The Shirpur Education Society's

R. C. Patel College of Engineering and Polytechnic, Shirpur

Department of Mechanical Engineering

NAME OF COURSE: - POWER PLANT ENGINEERING

CODE OF COURSE: - 315374

SEMESTER: - TYME-5K

SUBJECT TEACHER: - Mr. ANUP PRALHAD PATIL

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R. C. Patel College of Engineering and Polytechnic, Shirpur

Department of Mechanical Engineering

NAME OF COURSE & CODE: - POWER PLANT ENGINEERING -315374	Academic Year: 2026-27
Program Code, Semester & Scheme: ME-5K	

CHAPTER:- 01:- Fundamental of Power plant

COURSE LEVEL LEARNING OUTCOMES (COS):- Choose appropriate fuel for power plant in given situation.

Learning Hours	R-Level	U-Level	A-Level	Total Marks
6	4	4	4	12

Subject Teacher

Mr.Anup P.Patil

HOD ME 24/06/26

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Program Name: Mechanical Engineering **Program Code:** ME5k

Name of Subject & Code : Power Plant Engineering (315374) **Semester :** Fifth **Date:-** 18/06/2026

QUESTION BANK

Unit - I Fundamental of Power Plant

Sr.No	QUESTION	MSBTE QUE. NO	MARKS	EXAMINATION		BLOOSMS LEVEL
1	List different types of power plants.	QUE-01	2M	W-2025	S-2026	CO-01,TLO-1.7,R
2	State types of fuels used in conventional power plant.	QUE-01	2M		S-2026	CO-01,TLO-1.8,R
3	Mention the factors to be considered while selecting site for steam power plant.	QUE-02	4M	W-2025	S-2026	CO-01,TLO-1.3,R
4	State importance of power plant.	QUE-02	4M		S-2026	CO-01,TLO-1.6,U
5	State the Maharashtra Pollution Control Board (MPCB) norms for power plants.	QUE-04	4M		W-2025	CO-01,TLO-1.5,R
6	Explain world and national scenario of demand and supply of energy in India.	QUE-05	6M		S-2026	CO-01,TLO-1.1,U
7	Explain Indian Boiler Regulation Act.	QUE-06	6M		W-2025	CO-01,TLO-1.4,U

Subject Teacher
Mr.Anup P.Patil

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Unit-1 - Fundamental of Power plant.

TLO:-1.1- Present Indian & Global scenario of demand and supply of Conventional Power Plant with respect to available Resources :-

The Indian Scenario:-

(1) The Demand:- Peak electricity demand has hit record high due to economic Growth and extreme heat waves.

(2) The Supply :- Over 40% of Indian Power Capacity is green, but Coal still generates over 70% of the actual electricity used.

(3) The strategy:- India has massive domestic coal reserve. To keep the light on during evening peak when solar drop to zero, the goverment is buiding new, highly efficient coal plants. and keeping fuel stockpiles high.

The Global Scenario:-

(1) The Demand:- Global electricity use is rising at its fastest pace in a decade.
In wealth nations, AI data centres are sucking up massive amount of power.

(2) The supply:-
Natural Gas & Coal plants are being kept online longer than planned to act as a safety net.

(3) The strategy:-
Traditional plants are changing roles. Instead of running flat out all day, they are becoming "flexibility Providers". ramping down when the sun is shining, and roaring to life the second it sets.

* Resources Availability :-

Resource	Indian Location	Global location
① Coal & Lignite	- Jharkhand - Odisha - Chhattisgarh - West Bengal	- united state (Wyoming) - Russia (Siberia) - China (Shanxi) - Australia (Queensland)
② Natural Gas	- Eastern offshore (Krishna-Gadavari Basin) - Western offshore (mumbai High) - Onshore - Assam, Gujarat, Rajstan	- United state (Texas - Russia (siberia) - middle East (Qatar - North Field, Iran) - Australia.
③ Hydro Power plant	- Himachal Pradesh - Uttara Khand - Arunachal Pradesh - Jammu - Kashmir	- China. - Brazil - Canada - USA.
④ Nuclear power plant (Uranium)	- Jarkhand - Andrapradesh - maharashtra - Gujarat - Rajstan - Tamilnadu	- Kazakhstan - Canada - Australia - Namibia & uzbekistan.

TLO:- 1.2. Overview of Power plant Generation :- Govt and Private Corporation in India with including Power generating capacity:-

The total National power generation capacity has crossed a massive milestone of 532 GW.

(1) sector wise share of India's Power Grid:-

(1) Private sector:- (51.5%) span across heavy-industry primary managing modern mega-solar parks and vast thermal unit.

(2) State Governments:- (24.5%) managed by individual state electricity board (MAHAGENCO, MSPGCL) focusing on regional thermal and Hydro Supply

(3) Central Governments:- (24%) Large, Highly efficient public sector undertaking (PSU's) controlled by the Union Govt.

