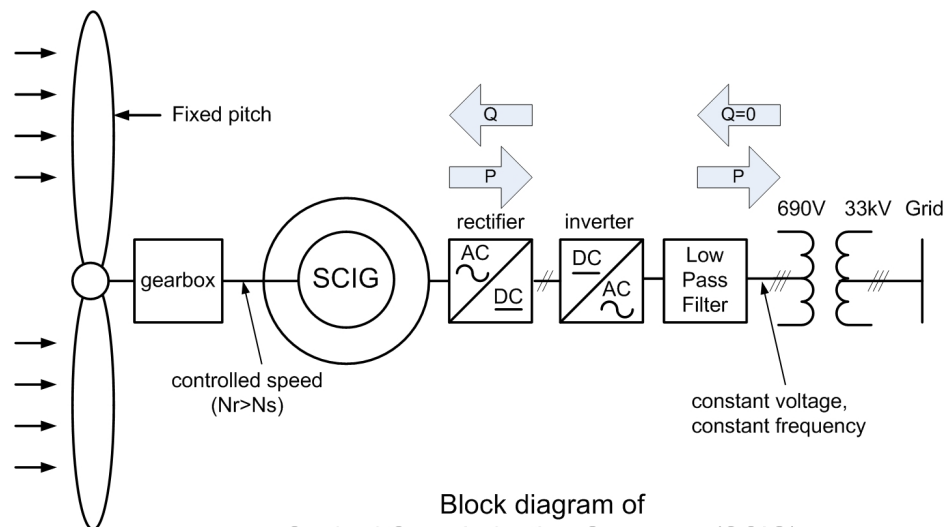
Explanation (Operation):-

- In this system multistage gearbox is used to obtain constant speed irrespective of wind speed.
- SCIG require reactive excitation power.
- The SCIG takes the reactive excitation power from a capacitor bank, connected across the stator terminals of the IG



- Rotor of SCIG is rotated at **more than synchronous speed**(i.e. **low negative slip**) to generate emf (to export power)with the help of wind power.
- Generated voltage is 690 V AC. So it must be step up to 33 KV to connect to power grid.

OR



Block diagram of
Squirrel Cage Induction Generator (SCIG)
Wind power plant (variable speed)

OR Equivalent Figure

Explanation (Operation):-

- In this system gearbox is used to increase the speed of high speed shaft as per design.
- IG require reactive power for excitation.
- Rotor of SCIG is rotated at **more than synchronous speed** (i.e. **low negative slip**) **in the variable range** to generate emf with the help of wind power.
- It uses AC-DC-AC power converter (Rectifier, Inverter & Filter) to convert variable frequency, variable voltage output of the generator into the fixed frequency, fixed voltage output required for grid.

d) Explain the choice of size and number of generator units in a power plant.

Ans: Selection of Size and Number of Generating Units:

(Any Four Point expected : 1 Mark each: Total 4 Marks)

1. The size/rating and number of generating units in such way that they approximately match with the load curve/load duration curve as closely as possible.
2. In order to calculate the size of the units, the station auxiliary load should be taken in



