POWER PLANT ENGINEERING **Course Code : 315374**

Programme Name/s : **Mechanical Engineering**
Programme Code : **ME**
Semester : **Fifth**
Course Title : **POWER PLANT ENGINEERING**
Course Code : **315374**

I. RATIONALE

The economic growth of a nation essentially results in growth in the power sector and electric power is the main resource. Various power plants are playing a vital role in the generation of electricity. Most of the power plants are using mechanical engineering equipment and components. Hence, this course will provide the basic knowledge of the components, operation, and maintenance of power plants to the students and also acquaint them with the latest technological advances taking place in the sector. Therefore, this course is designed to cater the requirements of energy efficient devices of power plant.

II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to help the student to attain the following industry/employer expected outcome through various teaching learning experiences: "Apply knowledge & skills related to power plant engineering to carryout assigned task(s) in conventional power plants and other industrial applications".

III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Choose appropriate fuel for power plant in given situation.
- CO2 - Apply relevant knowledge & skills to maintain modern steam power plant efficiently and safely.
- CO3 - Use knowledge and skills related to Gas Power Plant and Waste Heat Recovery properly in given situation.
- CO4 - Use suitable strategies to run nuclear power plants safely.
- CO5 - Calculate economic parameters of various power plants.

IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL & TL				Based on SL		Total Marks
															Practical						
				CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
											Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
315374	POWER PLANT ENGINEERING	PPE	DSE	4	-	2	-	6	2	3	30	70	100	40	25	10	25#	10	-	-	150

Total IKS Hrs for Sem. : 0 Hrs
Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment
Legends: @ Internal Assessment, # External Assessment, *# On Line Examination , @$ Internal Online Examination
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.* 10 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. * Self learning hours shall not be reflected in the Time Table.
7. * Self learning includes micro project / assignment / other activities.

V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Compare different power plants in India and world TLO 1.2 List various power corporations in India. TLO 1.3 List the different criteria for site selection. TLO 1.4 State the IBR Norms for steam power plant. TLO 1.5 State the regulation for pollution control in power plants. TLO 1.6 State the importance of power plant. TLO 1.7 Classify the power plants on the basis of given criteria. TLO 1.8 Classify the fuel used in given power plant.	**Unit - I Fundamental of Power plant** 1.1 Present Indian & Global scenario of demand and supply of conventional power plant with respect to available resources. 1.2 Over view of Power generating plants- Govt. and Private corporations in India with including power generating capacity. 1.3 Site selection criteria for steam power plant. 1.4 IBR (Indian Boiler Regulation) Norms for steam power plant. 1.5 CPCB (Central Pollution Control Board) and MPCB (Maharashtra Pollution Control Board) Norms for Power Plants. 1.6 Introduction to power plants: their importance and classification. 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).	Chalk-Board Presentations Model Demonstration Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Sketch the layout of modern steam power plant. TLO 2.2 Explain working of different components of steam power plant. TLO 2.3 State the functions of different components of steam power plant. TLO 2.4 Sketch the constructional details of different components of steam power plant. TLO 2.5 Illustrate the fuel handling equipments. TLO 2.6 Explain the construction and working of different components of ash handling system. TLO 2.7 Write the various applications of fly ash. TLO 2.8 State the objectives of feed water treatment. TLO 2.9 Describe with sketches working of the given FBC boilers. TLO 2.10 Explain the construction and working of various temperatures & feed water control system.	**Unit - II Modern Steam Power Plant** 2.1 Schematic diagram of modern steam power plant. 2.2 Construction, working and functions of super heater, air preheater, economizer, feed pump, electrostatic precipitator, steam traps and its types. 2.3 Fuel handling system- Coal handling layout, Pulverization of coal – Ball Mill 2.4 Ash Handling System- Types of ash (Bottom Ash & Fly Ash) , Layout, Components used & their functions. Commercial use of fly ash. 2.5 Feed Water Treatment- Objective of feed water treatment, Parameters of feed water. (Total Hardness, pH, Total Dissolved Solid (TDS)) 2.6 Fluidized Bed Combustion Boiler (FBC): Types, Construction and Working, Advantages and Disadvantages. 2.7 Concept of steam temperature control and boiler feed water control (Three Element Control only).	Chalk-Board Presentations Model Demonstration Video Demonstrations
3	TLO 3.1 Draw layout of gas power plant. TLO 3.2 List components of gas power cycle. TLO 3.3 Compare different methods for improving efficiency of gas turbine power plant. TLO 3.4 Explain the need of waste heat recovery system. TLO 3.5 Describe with sketches working principle of cogeneration. TLO 3.6 Describe Trigeneration in the given power plants.	**Unit - III Gas Power Plant and Waste Heat Recovery** 3.1 Introduction to Gas Turbine Power Plant, Concept of Brayton cycle. (No Numerical) 3.2 Arrangement of open and close cycle with constant pressure gas turbine power plant. 3.3 Components of gas turbine power plant and its function. 3.4 Methods to improve the thermal efficiency of a simple open cycle constant pressure gas turbine power plant (No derivation). Advantage & Disadvantages over other power plant.(No Numerical) 3.5 Waste heat recovery in thermal power plants, its need, opportunities, present practices. 3.6 Cogeneration, its need, opportunities, Application of cogeneration in sugar industry, Introduction to bagasse fired boiler. 3.7 Trigeneration, its need, opportunities, presents practices.	Chalk-Board Presentations Model Demonstration Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	TLO 4.1 Sketch the layout of nuclear power plant. TLO 4.2 Explain various nuclear reactor used in nuclear power plant. TLO 4.3 Choose the waste disposal methods. TLO 4.4 Explain the present scenario of nuclear power plant in India. TLO 4.5 State the regulation for nuclear power plant.	**Unit - IV Nuclear Power Plant** 4.1 Introduction to nuclear power plant - Site selection Criteria - Nuclear fuel - Layout 4.2 Nuclear reactor - Construction and Working of - Pressurized Water Reactor (PWR) - Boiling Water Reactor (BWR) 4.3 Nuclear Waste and Disposal. 4.4 Present Nuclear power scenario in India 4.5 Introductions to regulating agencies and regulations, Atomic Energy Regulatory Board (AERB), International Atomic Energy Agency (IAEA), it's a regulation method.	Chalk-Board Presentations Model Demonstration Video Demonstrations
5	TLO 5.1 Explain captive power plant. TLO 5.2 State the National Mission for Enhanced Energy Efficiency (NMEEE) in power plant. TLO 5.3 Estimate the cost of electricity in the given situation using simple numerical problems. TLO 5.4 Calculate performance parameters for the given power plant using simple numerical problems.	**Unit - V Recent Trends And Economic Analysis of Power Plants** 5.1 Introduction to captive power plant, Definition, Benefits. 5.2 National Mission for Enhanced Energy Efficiency (NMEEE) in power plants- Perform, Achieve and Trade (PAT), Market Transformation for Energy Efficiency (MTEE), Market Transformation for Energy Efficiency (MTEE), Framework for Energy Efficient Economic Development (FEEED). 5.3 Estimation of the production cost of electrical energy. (Simple numerical) 5.4 Estimation of various performance parameters. (Simple numerical)	Chalk-Board Presentations Model Demonstration Video Demonstrations

VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Select appropriate fuel for given conventional power plant based on properties of fuel. LLO 1.2 Compare any two fuels used in conventional power plants on basis of three parameters.	1	*Conventional Power Plant: Fuels and their properties.	2	CO1
LLO 2.1 Use Digital pH meter and TDS meter. LLO 2.2 Measure the parameters of feed water by using Digital pH meter and TDS meter.	2	*Find the feed water parameters.	2	CO2
LLO 3.1 Dismantle Float and thermodynamic steam trap. LLO 3.2 Check the status of components in the float and thermodynamic steam trap. LLO 3.3 Assemble float and thermodynamic steam trap.	3	Assembling and dismantling of Float and thermodynamic steam trap.	2	CO2
LLO 4.1 Demonstrate the ash handling system using suitable media. LLO 4.2 Prepare a layout comprising various components of the of the ash handling system.	4	Ash handling system or electrostatic precipitator (ESP).	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 List the components of gas turbine power plant. LLO 5.2 Prepare the model of gas turbine power plant using waste material in the institute.	5	Layout model of gas turbine power plant.	2	CO3
LLO 6.1 Identify the components of thermal power plant. LLO 6.2 Demonstrate the working of cogeneration in thermal power plant using media.	6	*Cogeneration in the given thermal power plant	2	CO3
LLO 7.1 Identify the components of nuclear power plant. LLO 7.2 Demonstrate the construction and working of nuclear power plant using available animation. LLO 7.3 Draw layout of nuclear power plant.	7	*Working of nuclear power plant.	2	CO4
LLO 8.1 Choose the waste disposal method for nuclear waste. LLO 8.2 Prepare the model of waste disposal process for nuclear waste using waste material in the institute.	8	Waste disposal model for nuclear waste.	2	CO4
LLO 9.1 Demonstrate the working of captive power plant using media. LLO 9.2 Identify the components of nuclear power plant. LLO 9.3 Draw layout of nuclear power plant.	9	Captive steam power plant with all technical specifications.	2	CO5
LLO 10.1 Calculate the connected electricity load of any one lab. LLO 10.2 Suggest the type of power plant required on the basis of load and justify your answer.	10	*Connected electricity load of any one laboratory.	2	CO5
LLO 11.1 Use EES software or equivalent. LLO 11.2 Select the working parameters of a given power plant LLO 11.3 Determine the efficiency of steam power plant considering any two parameters using EES software.	11	Modern steam power plant efficiency.	2	CO2 CO5