(2) Capacities:-

(1) Central Government Giants:- (PSU's)

- NTPC — Capacity exceeding 76000 MW (76 GW)
- NHPC - Capacity installation - 7000 MW
- NPCIL (National Power Corporation of India) - Operating Cumulative Capacity - 8780 MW - Kudankulam & Tarapur
- SJVN & NEEPCO — Prominent regional Central PSU's managing an additional 3000 MW of mixed Hydro & solar power plant.

(2) Private Corporation:-

(1) - Adani Power & Adani Green Energy:-
  - 17000 MW - thermal Energy.
  - 11000MW - Green Operative Massive.
- Tata Power:- 14500 MW - solar & Hydro Power
- JSW Energy:- 6800 MW - Hydro & solar Power
- Reliance Power:- 6000 MW - Sasan Ultra Mega power plant in M.P.
- Greenko Group & Renew power — 15000MW — Wind, Solar & Advanced pumped Hydro storage.

TLO:-1.3:- Site selection Criteria for steam Power plant:-

① Fuel Supply:-
- Steam plants Consume amount of Coal or biomass
- Best location near Coal mines or fuel depots to reduce transport costs.
- If not possible, proximity to railway stations or port is essential.

② Water Availability:-
- Large volumes of water are needed for steam generation and Condenser cooling.
- Site near River, Lakes, Canals ensure uninterrupted supply.

③ Land Characteristics:-
- Land must have high bearing Capacity to support heavy machinery.
- should be cheap, Flat, spacious for plant Construction and future expansion.

④ Transportation facilities:-
- Good Connectivity via rail, road or waterways is vital for fuel, machinery, spare parts
- Reduces delays during construction and ensure smooth operation.

⑤ Proximity to Load centers:-
- locating near industrial hubs or cities minimize transmission losses and costs.
- Modern HV transmission allow plants to be farther away, but closer is still economical.

⑥ Ash Disposal facilities:-
- Coal Combustion produces large amount of hot, corrosive ash.
- Adequate space and system for safe disposal are essential.

⑦ Work force Availability:-
- Construction and operation require skilled and unskilled labour.
- site should have access to affordable work force.

⑧ Environmental Regulation:-
- must comply with pollution control laws
- space for emission control system & Fly ash Handling.

TLO 1.4 - Indian Boiler Regulation (IBR) Norms for steam power plant:-

IBR norms are compresive set of legal & technical standards created under The Boiler Act, 1923 to ensure the safe design, construction, inspection, testing and operation of steam boiler & pressure vessel across India.

① Boiler Registration & Certification:-
- A steam power plant must be registed with the Chief Inspector of Boiler with respective state.
- A Boiler operation certificate is mandatory before commissioning.

② Design & Construction:-
- must Comply with IBR design standard (material thickness, pressure rating, allowable stresser)
- Boiler component such as drums, pipes, headers must be design as per IBR guidelines.

③ material & Manufacturing:-
- All material used (plates, tubes, forging, Casting etc) must be IBR certificates.
- material must be tested for mechanical & chemical properties.

④ Testing Requirment:-
- Hydrostatic test:- Carried out at 1.5 times the working Pressure.
- Radiographic test:- performed mandatory for welded joints depending on thickness and servicer condition.
- NDT :- Required for weld inspections.
- Steam test:- performed post installation before issue of certification.

⑤ Operation & Maintenance:-
- Boiler must be operated by licensed Boiler operation Engineers (BOEs)
- Regular Inspection:- Annually or as prescribed by Inspector.

⑥ Safety Provision:-
- Safety valves
- Pressure guages
- Water level Indicator
- safety valve must be set & sealed at designated pressure by Inspector.

TLO-1.5 - Central Pollution Control Board (CPCB) and Maharashtra Pollution Control Board (MPCB) Norm for Power plant:-

(1) Central Pollution Control Board:-

(A) Emission standards for Power plant:-

- Particulate Matter (PM):- Thermal power plant should have a PM emission limit of 30 mg/Nm³ for new plant
- Sulphur Dioxide (SO_2):-
  (1) 1000 mg/Nm³ for unit using coal with sulphur content < 0.5%.
  (2) 600 mg/Nm³ for unit using coal with sulphur > 0.5%.
- Nitrogen oxides:- (NO_x)
  The standard for NO_x is typically 100 mg/Nm³
- Mercury Emission:-
  Limits on mercury emission are stricter, with maximum allowable mercury limit at 0.03 mg/Nm³
- Water Consumption:-
  Especially the goal of reducing thermal pollution and enhancing water conservation.
  (1) Zero Discharge Norms:- Power plant must be follow ZLD or recyle the water used.
  (2) Cooling system Efficiency:- It mandates the use of cooling tower or system that reduce the water requirments.

(2) Maharashtra Pollution Control Board:-

- Pollution Control Devices (PCDs):-
  MPCB are required to install Flue Gas Desulfurization (FGD) system to control SO_2 emissions.
- Effluent standard:-
  Power plant must be treat their water waste before discharge it into rivers.
- Ash Handling & Disposal:-
  Follow the specific Rules regarding the ash disposal & utilization of fly ash.
- Water Recyling & Reused:-
  MPCB enforce the recyling of cooling water wherever possible to prevent Wastage.