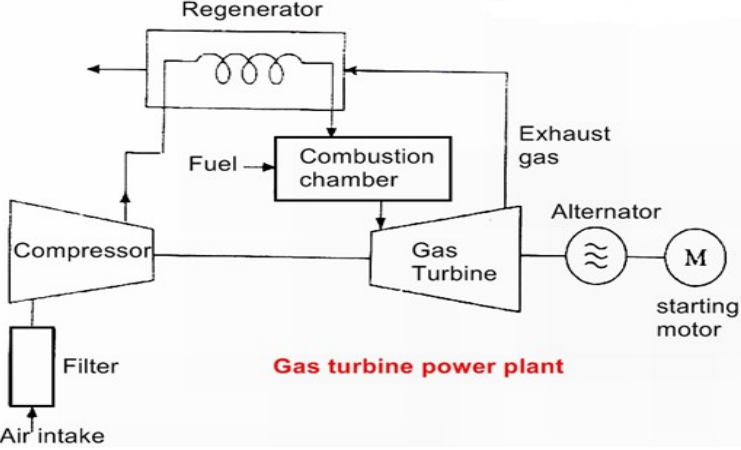
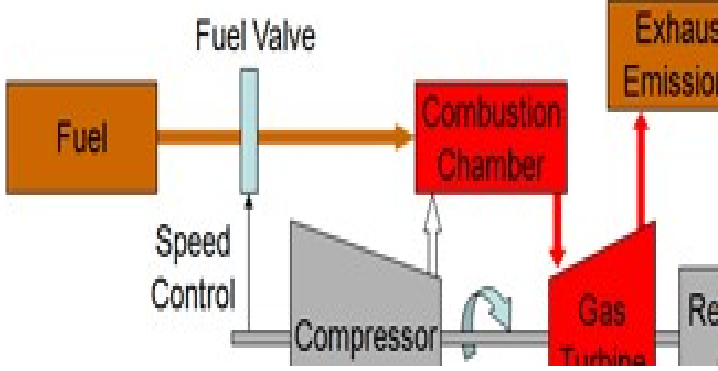
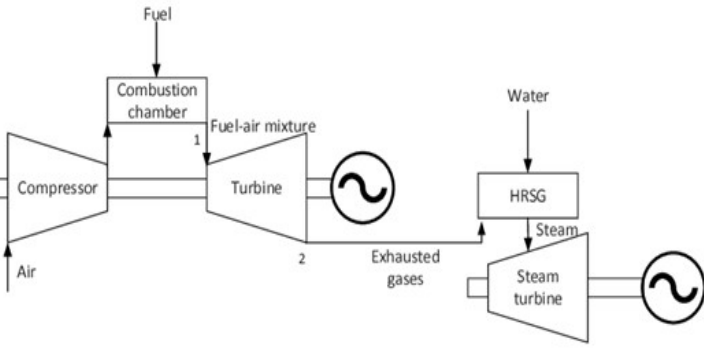
to account.

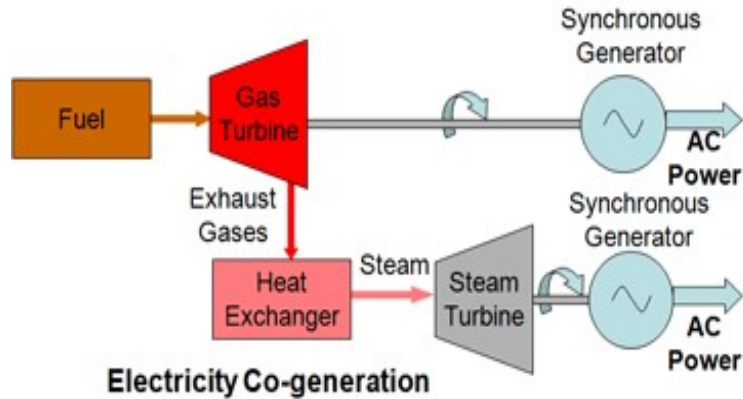
3. Also the transmission line losses should be considered. It can be approximately taken as 20 % of the consumer load.
4. The future demand and expansion should also be considered as the load on the station always increases.
5. The plant must have some reserve capacity at least 15-20 % more than M.D. under abnormal conditions.
6. Select size/rating of generating units in such way that reliability to maintain supply will be more.
7. Select size/rating of generating units in such way that the plant capacity factor, load factor diversity factor, plant use factor will be more.
8. Select size/rating of generating units in such way that unit almost run at full load or at load which gives maximum efficiency.
9. Select size/rating of generating units in such way that power generation will be economical.
10. Initial and operating cost also to be taken in to account
11. Space required also to be considered.
12. The minimum number of units should be two.
13. As far as possible, the units of equal capacities are selected which will have following advantages.
 - i) The parts can be interchanged.
 - ii) The maintenance will be easier.
 - iii) The working time of each plant regulated.
 - iv) The spare parts required to be stored are less.
14. While selecting the size/rating and number of generating units there are two options
 - i) To select single generating unit of large capacity
 - ii) To select more numbers of small capacity generating unit either of same ratings or different ratings.Both options have its own advantages and disadvantages.
15. In summary,

Load on the power system is variable where reliability of supply is important so it is neither practicable nor economical to use a single unit of large capacity.

