UNIT III

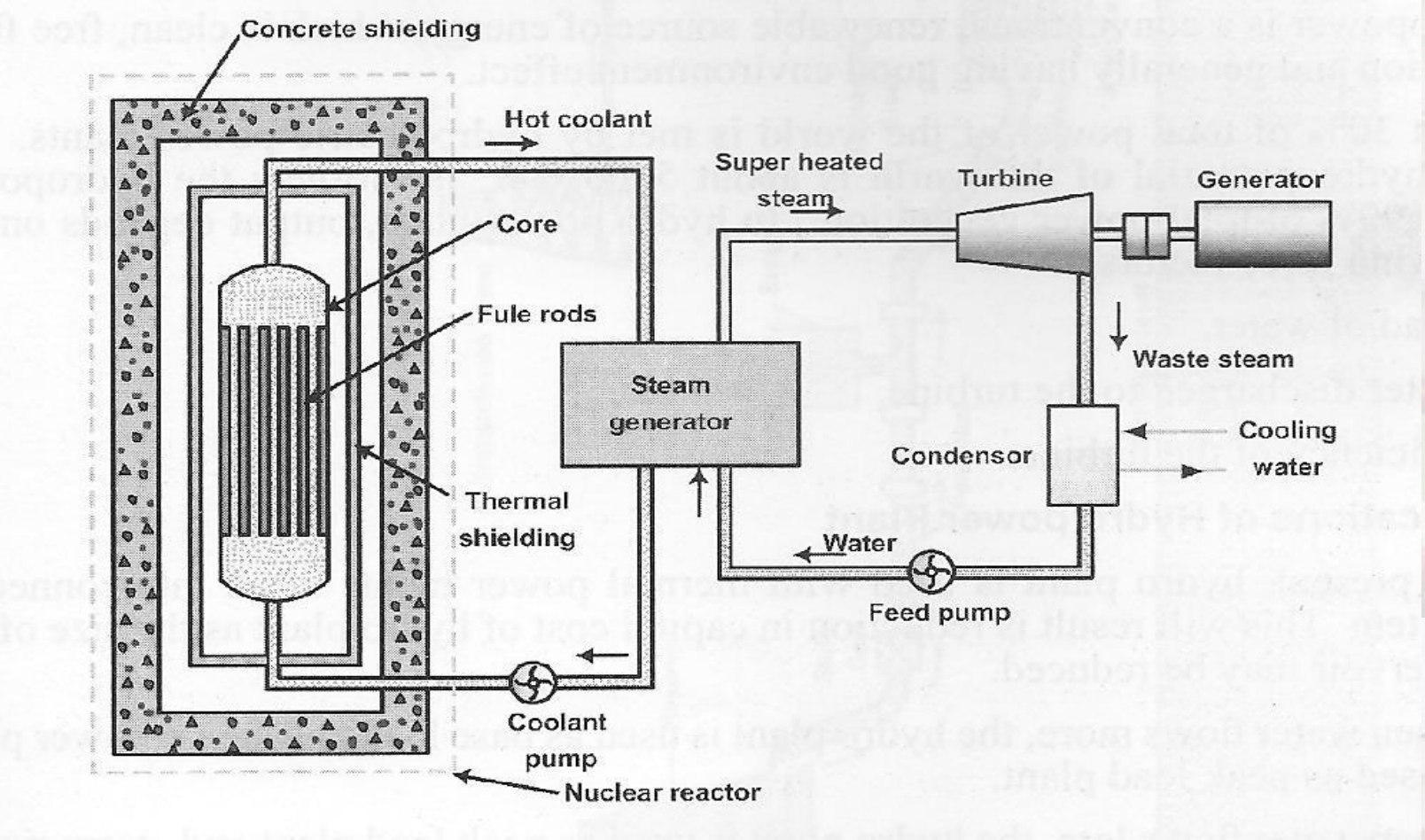
NUCLEAR POWER PLANT

Basic Civil and Mechanical Engineering

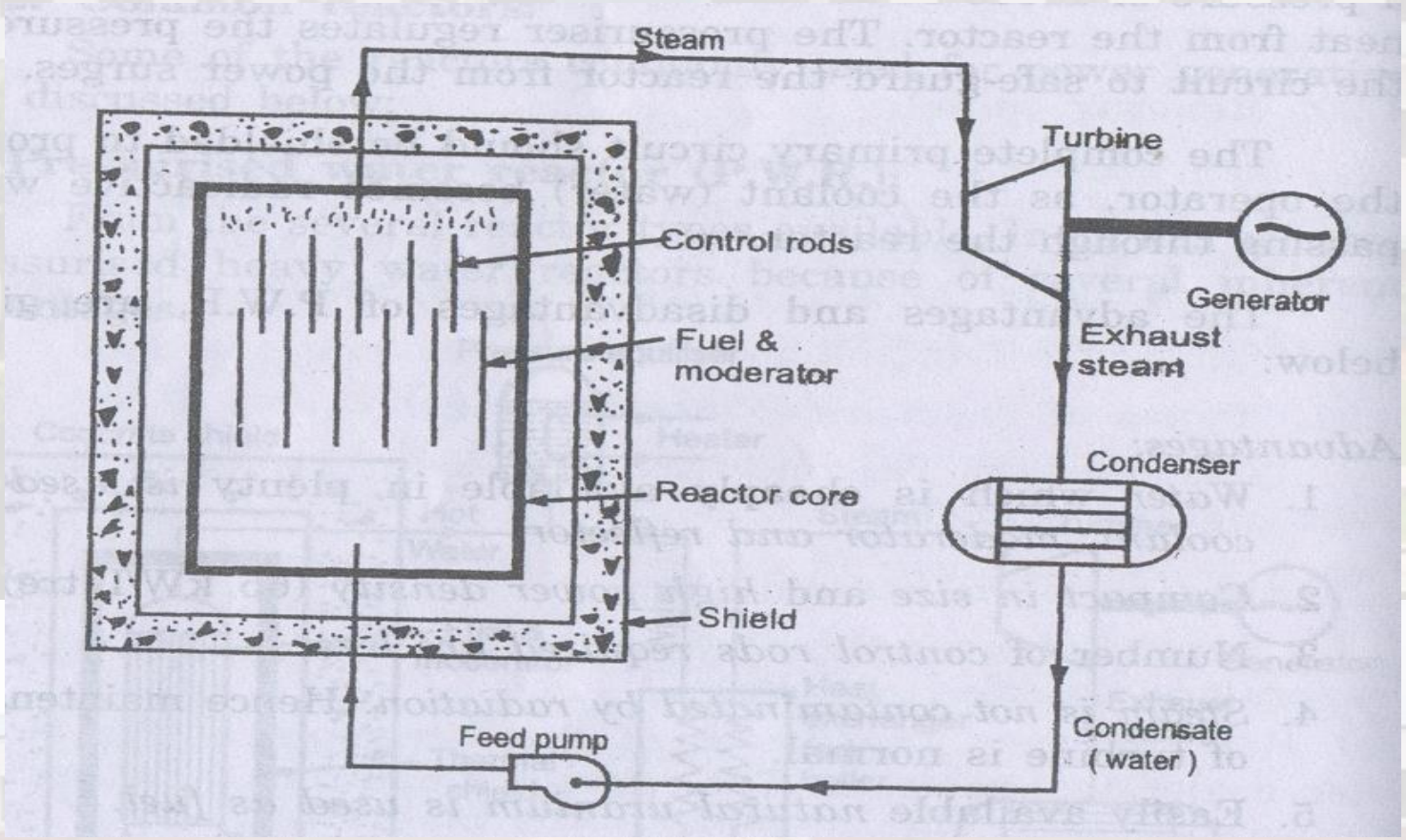
KARTHICK B

ASSISTANT PROFESSOR / MECHANICAL ENGG

NUCLEAR POWER PLANT - LAYOUT



NUCLEAR POWER PLANT



NUCLEAR POWER PLANT

- Nuclear power plant uses nuclear energy from radio active element for generating electrical energy.
- More than 15% of the world's electricity is generated from Nuclear power plants.
- It is generally located far away from populated areas.
- In future generation of electricity will be depending on Nuclear Power Plant, as it is economical.
- 1 kg of uranium U -235 can produce electrical power electrical that can be produced by using 3000 -4500 tonnes of high grade coal or 2000 tonnes of oil.

