Q no.1:-

Comperison Between Conventional Hydropower & MHD generator

Turbogenerator	MHD generator
i) Fuel Hot vapours or gas	i) Fuel source of hot electrically conducting gas.
ii) Magnetic source Present in this system.	ii) Magnetic source Also present in this system.
iii) Brushes Two brushes, one Positive and one negative	iii) Brushes Not present
iv) Electrodes No electrodes in this system.	iv) Electrodes Two electrodes in this system is working.
v) Coil Moving conductor forming coil that rotates in the magnetic field.	v) Coil No moving coil is present.
vi) Combustion chmaber No combustion chamber is present in conventional hydropower system.	vi) Combustion chmamber Combustion chamber is present in MHD generators.
vii) Working Principle Based on the Principle of Seebeck effect.	vii) Working principle Based on the principle of Flaming's Right-Hand Rule.

Power of thermo electric

Power, $P = I^2 R_L$

$V = IR, \quad I = V/R$

$$\Rightarrow P = \frac{(\alpha_{S12} \Delta T)^2}{(R + R_L)} R_L$$

$P_{max} = (\text{when } R = R_L) = P$

$$P_{max} = \left| \frac{(\alpha_{S12}^2 \Delta T^2)}{(4R)} \right|$$

where α is Seebeck coefficient.

The potential of a material for thermoelectric applications is determined in large parts to a measure of the material dimensionless figure of merit.

$$ZT = \frac{\alpha^2 \sigma T}{K} = \frac{\alpha^2 T}{\rho K}$$

σ is the electrical conductivity.

K is the total thermal conductivity.

ρ is the electrical resistivity.

Power of MHD generator

$P = \sigma B^2 v^2 K (1 - K) \ W/m^3$

where σ is the specific electrical conductivity.

B is the magnetic field strength in Tesla (Wb/m^2).

v is the velocity of gas in m/s.

K is the ratio of external load voltage to open-circuit voltage.

Q.no.2, Factors determine out put Power of thermoelectric generator

Thermoelectricity refers to class of phenomena in which temperature difference creates an electric potential or an electric potential creates a temperature difference

1, Effect of temperature.

The performance of the thermoelectric devices is influenced by the allocation of thermal conductance of heat exchanges between hot and cold sides when the external heat transfer is considered

The power and efficiency will always improve with increase in temperature difference, if the temperature dependences of thermoelectric properties is not included.

2, Effect of heat transfor Law,

The heat transfer low represent the characteristics and regularity of the transfer. The characteristics of the thermoelectric device are influenced by the external heat transfer law. When the heat transfer law is non linear then there are optimol working electrical current and optimal ratio of thermal conductance allocations corresponding to the maximum power output and maximum efficiency.

3, Effect of contact resistance & length

Good thermoelectric material properties are inevitable requirements for a thermoelectric module exhibiting high efficiency.

4. Mathematical Modeling

The power out is the power dissipated in the load. The thermal power input to the hot junction is given by

$$ph = \alpha T h I + \frac{1}{2} I2R + K\Delta T$$

where α is the seebeck coefficient.

K is the total thermal conductance

ΔT is the temperature difference

The electrical power output is

$$Po = RLI^2$$

Where RL is the load resistance.

The current is given by

$$I = \frac{\alpha \Delta T}{(R + RL)}$$

Since the open circuit voltage is $\alpha \Delta T$. Thus the efficiency is

$$\eta = \frac{RLI^2}{\alpha ThI + \frac{1}{2} I2R + K\Delta T}$$

The operating design which maximizes the efficiency.

Lets take

$$s = RL/R.$$

The efficiency is

$$\eta = \frac{\left(\frac{\Delta T}{Th}\right)s}{(1+s) - \left[\frac{\Delta T}{2Th}\right] + \left[\frac{(1+s)^2 RK}{\alpha^2 Th}\right]}$$

5. Conclusion

It is concluded that various factors that effect on the performance of Thermo-electric generating system is disscused above. Operating principles are seebeck and peltier effect and device offer several advantages over other heat to electric technologies.

Ans 3: Thermionic generator"

A thermoionic converter consist of a hot electrode which thermoionically emitts electrons over a potential energy barrier to a cooler electrode, producing a useful electric power output.

Caesium vapour is used to optimize the electrade work functions and provide an ion supply to neutralize the electron space charge.

Vacuum Closed Spaced Converter

→ It has been under extensive research since 1957.

→ Physical spacing of 0.0005 inch or less is maintained between anode and cathode.

→ It will have engineering difficulty. Lifetime is 40 hours.

Cesium Gass Filled Convertors

→ Cesium gass is filled between anode and cathode.

→ Working efficiency is higher than former one.

→ Lifetime is nearly 600 hours.

→ Main problem is efficient sealing and corrosive nature of cesium.

Conclusion,

Cesium - Gass Converter is more better than Vacuum closed-space converter. The reason is given below in detail.

1. Efficiency,

The efficiency of cesium - Gass converter is higher than all other types of converter.

2. Life time,

The life time of cesium gass converter is 600 hours which is greater than the life time of vacuum closed - spaced converter.