But, if power plant is connected to grid system then generating unit of higher capacity can be installed.



Q.4	Attempt any THREE of the following	12 Marks
a)	Draw the schematic arrangement for a gas power plant.	
Ans:	<p data-bbox="288 459 1161 497">Schematic arrangement for a gas power plant Simple Systems:-</p> <p data-bbox="1337 459 1485 497">(4 Marks)</p>  <p data-bbox="746 981 1059 1019">OR Equivalent Figure</p>  <p data-bbox="746 1435 1059 1473">OR Equivalent Figure</p> <p data-bbox="277 1473 1289 1512">Schematic arrangement for a gas power plant Combined Cycle Systems :-</p>  <p data-bbox="746 1980 1059 2018">OR Equivalent Figure</p>	

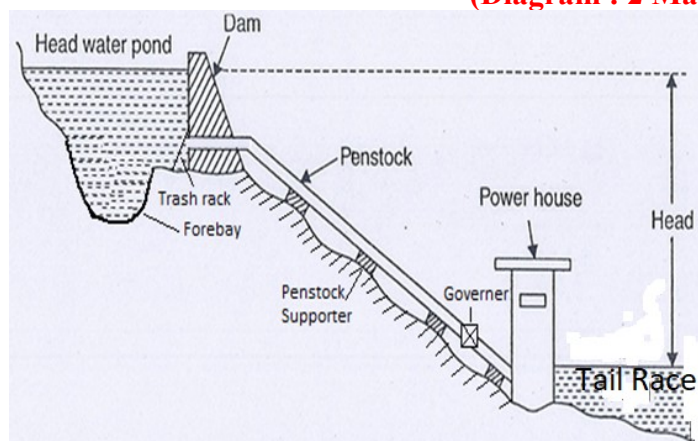


OR Equivalent Figure

b) With a neat diagram explain medium head hydro-electric power plants.

Ans: Diagram of medium head hydro-electric power plants:

(Diagram : 2 Marks & Explanation : 2 Marks)



OR Equivalent Figure

Explanation:-

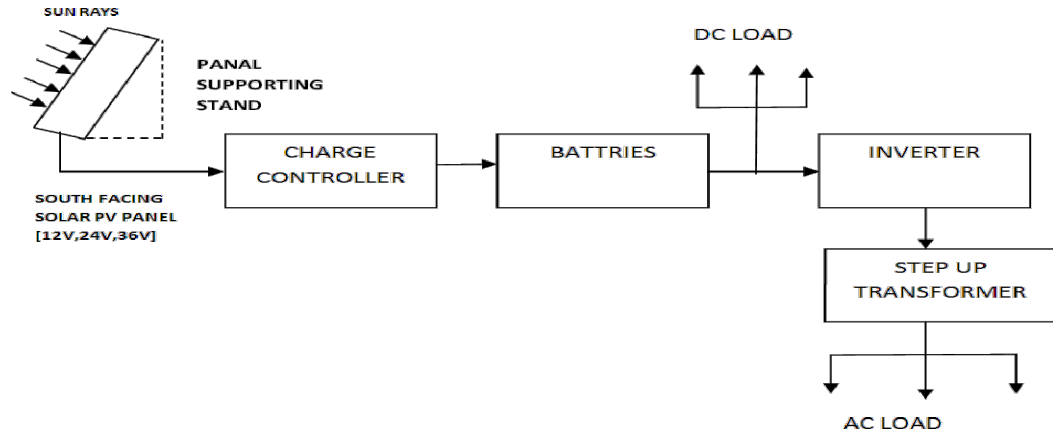
- If head of water is between 30 and 100 m, the plant is called a medium-head plant.
 Potential energy of stored water is medium.
 Larger volume of water is required
- Catchment area of medium capacity is required as water requirement is more.
- The power plant is situated at medium distance from dam.
- There is no surge tank forebay acts as a surge tank.
- Penstocks are of medium length and comparatively medium in diameter
- Francis turbines are normally used.
 Alternator required in these plants is of low speed and large in diameter.



c) With a neat diagram explain solar photovoltaic power plant.