Note : Out of above suggestive LLOs -

- '*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE

VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	EES freeware (https://fchart.com/ees/demo.php)	11
2	Digital pH meter : pH Range-0-14pH, pH Resolution- 0.01pH, pH Accuracy-+0.002pH,	2
3	TDS meter: TDS Measuring Range: 0-9990 PPM, Resolution: 1 PPM (10 PPM for1000 to 99990 PPM), Accuracy: ±2%, Temperature Measuring Range: 0° to 50°C	2

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
4	Single Orifice Float Trap: size 25mm	3
5	Thermodynamic steam strap: Size 15mm	3

IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamental of Power plant	CO1	6	4	4	4	12
2	II	Modern Steam Power Plant	CO2	12	4	8	6	18
3	III	Gas Power Plant and Waste Heat Recovery	CO3	10	4	4	6	14
4	IV	Nuclear Power Plant	CO4	6	4	4	4	12
5	V	Recent Trends And Economic Analysis of Power Plants	CO5	6	2	4	8	14
Grand Total				**40**	**18**	**24**	**28**	**70**

X. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)

- • Two-unit tests of 30 marks and average of two-unit tests.
- • For laboratory learning 25 Marks

Summative Assessment (Assessment of Learning)

- • End semester assessment of 25 marks for laboratory learning.
- • End semester assessment of 70 marks.

XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	-	-	2	3	3	3			
CO2	3	-	-	3	3	3	3			
CO3	3	-	-	3	3	3	3			
CO4	3	-	-	3	3	3	3			
CO5	3	3	3	3	3	3	3			

Legends :- High:03, Medium:02,Low:01, No Mapping: -
*PSOs are to be formulated at institute level

XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number

Sr.No	Author	Title	Publisher with ISBN Number
1	R.K. Rajput	A Text Book of Power Plant Engineering.	Laxmi Publications, New Delhi 2016,ISBN-13 978-8131802557
2	Arora and Domkundwar	Power Plant Engineering	Dhanpat Rai & CO (P) LTD 2022, ISBN-13 978-8177001952
3	P. K. Nag	Power Plant Engineering	McGraw Hill 2017, ISBN-13 978-9339204044
4	G. R. Nagpal	Power Plant Engineering	Khanna publishers 2002, ISBN-13 978-8174091550
5	Dr. P. C. Sharma	Power Plant Engineering.	S. K. Kataria 2013, ISBN-13 978-9350143841
6	M.M. EL-Wakil	Power Plant Technology	McGraw Hill 2084 ISBN-13 978-0070192881
7	Bernhardt G A Sarotzki, William A Vopat	Power Station Engineering and Economy	Tata Mc Graw Hill 2001, ISBN-13 978-0070995734
8	P.K.Das & A.K.Das	An Introduction to Thermal Power Plant Engineering and Operation : For Power Plant Professionals	Notion Press; 1st edition 2018, ISBN-13 978-1643248622
9	A K Raja, Amit Prakash Srivastava and Manish Dwivedi	Power Plant Engineering	New age international Publishers 2020, ISBN-13 978-9380386782
10	Gupta Manoj Kumar	Power Plant Engineering	PHI Learning Publication 2012, ISBN-13 978-8120346123

XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	https://static.investindia.gov.in/s3fs-public/2023-04/Energy StatisticsIndia2023.pdf	Present Indian Energy scenario
2	https://beeindia.gov.in/en/nmeee-0	Bureau of Energgy Efficiency (BEE)
3	http://www.indiaenvironmentportal.org.in/files/NMEEE.pdf	Recent Trends
4	https://www.youtube.com/watch?v=IdPTuwKEfmA	Thermal Power Plant
5	https://www.youtube.com/watch?v=zcWkEKNvqCA	Gas Power Plant
6	https://www.youtube.com/watch?v=vggzl9OngaM	Nuclear Power Plant
7	https://www.youtube.com/watch?v=NgCb4Er9mew	Nuclear Power Plant
8	https://www.youtube.com/watch?v=ell3ExEpzd8	Waste Heat Recovery
9	https://www.youtube.com/watch?v=1kMT7BJ0d-8	Cogeneration Power Plant
10	https://www.youtube.com/watch?v=w4MnNfUsBPU	Thermodynamics Steam Trap
11	https://www.youtube.com/watch?v=5ZjQhh-7Dkc	Thermodynamics Steam Trap
12	https://www.youtube.com/watch?v=FV9pmX86j8o	Float Steam Trap
13	https://www.youtube.com/watch?v=AcyFY3iAdlw	Electrostatic Precipitator
14	https://www.youtube.com/watch?v=is5wdVgPOkI	Feed Water Treatment

Note :

- Teachers are requested to check the creative common license status/financial implications of the suggested online educational resources before use by the students