3. operation,

Cesium - Gass Converter is easy to construct and has no engineering difficulty while ~~cont~~ constructing.

Q.no.4:

Thermo electric generator

Thermoelectric power generator is a device that convert the heat energy into electrical energy based on the principle of seebeck effect.

→ When the junctions of two different metals are maintained at different temperature the emf is produced in the circuit. This is known as seebeck effect.

Thermionic electric generator

Thermoionic Power Converter is a static device that converts heat into electricity by boiling electrons from a hot emitter surface across a small inter electrode gap to a cooler collector surface.

→ A Thermionic Generator consist of one or more of these convertors coupled to give desired power output.

→ Thermionic generator can be operated from any primary heat source.

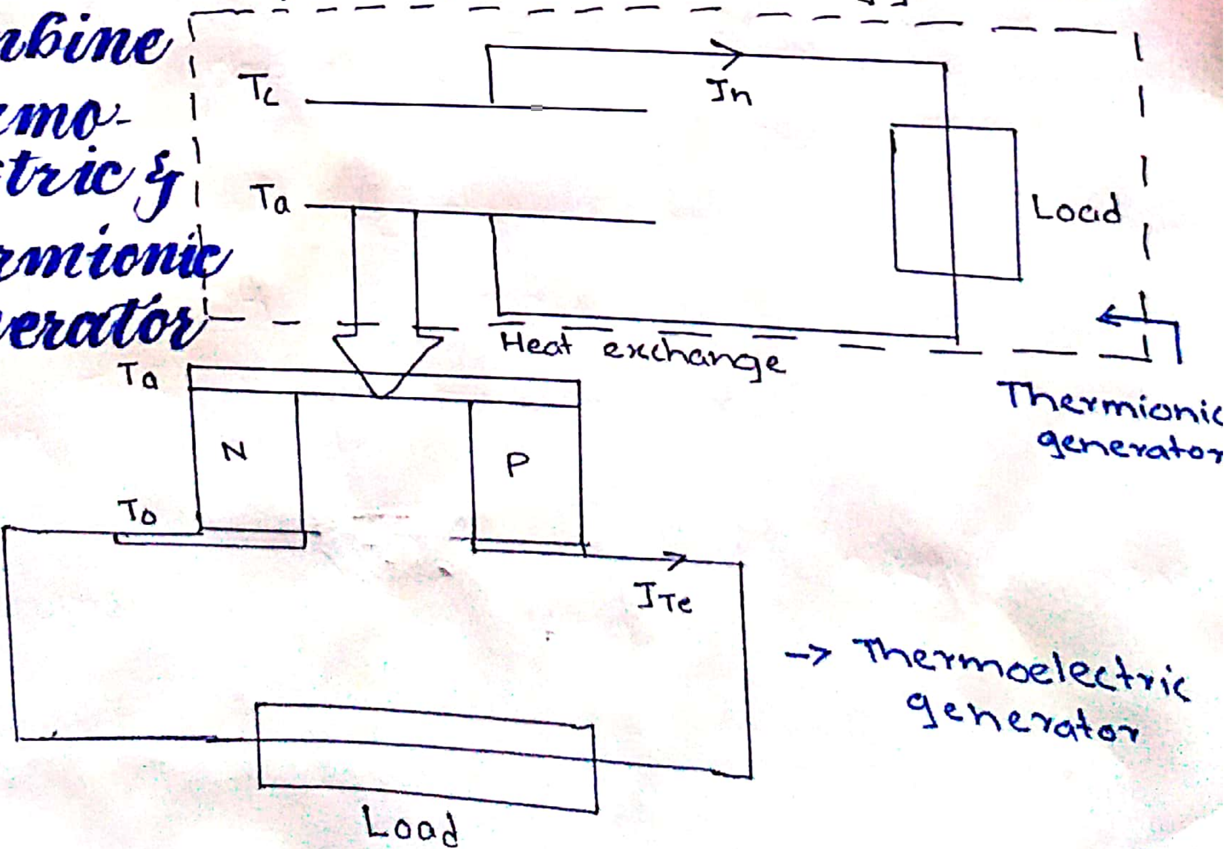
→ For low power level solar energy can be used.

→ For high power level nuclear heat source can be used.