Ans: Diagram of solar photovoltaic power plant :

(Diagram : 2 Marks & Explanation : 2 Marks)



OR Equivalent Figure

Explanation:

Solar power plant consists of following components:

1. Photovoltaic cell panel:

Its function is to convert sunrays directly into DC electricity.

2. Battery charge Controller:

It protects battery from over charging and it prevents battery from over discharging.

In this way it increases life of storage battery. (OR a charge controller is needed to ensure the battery is neither over nor under-charged)

3. Storage Battery:

Its function is store DC electrical energy generated by P.V. cell which can be used whenever required.

Generally battery having long life are used .There are two types of battery:

1. Lead acidic battery
2. Nickel cadmium battery

4. Inverter:

It converts DC supply into AC supply.

5. Step-up transformer:

It step-up input voltage to utilization voltage e.g. 230V



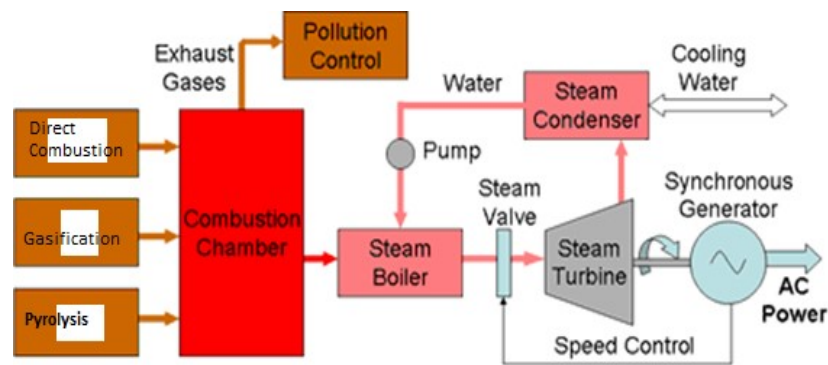
d) Draw a layout of a thermo-chemical based power plant.

Ans: **Layout of a thermo-chemical based power plant:** (4 Marks)

In this process dry biomass fuels converted to produce gas ,liquid fuels or oil by thermo chemical conversion

Thermo-Chemical conversion are of following ways:-

1. Direct combustion
2. Gasification
3. Pyrolysis



OR Equivalent Figure

e) Define the following term: i) Average demand ii) Load factor iii) Plant capacity factor iv) Plant use factor (Each definition 1 mark ,Total 4 Marks)

Ans: **i) Average Demand :-** (1 Mark)

The average of loads occurring on the power station in a given period (day or month or year) is known as Average load or Average demand.

OR

$$\text{Daily Average Demand} = \frac{\text{Number of units generated (KWH) in one day}}{\text{Number of hours in a day (24 hours)}}$$

OR

$$\text{Monthly Average Demand} = \frac{\text{Number of units generated (KWH) in month}}{\text{Number of hours in a month}}$$

OR

$$\text{Yearly Average Demand} = \frac{\text{Number of units generated (KWH) in one Year}}{\text{Number of hours in one year}}$$



ii) Load Factor: -

(1 Mark)

It is the ratio of average demand /load to maximum demand during given period is known as Load Factor.

OR

$$\text{Load Factor} = \frac{\text{Average Demand (load)}}{\text{Maximum demand (load)}}$$

OR

$$\text{Daily Load Factor} = \frac{\text{Number units generated in 1 Day}}{\text{Number of hours in a day (24 hours)} \times \text{Maximum Demand}}$$

OR

$$\text{Monthly load Factor} = \frac{\text{Number of units generated (KWH) in month}}{\text{Number of hours in a month} \times \text{Maximum Demand}}$$

OR

$$\text{Yearly load Factor} = \frac{\text{Number of units generated (KWH) in one Year}}{\text{Number of hours in one year (8760H)} \times \text{M.D}}$$

iii) Plant capacity factor:

(1 Mark)

“The net capacity factor of a power plant is the ratio of its actual output over a period of time, to its potential output if it were possible for it to operate at full nameplate capacity indefinitely.

OR

It is the ratio of actual energy produced (generated) to the maximum possible energy that could have been produced (generated) during a given period.

