Course Syllabus
Gyanmanjari Degree Engineering College
Semester-7 (B. Tech)

**Subject**: Power Plant Engineering - BETME17331

**Type of course:** Professional Core.

**Prerequisite:** Basic knowledge of Thermodynamics, Heat Transfer, Fluid Mechanics, and Internal Combustion Engines.

**Rationale:** This subject provides knowledge of different power generation systems, their operation, performance, and applications. It helps students understand conventional and non-conventional power plants, energy conversion processes, and the importance of efficient power generation in industrial and utility sectors. The subject also develops awareness about energy management, environmental impact, and modern power plant technologies.

## Teaching and Examination Scheme:

| Teaching Scheme | | | Credits | Examination Marks | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | CA | |
| CI | T | P | C | ESE | MSE | V | P | ALA | |
| 3 | 0 | 0 | 3 | 60 | 30 | 10 | 00 | 50 | 150 |

*Legends: CI-Classroom Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.*

## Course Content:

| Unit No | Course content | Hrs. | % Weightage |
|---|---|---|---|
| 1 | **Thermal Power Plant and Boiler Systems:** General layout, site selection, status of power generation in India; High pressure boilers – features, LaMont, Benson, Loeffler, Schmidt-Hartmann, supercritical, supercharged and fluidized bed combustion, superheat control, boiler corrosion and prevention; Coal and ash handling – storage, burning systems, stokers, pulverized fuel systems (unit & central), mills (ball, bowl, ball & race, hammer), burners (coal & oil), ash disposal methods (mechanical, hydraulic, pneumatic, steam jet), dust collection (mechanical, electrostatic precipitator) | 12 | 30 |
| 2 | **Steam Generation and Turbine Systems:-** Draught – natural (chimney height), maximum discharge, forced, induced, balanced, fan power; Steam nozzles – types, velocity, discharge, critical pressure ratio, maximum discharge, significance, efficiency; Steam turbines – principle, types, compounding, impulse (velocity diagram, work, power, efficiency, max efficiency), reaction (diagram, degree of reaction, reheat factor), governing (throttle, nozzle, bypass), blade attachment, labyrinth packing, losses | 12 | 30 |
| 3 | **Condensers, Cooling, Feed Water and Gas Turbines :-**Condensers – types, air leakage sources/effects, vacuum methods, efficiency, cooling water, Edward air pump; Cooling – ponds, towers, systems, types; Feed water treatment – necessity, impurities, effects, pH role, treatment (lime soda, zeolite, demineralization, reverse osmosis incl. seawater), de-aeration; Gas turbines – classification, cycles (open/closed), fuels, Brayton cycle, optimum pressure ratio, work ratio, air rate, operating variables effect, combined cycle plant, blade cooling | 12 | 20 |
| 4 | **Advanced Power Generation and Economics;-** Nuclear power – fusion, fission, chain reaction, fuels, reactor components & types (PWR, BWR, gas cooled, CANDU, fast breeder), waste disposal, plants in India; Jet propulsion – turbojet, thrust, thrust power, propulsive & thermal efficiency, turboprop, ramjet, pulsejet, rocket engines; Economics – load curves, load duration, connected/max/peak load, base & peak plants, load factor, capacity/use factor, demand & diversity factor, cost, performance, tariff | 9 | 20 |

## Continuous Assessment:

| Sr. No | Active Learning Activities | Marks |
|---|---|---|
| 1 | **Thermal Power Plant Component Study.** Each student will observe any thermal power plant component through industrial visit, online resources, or technical videos (e.g., boiler, cooling tower, condenser, steam turbine, chimney, coal handling system). Note down its function, working principle, and one special feature. Prepare a poster or short report and upload it on the GMIU Portal. | 10 |
| 2 | **Boiler Comparison Chart.** Students will prepare a comparison table of different high-pressure boilers such as LaMont, Benson, Loeffler, Schmidt-Hartmann, and Fluidized Bed Combustion boilers. The comparison should include working principle, pressure range, advantages, limitations, and applications. Conclude with the most suitable boiler for modern thermal power plants with proper justification. Prepare a report and upload it on the GMIU Portal. | 10 |
| 3 | **Concept-Based Mini Project.** The faculty will allocate one specific power plant system or component (e.g., steam turbine, condenser, cooling tower, gas turbine, nuclear reactor, or coal handling system) to each student group. Students will develop a simple conceptual model, CAD representation, animation, or simulation explaining the working principle and propose one method for improving efficiency, reducing pollution, or saving energy. Each group will prepare a presentation based on their work and upload it on the GMIU Web Portal. | 10 |
| 4 | **Power Plant Economics Survey.** Each student group will collect electricity consumption data from homes, shops, or industries and prepare simple load curves, peak load analysis, and tariff calculations. Students should identify methods for reducing electricity consumption and improving energy management. Prepare a report with charts and upload it on the GMIU Portal. | 10 |
| 5 | **Future Power Generation Technology Activity.** Students will work in groups to study one advanced power generation technology such as solar thermal power plant, combined cycle power plant, fast breeder reactor, hydrogen-based power generation, or waste-to-energy plant. Students should prepare a technical presentation including working principle, advantages, limitations, and future scope in India and upload the presentation on the GMIU Portal. | 10 |
| | Total | 50 |

## Suggested specification table with marks (Theory):

| Distribution of Theory Marks (Revised Bloom's Taxonomy) | | | | | | |
|---|---|---|---|---|---|---|
| **Level** | **Remembrance (R)** | **Understanding (U)** | **Application (A)** | **Analyze (N)** | **Evaluate (E)** | **Create (C)** |
| **Weightage** | 20 | 30 | 25 | 15 | 5 | 5 |

## Course Outcome:

| After learning the course, the students should be able to: | |
|---|---|
| CO1 | Explain the layout and working of thermal power plants, boilers, and fuel handling systems. |
| CO2 | Apply the principles of draught, steam nozzles, and steam turbines in power generation. |
| CO3 | Analyze condensers, cooling systems, feed water treatment, and gas turbine systems. |
| CO4 | Evaluate nuclear power plants, jet propulsion systems, and power plant economics. |

## Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

## Reference Books:

[1] Power Plant Engineering by P. K. Nag, McGraw-Hill Education

[2] A Course in Power Plant Engineering by S. C. Arora and S. Domkundwar, Dhanpat Rai Publications

[3] Power Plant Engineering by R. K. Rajput, Laxmi Publications

[4] Steam and Gas Turbines by R. Yadav, Central Publishing House

[5] Thermal Engineering by R. K. Rajput, Laxmi Publications

[6] An Introduction to Thermal Power Plant Engineering and Operation by Dipak Sarkar, PHI Learning

[7] Power Plant Technology by M. M. El-Wakil, McGraw-Hill Publications