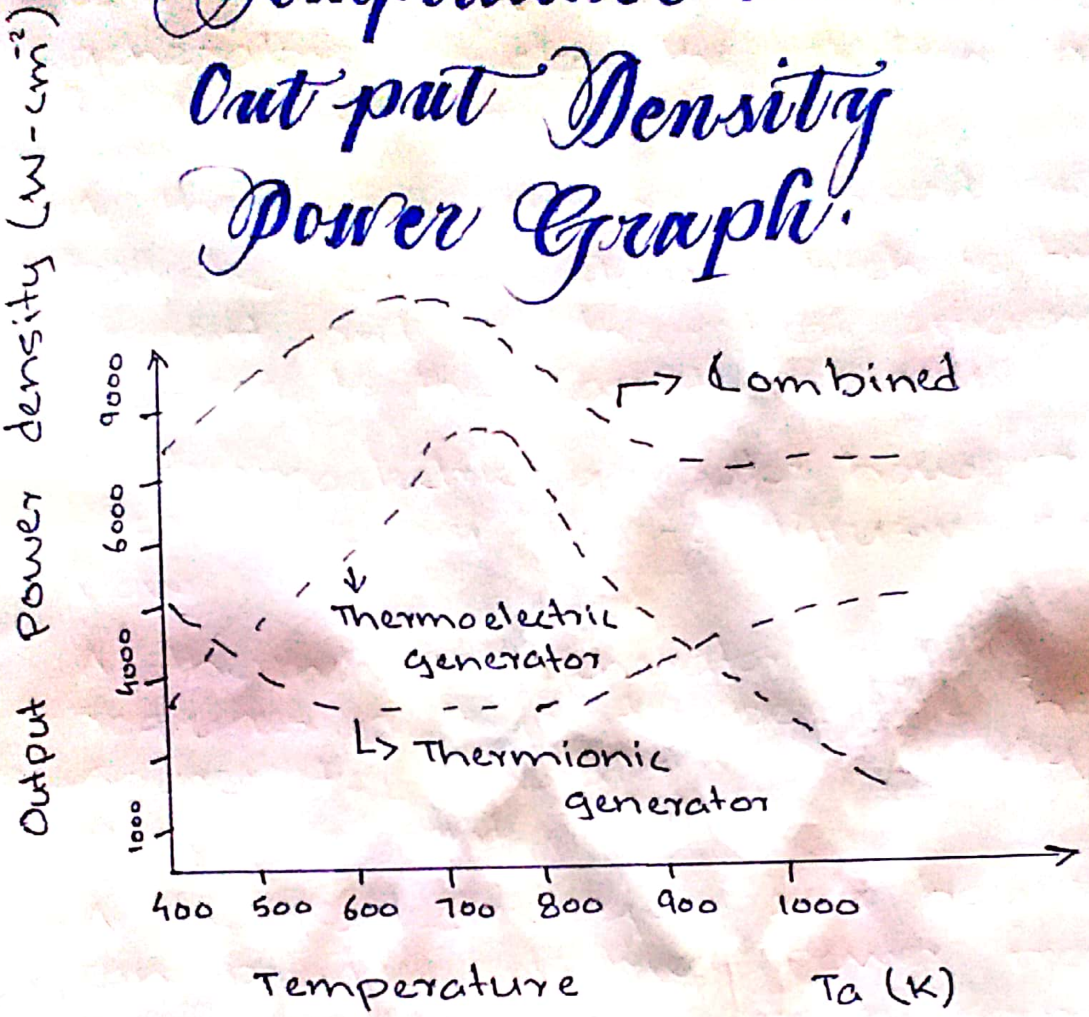
Compirision

- → Both thermionic and thermoelectric generators employ the electron gas as the working fluid.
- → A thermionic generator based on the ballistic current flow which is highly efficient and its theoretical efficiency is close to the Carnot efficiency.
- → A thermoelectric generator however has Poor efficiency due to diffusive current flow.
- → A thermoionic generator usually requires a high temperature heat source to generate a practically useful current.
- → A thermoelectric generator however, can produce electrical power from low quality heat energy sources.

Combine thermo-electric & thermionic generator



Temperature and Out put Density Power Graph.



QNS:-

Main Issue Of Thermo Nuclear Fussion:

1, Temperature:-

→ Components directly facing the very hot plasma include the first wall of the blanket on the outer edge of the torus and the divertor, which is usually placed round the bottom of the torus.

→ Even if you manage to generate extremely high temperature needed to initiate nuclear fusion reactions, there is no material container which can with stand such temperature.

→ One solution to this dilema is to keep the hot plasma out of contact with the walls of its container by keeping its moving in circular or helical paths by means of magnetic force on charged particles.

2 Helium Supply:

While the fuel for fusion power is abundent. this does not means that fusion power station would be free from energy security risk.

→ A move to liquid hydrogen for superconductivity would eliminate the jeopradry, possibly extant. in an over-reliance on helium.

3 Structural Integrity.

→ As a consequence of its basis as a transformer driven by a single sweep of the primary. A power station will operate with very long pulses, but during its life, it will still be subject to many tens of thousand of pulses.

A power station is a major structural engineering challenge, in term not of whether it can be built, but of whether it can survive years of reliable operation.

4 Planned Availability.

→ Large capital cost with small marginal cost of electricity generation force fusion power towards base-load supply.

The 80% target now routinely achived by fission technology, will be stretched for any planned fusion power station.

0. Relibility,

An even greater challenge than availibility is the need to achive very high levels of reliablity.

→ That is unscheduled and unanticipated interruptions to power generation must be avoided.

→ This issue is relatively easy to address with on-site generation or energy storage such as fly wheels, which can already deliver hundred of megawatts.

→ Such iteams would provide the re-start power but would represent a capital cost for the power station and in a conventional concept would only be used intermittently.