OR

$$\text{Plant Capacity Factor} = \frac{\text{Energy that is produced}}{\text{Maximum energy that can be produced}}$$

$$\text{Plant Capacity Factor} = \frac{\text{Average demand}}{\text{Plant Capacity}}$$

OR

$$\text{Plant capacity factor} = \frac{\text{Actual energy generated}}{\text{Maximum possible energy (KWH) that could have been generated}}$$



iv) Plant use Factor:-

(1 Mark)

The definition such that the ratio becomes the amount of energy **used** divided by the maximum possible to be **used**.

It is the ratio of number of unit (kWh) generated to the product of plant capacity and the number of hours for which plant was in operation.

OR

$$i.e \text{ plant use factor} = \frac{\text{Station output in kWh}}{\text{Plant capacity} \times \text{hours of use}}$$

OR

$$\text{Plant Use Factor} = \frac{\text{Actual energy produced (kWh)}}{\text{Installed Capacity (kW)} \times \text{no. of operation hours (h)}}$$

Or

$$\text{Plant Use Factor} = \frac{\text{Average Demand} \times T}{\text{Installed Capacity} \times \text{no. of operating hours}}$$

Where

T = 24 h if the time is a day

T = 24 × 30 h if the time is a Month

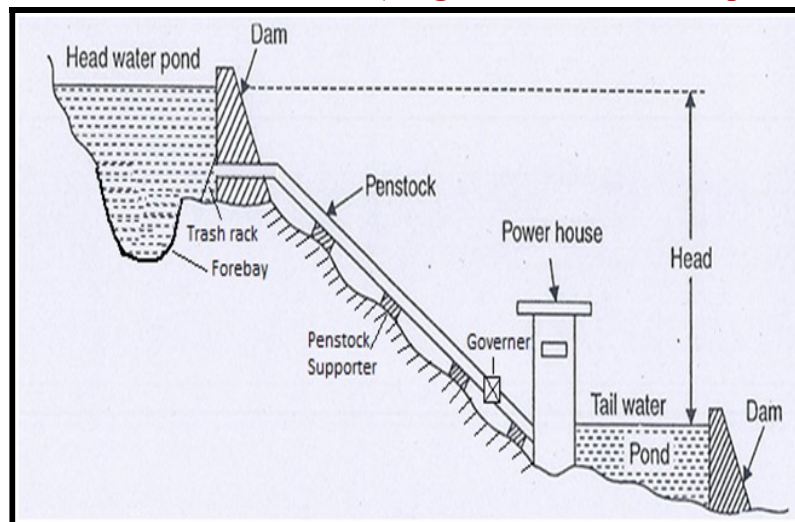
Q.5 Attempt any TWO of the following

12 Marks

a) With a neat diagram explain pumped storage hydro power plant.

Ans: Diagram of pumped storage hydro power plant:

(Diagram : 3 Marks & Explanation : 3 Marks)





Explanation:

In this power plant, generator is so designed that it Converts mechanical power into electrical power and also works as a motor i.e. converts electrical power into mechanical power And water turbine is so designed that when it is rotated then it works as a centrifugal pump.

