Lok Jagruti Kendra University
University with a Difference

Diploma in Automation & Robotics

Course Code: 025120401

Thermal Engineering

Programme / Branch Name			Diploma in Automation & Robotics			
Course Name	Thermal Engineering				**Course Code**	025120401
Course Type	HSSC	BSC	ESC	PCC	OEC	PEC

Legends: HSSC: Humanities and Social Sciences Courses BSC: Basic Science Courses
ESC: Engineering Science Courses PCC: Program Core Courses
OEC: Open Elective Courses PEC: Program Elective Courses

1. Teaching and Evaluation Scheme

Teaching Hours / Week				**Evaluation Scheme**			
L	**T**	**P**	**Total Credit**	**CCE**	**SEE (Th)**	**SEE (Pr)**	**TOTAL**
3	0	2	4	50	50	50	150

Legends:
L: Lectures T: Tutorial P: Practical
CCE: Continuous & Comprehensive Evaluation
SEE (Th): Semester End Evaluation (Theory)
SEE (Pr): Semester End Evaluation (Practical)

2. Prerequisites

- ✓ Engineering Physics
- ✓ Engineering Mathematics- I & II
- ✓ Thermodynamics
- ✓ Fluid Mechanics & Machines

3. Rationale

Thermal engineering is one of the core engineering subject for students of mechanical engineering branch. Technologists have to work with various power producing devices like boilers, turbines, condensers, and cooling towers. This course will enable students to establish basic fundamental required to understand, operate and maintain these devices. Students will be able to calculate various parameters required to find out the performance of all these devices. Steam power plants are still contributing vital role in electricity production in India.

4. Objectives

- ✓ 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.
- ✓ Explain the working, construction and applications of steam boilers and steam generators.
- ✓ Identify the elements and processes of steam condensers and cooling towers.
- ✓ Basic heat transfer mechanisms (conduction, convection and radiation).
- ✓ Work on multi-disciplinary projects to enhance skills, make effective oral presentations and prepare technical documents effectively.
- ✓ Possess knowledge of modern technological concepts, conduct in-depth studies and experiments and apply specialized expertise practically.

5. Contents

Unit No.	Unit Name	Topics	Learning Outcome	% Weightage	Hours
1.	**Mechanisms of Heat Transfer**	1.1. Introduction 1.2. Mode of heat transfer 1.2.1. Conduction 1.2.2. Convection 1.2.3. Radiation 1.3. Simultaneous heat transfer mechanism 1.4. Examples	• To learn about mode of heat transfer. • To understand about basic mechanism of conduction, convection and radiation. • To obtain numerical solutions for conduction, convection and radiation heat transfer problems.	15	6
2.	**Properties of Steam**	2.1. Introduction 2.2. Basic terminology 2.2.1. Comp liquid 2.2.2. Saturated liquid 2.2.3. Saturated vapor 2.2.4. Super heated vapor 2.2.5. Saturation temp & pressure 2.3. PVT surface 2.4. T-S diagram for liquid, vapor and steam 2.5. Study of steam table and mollier chart 2.6. Quality of steam or dryness fraction 2.6.1. Bucket calorimeter 2.6.2. Separating calorimeter 2.6.3. Throttling calorimeter 2.6.4. Combined separating & throttling calorimeter 2.7. Examples	• To learn about formation of steam. • To understand basic concept of temperature. • To understand steam table data and learn reading about it. • To understand measurement of quality of steam	20	8
3.	**Steam Generators**	3.1. Introduction of steam boiler. 3.2. Classification of boilers. 3.3. Boiler terms.	• To trace the flow of water and steam through the boiler system. • To understand the relationship between temperature and	30	14

		3.4. Boiler construction, advantages and disadvantages. 3.4.1. Horizontal boiler 3.4.2. Vertical boiler 3.4.3. Fire tube boiler 3.4.4. Smoke tube boiler 3.5. Boiler mountings functions, location and working of boilers. 3.6. Boiler accessories functions, location and working of boilers. 3.7. Performance of boiler. 3.8. Rankine cycle: ideal cycle for vapor power cycles 3.9. Causes of boiler tube failures & prevention 3.10. Maintenance and inspection of boiler 3.11. Indian boiler regulation act (IBR) 3.12. Examples	pressure and explain why superheated steam has a higher quality than saturated steam. • To understand how to read a steam table properly and apply its information to a boiler system. • To compare natural circulation boilers with forced circulation boilers, and explain how pressure and temperature affect the type of boiler used. • To describe how proper maintenance of steam traps, valves, packing, flanges, and insulation improve the energy conservation rate in a boiler system.		
4.	**Steam Turbines**	4.1. Introduction 4.2. Classification of steam turbines 4.3. Types of turbine 4.3.1. Impulse turbine 4.3.2. Reaction turbine 4.4. Difference between impulse turbine and reaction turbine. 4.5. Compoundings of steam turbine 4.6. Pressure compounding 4.7. Velocity compounding 4.8. Pressure-velocity compounding 4.9. Losses in steam turbine 4.10. Industrial steam turbine 4.11. Examples.	• To understand concept of steam prime movers. • To learn difference of impulse and reaction turbine. • To understand the pressure, velocity compounding and its graphs. • To learn industrial application of steam prime movers.	15	6
5.	**Condenser & Cooling Tower**	5.1. Introduction 5.2. Condenser (function, classification) 5.3. Elements of water cooled condenser and cooling system	• To understand the construction of an air-cooled condenser, including the tubes, fins.	20	8