TLO.1.6 :- Introduction to Power plant :- their importance and classification :-

A power plant is an individual facility where energy is converted in Electrical Power.
It is used various resources of energy like Coal, Natural gas, water Nuclear fuel, wind or solar.

* Importance of Power plant :-
- Power plant are backbone of modern civilization as electricity is essential for all sector.
- Enable functioning of essential services like Hospital transport, education and communication.
- Support industrial development by providing reliable energy for machinery & Manufacturing.
- Help in national development by powering infrastructure, defense, administrative system.
- influence environmental and energy policies based on the type of energy they use.

* classification of Power plant :-

① Based on source of Energy :-

ⓐ Conventional Power plant :-
- use non-renewable energy sources like Coal, oil, gas and nuclear fuel
- include thermal, nuclear and gas turbine power plant.
- High generation capacity and are used for base load supply.

ⓑ Non Conventional Power plant :-
- use renewable source like solar, wind, biomass and small Hydro.
- Environmentally friendly & sustainable.
- useful for decentralized and Rural power generation.

② Based on ~~[illegible]~~ Nature of Fuel :-

① Coal Fired Power plant :-
- Coal as a fuel to be used in Power plant
- Use various types of grade of coal (Anthracite, Bituminous, or Lignite)

② oil Fired Power Plant :-
- Use diesel or petroleum product.
- Common in small & stand by plant

③ Gas fired Power plant:-
- Use Natural Gas
- Faster starting & cleaner than Coal plant.

④ Nuclear Power plant:-
- Use nuclear fuel like Uranium or plutonium.

⑤ Biomass Power plant:-
- Use Agricultural waste, wood and organic material.

⑥ Hydro-electric Power plant:-
- Use Potential energy of stored or flowing water to rotate turbine.
- Clean & Renewable source, but site-specific.

(3) Based on Usage:-

① Base load Power plant:-
- Operate continuously and supply the constant demand of electricity.
- Usually large-scale plant like Coal & Nuclear power station.

② Peaking power plant:-
- Operate during peak demand hours when electricity consumption is high.
- Include gas turbine & diesel plant due to their quick startup.

③ standby Power plant:-
- serve as backup source during power outages or ~~main~~ main plant failures.
- often small diesel or battery-operated system.

(4) Based on Location:-

① Centralized Power plant:-
- Located far from cities & connected to the grid through long transmission lines.
- Designed for bulk power generation.

② Decentralized Power plant:-
- Located closed to load Centers or Consumer.
- Include rooftop solar, wind or biomass units.

TLO-1.7 - Types of fuels used in conventional power plant and their properties:- (calorific value, Flash point, & fire point) & Relative cost per KWh (power plant production cost on the basis of fuel used:-

* Types of Conventional Fuels & Physical Properties:-

① Solid fuels:- (Coal)

- Bituminous / Anthracite (High Grade):-
  Used in major base-load utility plants due to high energy density.

- Lignite (Brown Coal):-
  Low grade coal with high moisture content, usually burned right next to the mine because it is uneconomical to transport.

② Liquid Fuels:- (Petroleum)

- Heavy fuel oil:-
  A thick, viscous byproduct of petrolum refining it must be pre-heated just to flow through pipes into plant Boilers.

- Light fuel oil:-
  Clean-burning liquid used primarily in internal combustion diesel generator set for emergency backup.

③ Gaseous fuel :- (Natural Gas)
Natural Gas is cleanest burning fossile fuel. It is the standard fuel for combined cycle Gas turbine plant, which utilize both gas and steam turbine to maximize efficiency.

* Properties:-

① Calorific Value:- (Heating Value):-
The amount of Heat Energy released by complete combustion of a unit mass or volume of the fuel. High calorific value fuel produce more steam and electricity per ton.
It is measured in megajoules per kilogram (MJ/kg)

$$C.V. = \frac{\text{Heat Energy Released}}{\text{Mass of Fuel.}}$$

(2) Flash Point:-

The lowest temperature at which a liquid fuel gives off sufficient vapour to form a temporary ignitiable mixture with air near the surface.

(3) Fire Point:-

The lowest temp. at which the fuel vapour will continue to burn for least 5 sec. after ignition by an open flame. It is typically a few degrees higher than the Flash Point.

(4) Relative Cost per kWh:-

Relative Cost (Production Cost per Kilowatt/hr) dependent heavy or regional availability and global market prices.

Fuel	Power plant Type	Calorific value	Flash point	Fire point	Relative Cost per kWh.
Coal	Thermal plant	15-35 MJ/kg	Not Applicable	400-700°C	Low
Diesel Oil	Diesel Power plant	42-45 MJ/kg	52-96°C	62-120°C	Very Low
Furnace oil	Thermal plant	40-42 MJ/kg	≈66°C	≈93°C	High
Natural Gas	Gas Turbine Plant	48-55 MJ/kg	-188°C	-160°C	Medium
Uranium	Nuclear Power Plant	Very High	Not Applicable	Not Applicable	Low operating Cost.