COMPONENTS OF NUCLEAR POWER PLANT

Nuclear Fuel :

- Normally used nuclear fuel is uranium (U^{235})

Fuel Rods:

- The fuel rods hold nuclear fuel in a nuclear power plant.
- Neutron Source: A source of neutron is required to initiate the fission for the first time. A mixture of beryllium with plutonium is commonly used as a source of neutron.

Reactor:

- Nuclear fission takes place in the reactor only.
- Nuclear fission produces large quantity of heat.
- The heat generated in the reactor is carried by coolant circulate through the reactor

COMPONENTS OF NUCLEAR POWER PLANT

Control Rods:

- They are used to control the chain reaction.
- They are absorbers of neutrons.
- The commonly used control rods are made up of cadmium or boron.

Moderator:

- Moderators are used to slow down the fast neutrons.
- It reduces 2 MeV to an average velocity of 0.025 eV.
- Ordinary or heavy water are used as moderators

COMPONENTS OF NUCLEAR POWER PLANT

Fuel Rods:

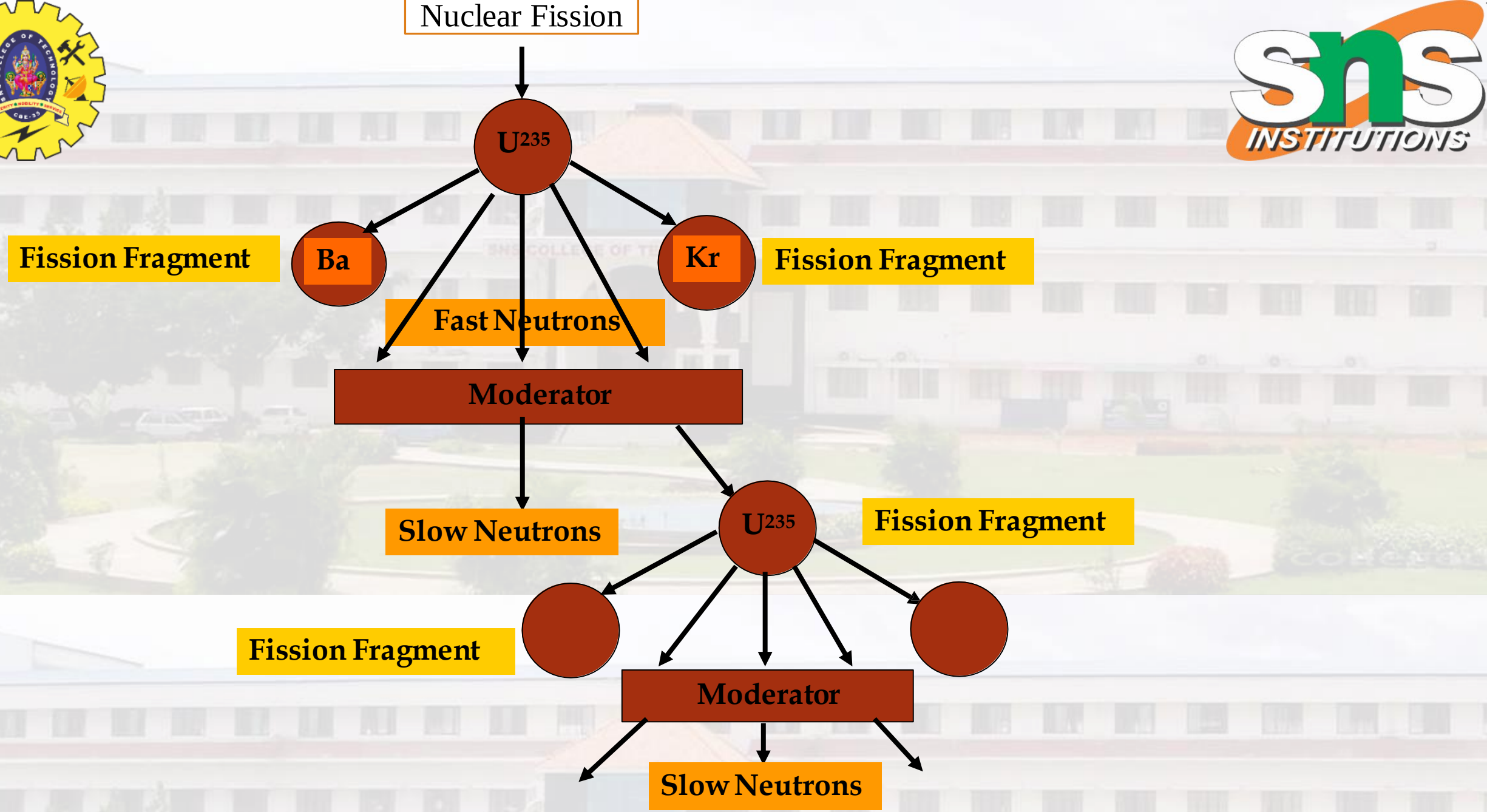
- The fuel rods hold nuclear fuel in a nuclear power plant.