		5.4. Types of condenser 5.5. Jet type condenser (parallel and counter flow) 5.6. Surface type condenser (down flow, central flow, evaporative) 5.7. Classification of cooling towers 5.8. Natural cooling tower 5.9. Mechanical draught cooling tower 5.10. Cooling tower environmental effect.	• To learn about the air cooled and water cooled condensers. • To learn the function of cooling towers and spray ponds and the factors that affect their capacities. • To identify the basic types and construction of cooling towers and spray ponds. • To learn cooling-tower and spray-pond maintenance procedures.		
				Total Hours	**42**

6. List of Practicals / Exercises

The practicals/exercises have been properly designed and implemented in an attempt to develop different types of skills, so that students can acquire the competencies/programme outcomes. Following is the list of practicals/exercises.

Sr. No.	Practical / Exercises	Key Competency	Hours
1.	To calculate heat transfer from in forced convection.	Do a calculation of heat transfer rate of forced convection on basis of reading and reach on conclusion.	2
2.	To calculate heat transfer rate from stefan boltzmann apparatus.	Do a calculation of heat transfer rate on basis of reading and reach on conclusion.	2
3.	To plot steam properties on mollier chart for given sample of steam.	Identify the steam quality. (wet, dry or superheated).	2
4.	To demonstrate of various types of steam boilers.	Application of various boiler.	8
5.	Calculate thermal efficiency and boiler power for given data of steam boiler.	To provide quality of steam and specifications of boiler to calculate the power and efficiency of boiler.	2
6.	Activity to prepare a poster on different types of steam turbines.	steam turbine and sketch the setup, write the specifications	2
7.	To make a model of surface condenser (water cooling or air cooling).	To make model of surface condenser with the help to	4

		wood, plastic and thermocole.	
8.	To study and analysis jet condensers.	Make a analysis chart of jet condenser types which one is better as per its specifications.	2
9.	Seminar presentation	Prepare the seminar and make presentation on power point.	4
		Total Hours	**28**

7. Suggested Specification Table for Evaluation Scheme

Unit No.	Unit Name	Distribution of Topics According to Bloom's Taxonomy					
		R %	U %	Ap %	C %	E %	An %
1.	Mechanisms of Heat Transfer	28	35	21	-	8	8
2.	Properties of Steam	44	35	7	-	7	7
3.	Steam Generators	35	45	16	-	4	-
4.	Steam Turbines	35	44	-	-	7	14
5.	Condenser & Cooling Tower	30	40	15	-	-	15

Legends: R: Remembering U: Understanding
App: Applying C: Creating
E: Evaluating An: Analyzing

8. Textbooks

1) Power Plant Engineering by R K Rajput, Laxmi Publication.
2) Power Plant Engineering by Dom Kundwar, Dhanpat Rai & Co.

9. Reference Books

1) Fundamental of Thermal Fluid Sciences by Yunus Cengel / John M Cimbala / Rober H Turner, McGraw Hill Publication.
2) Thermodynamics – An Engineering Approach by Yunus Cengel & Michale A Boles, Tata McGraw Hill Publication.
3) Engineering Thermodynamics by P K Nag, Tata McGraw Hill Publication.
4) Power Plant Engineering by P K Nag, Tata McGraw Hill Publication.
5) Steam & Gas Turbine and Power Plant Engineering by Dr. R Yadav, Central Publishing House Allahabad.
6) Steam Table by R S Khurmi, S.Chand Publication.

10. Open Sources (Website, Video, Movie)

1) https://www.tpctraining.com/products/condensers-and-cooling-towers
2) https://nptel.ac.in/courses/112/103/112103277/
3) https://www.youtube.com/watch?v=Ec9kXfrZaR4
4) https://www.youtube.com/watch?v=IdPTuwKEfmA
5) https://www.sciencedirect.com/topics/engineering/steam-power-plant
6) https://www.energy.gov/eere/geothermal/electricity-generation
7) https://mechanicalenotes.com/category/thermal-engineering/
8) https://lecturenotes.in/subject/496/thermal-engineering-1
9) https://books.google.co.in/books?id=TEjZFUcVTbgC&printsec=frontcover#v=onepage&q&f=false
10) https://www.mechanicalbooster.com/2016/08/steam-power-plant.html