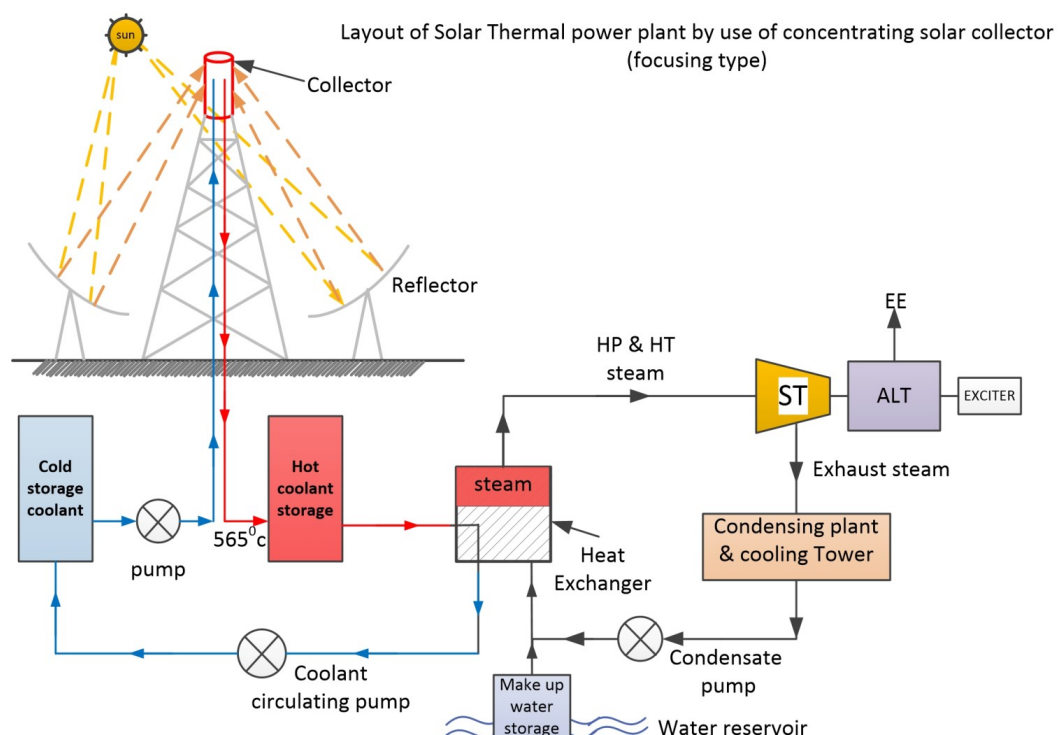
Following are the Advantages of Pumped storage Power Plant (PHPP):

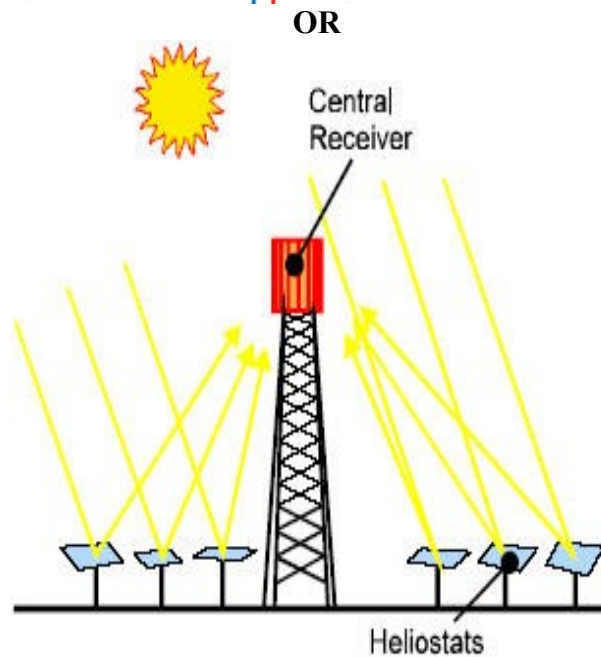
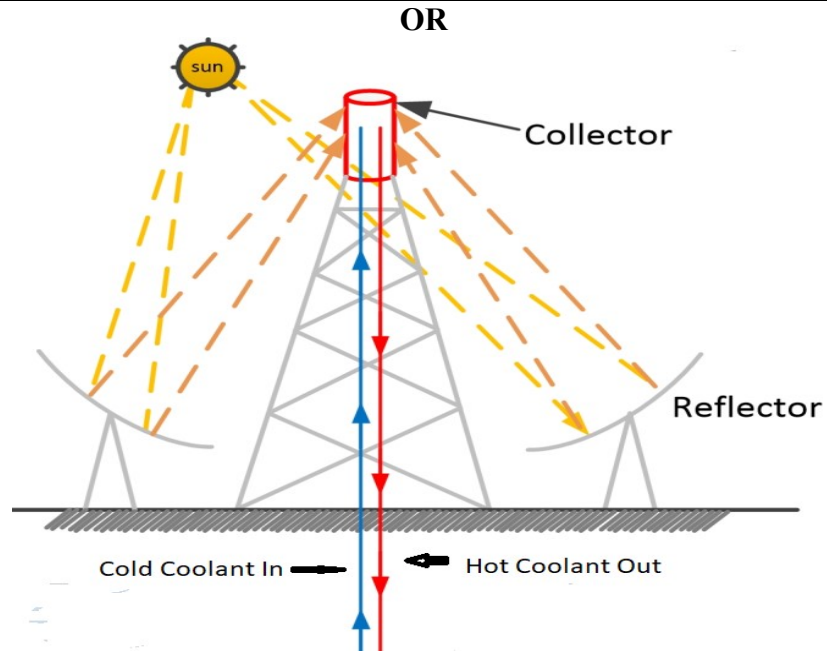
1. It saves water by reusing same water again & again.
2. There is less expenditure during pumping of water because water is pumped when surplus (extra) power is available.
3. It can be put into service immediately; hence it is useful to supply power during peak load period.
4. It increases load factor of power plant
5. It helps in reducing a reserve capacity of PP as it provides additional power during peak load period.