Neutron Reflectors:

- To prevent the leakage of neutrons to large extent.
- In PHWR, the moderator itself acts as reflectors.

Shielding:

- To protect from harmful radiations the reactor is surrounded b a concrete wall of thickness about 2 to 2.5 m.


Nuclear Fission
U235
Fission Fragment
Ba
Kr
Fission Fragment
Fast Neutrons
Moderator
Slow Neutrons
U235
Fission Fragment
Fission Fragment
Moderator
Slow Neutrons

NUCLEAR FISSION

- It is a process of splitting up of nucleus of fissionable material like uranium into two or more fragments with release of enormous amount of energy.
- The nucleus of U^{235} is bombarded with high energy neutrons

$$U^{235} + {}_0n^1 \longrightarrow Ba^{141} + Kr^{92} + 2.5\,{}_0n^1 + 200\ MeV\ energy.$$

- The neutrons produced are very fast and can be made to fission other nuclei of U^{235}, thus setting up a chain reaction
- Out of 2.5 neutrons released one neutron is used to sustain the chain reaction.

$1\ eV = 1.6X10^{-19}$ joule. $1\ MeV = 10^6\ eV$

WORKING PRINCIPLE OF NUCLEAR POWER PLANT

- The heat generated in the reactor due to the fission of the fuel is taken up by the coolant.
- The hot coolant then leaves the reactor and flows through the steam generator.
- In the steam generator the hot coolant transfers its heat to the feed water which gets converted into steam.
- The steam produced is passed through the turbine, which is coupled with generator.
- Hence the power is produced during the running of turbine.
- The exhaust steam from the turbine is condensed in the condenser.
- The condensate then flows to the steam generator through the feed pump.

ADVANTAGES OF NUCLEAR POWER PLANT

- Requires less space compared to steam power plant.
- Fuel required is negligible compared to coal requirement.
- Fuel transport cost is less.
- Reliable in operation.
- Cost of erection is less.
- Water required is very less.

DISADVANTAGES OF NUCLEAR POWER PLANT

- Initial Cost is higher.
- Not suitable for varying load condition.
- Radioactive wastes are hazardous. Hence these are to be handled with much care.
- Maintenance cost is higher.
- Trained workers are required to operate the plant.

THANK YOU