GUJARAT TECHNOLOGICAL UNIVERSITY

BRANCH NAME: Mechanical Engineering
SUBJECT NAME: Power Plant Engineering
SUBJECT CODE: 2171910
B.E. 7th SEMESTER

Type of course: Applied Engineering
Prerequisite: Engineering Thermodynamics, Fluid Mechanics, Heat Transfer
Rationale: The course is designed to give fundamental knowledge of construction and working of various types of thermal power plants i.e. steam turbine, gas turbine, nuclear etc.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	0	2	6	70	20	10	20	10	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	**Thermal Power Plant:** General layout of modern thermal power plant, Site selection, Presents status of power generation in India	2	4
2	**High Pressure Boilers:** (Unique features and advantages of high pressure boilers, LaMont; Benson; Loeffler and Schmidt-Hartmann boilers)*, supercritical boilers, Supercharged and fluidized bed combustion, Methods of superheat control, Corrosion in boilers and its prevention	4	7
3	**Coal and Ash Handling Systems:** Coal storage, Burning systems, Types of stokers and their working, Pulverized fuel handling systems, Unit and central systems, Pulverized mills- ball mill, Bowl mill, Ball & race mill, Impact or hammer mill, Pulverized coal burners, Oil burners, Necessity of ash disposal, mechanical; hydraulic; pneumatic and steam jet ash handling system, Dust collection and its disposal, Mechanical dust collector, Electrostatic precipitator	7	13
4	**Draught System:** Natural draught – estimation of height of chimney, Maximum discharge condition, Forced; induced and balanced draught, Power requirement by fans	3	5
5	**Steam Nozzles:** Types of nozzles, velocity of steam, discharge through nozzle, critical pressure ratio and condition for maximum discharge, physical significance of critical pressure ratio, nozzle efficiency	5	9
6	**Steam turbine:** (Principle of operation, types of steam turbines, compounding of steam turbines, impulse turbine – velocity diagram)*, calculation of work, power and efficiency, condition for maximum efficiency, Reaction turbines – velocity diagram, degree of reaction, reheat factor, (governing of steam turbine – throttle, nozzle and bypass governing)*, Methods of attachment of blades to turbine rotor, Labyrinth packing, Losses in steam turbine	7	13
7	**Condensers and Cooling Towers:** Types of condensers, sources of air in condenser, Effects of air leakage, Methods of obtaining maximum vacuum in	6	10

	condenser, vacuum & condenser efficiency, Mass of cooling water required, Edward air pump, Necessity of cooling ponds and cooling towers, Condenser water cooling systems, Types of cooling towers and cooling ponds		
8	**Feed Water Treatment:** Necessity of feed water treatment, Different impurities found in feed water, Effect of impurities, pH & its role in corrosion and scale formation, Internal & external water treatment systems – Hot lime soda process, Zeolite ion exchange process, Demineralization plants, Reverse osmosis process, Sea water treatment using reverse osmosis, De-aeration	5	9
9	**Gas turbine:** Classification, open and closed cycle, gas turbine fuels, actual Brayton cycle, optimum pressure ratio for maximum thermal efficiency, work ratio, air rate, effect of operating variables on the thermal efficiency and work ratio and air rate, combined steam and gas turbine plant, gas turbine blade cooling	8	14
10	**Nuclear Power Plant:** Nuclear fusion and fission, Chain reaction, Nuclear fuels, Components of nuclear reactor, Classification of reactors, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, CANDU reactor, Fast breeder reactor, Nuclear waste and its disposal, Nuclear power plants in India	5	9
11	**Jet Propulsion:** Turbojet Engine*, thrust, thrust power, propulsive efficiency, thermal efficiency, (Turboprop, Ramjet and Pulsejet engines, Rocket engines)*	2	5
12	**Economics of Power Generation:** Load curves, Load duration curves, Connected load, Maximum load, Peak load, Base load and peak load power plants, Load factor, Plant capacity factor, Plant use factor, Demand factor, Diversity factor, Cost of power plant, Performance and operating characteristics of power plant, Tariff for electric energy	4	8

*** This topic should be covered during laboratory sessions**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	10	17	18	11	7

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Power Plant Engineering, P.K. Nag, McGraw-Hill Education
2. Power Plant Technology, M.M. El-Wakil, McGraw-Hill Education
3. Thermal Engineering, R.K.Rajput, Laxmi Publication
4. Gas Turbines by V Ganeshan, McGraw Hill Education
5. Steam Turbine Theory and Practice, William J. Kearton, CBS Publication

Course Outcome:

After learning the course the students should be able to:

- Understand the different power generation methods, its economics and global energy situation
- Apply the basic thermodynamics and fluid flow principles to different power generation methods
- Analyze thermodynamic cycles of steam power plant and understand construction, working and significance of its various systems
- Analyze thermodynamic cycles of gas turbine power plant, nuclear power plant and jet propulsion systems

List of Experiments: (any ten experiments to be performed)

1. Study of Modern Steam Power Plant.
2. Study of Steam Turbines. (Impulse, Reaction and governing).
3. Study of Gas and Steam Turbine Combined Cycles.
4. Study of Nuclear Power Plant.
5. Study of various draught system.
6. Study of different feed water treatment plants.
7. Study of different types of steam nozzle and design a nozzle
8. Comparative study of different types of high pressure boilers
9. Study of Coal and Ash handling system.
10. Study of condenser and cooling tower.
11. Study of Jet Propulsion systems.

Design based Problems (DP)/Open Ended Problem:

1. Develop a working draught system.
2. Develop a working model of any water treatment system.
3. Develop a working model of cooling tower.

List of Open Source Software/learning website:

1. http://nptel.ac.in/
2. http://npti.in/default.aspx

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.