b) Draw a diagram of power tower of concentrated solar power plant.

Ans: **Diagram of power tower of concentrated solar power Plant:**

(Diagram : 6 Marks)





OR Equivalent Figure

c) Give the causes and impact and reasons of grid system fault.

Ans:

(Any Three Point expected : 1 Mark each point, Total 3 marks)

Following are the causes/reasons grid system fault:

1. Major imbalance between generation and consumption i.e. demand is more than generation.
2. Low frequency, due to some faults the frequency mismatches i.e (49.5 to 50.3 Hz). If



the frequency is falls or above the permissible limit then, there is possibility of failure of power grid. If fault is not clear in permissible time.

3. Due to breaking of conductor or due to short circuit between two conductors fault occurs which leads to failure of grid. If we cannot clear this fault in less than 1000 millisecond.
4. Power surges causes rapid overheating tends to lead failure of grid.
5. Minor fault in high voltage equipment's if not attended over a period of time results in a total breakdown of equipment suddenly causing grid failure.
6. Illegal utilization of electricity (theft of energy) is also a major reason for power grid failure.
7. Ageing of power equipment's have higher failure rates increases the risk of frequent breakdown.
8. Due to failure of grid connected one of the generator units suddenly.
Then load is shifted to other generator causes cascade tripping due to over loading.
9. Due to ineffective power delivery planning, co-ordination, supervision and control over generation system causes failure of grid (Due to ineffective work of LDC).

Impact of grid system fault:

(Any Three Point expected : 1 Mark each point, Total 3 marks)

1. All industries are badly affected due to failure of supply and causes huge losses.
2. All health care centers (Major hospitals) are badly affected due to failure of supply and causes disturbance in treatment on emergency patients.
3. Drinking water supply system are badly affected due to failure of supply and causes insufficient/no water supply.
4. All electrical long route trains, local trains, tramways, metro and railway signal system are badly affected due to failure of supply and causes inconvenience.
5. All communication system is badly affected due to failure of supply and causes inconvenience to people.
6. Disturb the routine work of common all people.



Q.6	Attempt any TWO of the following	12 Marks
a)	Explain the function of different parts of a typical nuclear power plant with neat sketch. (Layout 2 Marks, Explanation 4 Marks: Total 6 Marks)	
Ans:	<p>Diagram of nuclear power plant : (2 Marks)</p> <p>OR Equivalent Figure</p> <p>Functions of each part of Nuclear power plant:- (4 Marks)</p> <ol style="list-style-type: none"><u>1) Nuclear Reactor:</u> In nuclear reactor the fuel rod of U235 is placed through which tremendous amount of heat energy is liberated due to nuclear chain reaction. (Fission process)<u>2) Heat Exchanger (Steam generator):</u> In heat exchanger water is converted into steam at high temperature and high pressure by absorbing heat from hot coolant.<u>3) Coolant circulating system:</u> The function of this system is to circulate coolant from reactor core to heat	



	<p>exchanger. It consists of circulating pump and filter.</p> <p>4) <u>Condensing Plant:</u> Function of condenser is to convert exhaust steam again into water by reducing its temperature with the help of cold water. Also it reduces back pressure of steam turbine.</p> <p>5) <u>Cooling tower:</u> The function of cooling tower is to reduce the temperature of water coming from condenser.</p> <p>6) <u>Steam valve:</u> Function of Steam valve (Governor) is to control the flow of steam in such way that speed of turbine remains constant at all loads condition to maintain constant frequency.</p> <p>7) <u>Steam turbine:</u> Its function is it converts heat energy into mechanical energy. To drive alternator this is mechanically coupled with steam turbine.</p> <p>8) <u>Alternator:</u> It converts mechanical energy into electrical energy.</p>
b)	What are the criteria for selection of site for hydroelectric power plant?
Ans:	<p>Following Factors to be kept while site selecting for Hydro power plant: (Any Six Point Expected : 1 Mark each Point :Total 6 Marks)</p> <ol style="list-style-type: none">1. It should be located where high rain fall occurs.2. A large catchments area must be available to store water.3. It should be located as far as possible in hilly area to reduce construction cost of dam and water reservoir.4. Stored water should have a reasonable head (Potential Energy).5. There should be easy access towards the site.6. Land should have high bearing capacity to reduce the construction cost of dam and for better foundation of machinery.7. Power plant should be located as far as possible near load center to reduce transmission line cost and losses in it.8. During the construction of dam, it should be possible to divert the stream of river.9. The Area should be free from earthquake and natural hazards.10. It is necessary to see that water is of good quality (i.e.no chemical impurities) because



- polluted water may cause corrosion.
11. The catchment area should be such that there are less accumulation of slit and debris (Solid Impurities).
 12. Cost of land should be less.
 13. Skilled and unskilled man power should be available nearby.

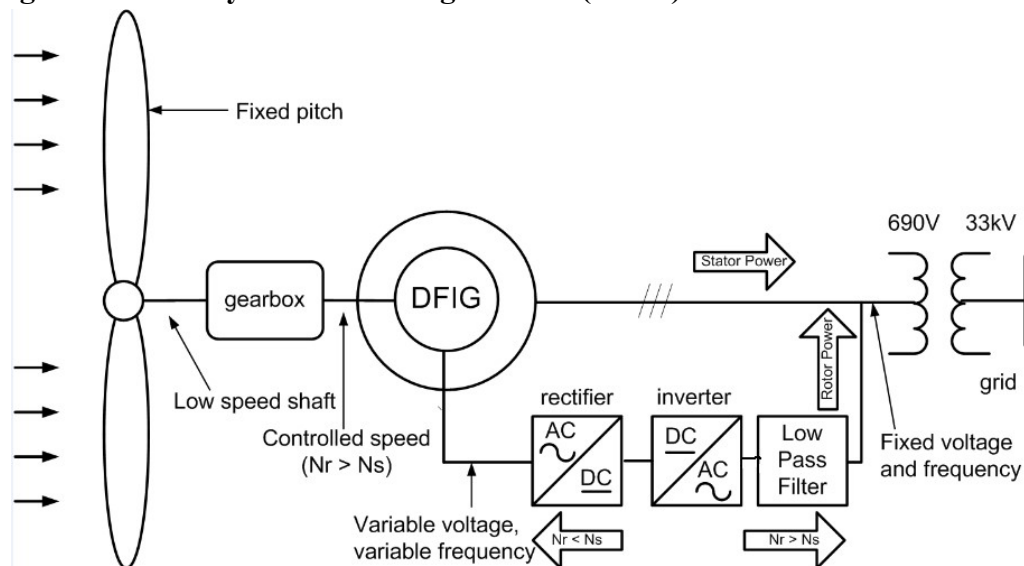
c) **With a neat diagram explain doubly fed induction generator (DFIG).**

(Layout 3 Marks, Explanation 3 Marks, Total 6 Marks)

Ans:

Diagram of Doubly fed induction generator (DFIG):

(3 Marks)



OR Equivalent Figure

Explanation :-

(3 Marks)

- DFIG can feed power through the stator as well as rotor to the grid.
- The stator is directly connected to the fixed frequency grid while rotor is connected via bi-directional back-to-back converters.
- If the generator is running super-synchronously (i.e. N_R speed is greater than N_S speed), the electrical power is delivered by both the rotor and the stator to the grid.
- If the generator is running sub-synchronously (i.e. N_R speed is less than N_S speed) the electrical power is delivered to the rotor from the grid.
- Generated voltage is 690 V AC. So it must be step up to 33 KV to connect to power grid.