SAMARTH EDUCATIONAL TRUST
SAWKAR INSTITUTES
SATARA

AGCE

SYLLABUS FIRST YEAR

Master of Technology

Syllabus and Course Structure of First Year M.Tech(Heat Power) Programme at Arvind Gavali College of Engineering, Satara - Designed to nurture foundational knowledge, practical skills, and holistic development for future engineers

ARVIND GAVALI COLLEGE OF ENGINEERING, SATARA.

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SAMARTH EDUCATIONAL TRUST

ARVIND GAVALI COLLEGE OF ENGINEERING, SATARA

(AN AUTONOMOUS INSTITUTE)

Master of Technology

in

Mechanical Engineering (Heat Power)

First Year Syllabus

2025-26

LIST OF ABBREVIATIONS

Sr. No.	Abbreviation	Description	Code
1	L	Lecture	
2	T	Tutorial	
3	P	Practical	
4	Cr	Credits	
5	BSC	Basic Science Course	BS
6	ESC	Engineering Science Course	ES
7	AEC	Ability Enhancement Course	AE
8	VSEC	Vocational and Skill Enhancement Course	VS
9	PCC	Program Core Course	PC
10	PEC	Professional Elective Course	PE
11	OEC	Open Elective Course	OE
12	IKS	Indian Knowledge System	IK
13	CC	Co-curricular Course	CC

SEMESTER – I

Sr. No.	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme			
				L	T	P	Hrs./ Week	Cr	Components	Max	Min for Passing	
1	PCC	25MHP1101	Thermodynamics and Combustion	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
2	PCC	25MHP1102	Advanced Fluid Dynamics	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
3	PCC	25MHP1103	Advanced Heat Transfer	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
4	PCC	25MHP1101 L	Thermodynamics and Combustion Laboratory	0	0	2	2	1	CA1	25		40
									CA2	25		
									POE	50	20	
5	PCC	25MHP1102 L	Advanced Fluid Dynamics Laboratory	0	0	2	2	1	CA1	25		20
									CA2	25		
									--	--	--	
6	PCC	25MHP1103 L	Advanced Heat Transfer Laboratory	0	0	2	2	1	CA1	25		40
									CA2	25		
									POE	50	20	
7	PEC	25MHP1104	Professional Elective Course- I	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
8	PEC	25MHP1105	Professional Elective Course- II	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
			Total	**15**	**0**	**6**	**21**	**18**		**750**		
Total Contact Hours – 21 Total Credits - 18												

Professional Elective Course List for F. Y. M. Tech (Heat Power) SEM – I:

Sr. No.	Track	Course Code	Course Name
PROFESSIONAL ELECTIVE COURSE- I			
1	Study and Design of Thermal Systems	25MHP1104A	Nuclear Engineering
2	Pumps and Turbines	25MHP1104B	Design of Thermal – Turbo Systems
3	Pumps and Turbines	25MHP1104C	Gas Turbines
PROFESSIONAL ELECTIVE COURSE- II			
1	Study and Design of Thermal Systems	25MHP1105A	Design of Hydro - Turbo Systems
2	Heating Ventilation and Air Conditioning	25MHP1105B	Air Conditioning System Design
3	Energy Engineering	25MHP1105C	Design of Solar and Wind System

SEMESTER – II

Sr. No.	Category	Course Code	Course Name	Teaching Scheme					Evaluation Scheme			
				L	T	P	Hrs./ Week	Cr	Components	Max	Min for Passing	
1	PCC	25MHP1201	Steam Engineering	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
2	PCC	25MHP1202	Computational Techniques in Fluid Flow and Heat Transfer	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
3	PCC	25MHP1203	Internal Combustion Engine Design	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
4	PCC	25MHP1201 L	Steam Engineering and I.C. Engine Laboratory	0	0	2	2	1	CA1	25		40
									CA2	25		
									POE	50	20	
5	PCC	25MHP1202 L	CFD Laboratory	0	0	2	2	1	CA1	25		20
									CA2	25		
									--	--	--	
6	PCC	25MHP1204	Seminar	0	0	2	2	1	CA1	25		40
									CA2	25		
									OE	50	20	
7	PEC	25MHP1205	Professional Elective Course-III	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
8	PEC	25MHP1206	Professional Elective Course-IV	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
9	OEC	25MHP1207	Research Methodology	3	0	0	3	3	CA-1	10		40
									MSE	30		
									CA-2	10		
									ESE	50	20	
			Total	**18**	**0**	**6**	**24**	**21**		**850**		
Total Contact Hours – 24 Total Credits - 21												

Professional Elective Course List for F. Y. M. Tech (Heat Power) SEM – II:

Sr. No.	Track	Course Code	Course Name
PROFESSIONAL ELECTIVE COURSE– III			
1	Study and Design of Thermal Systems	25MHP1205A	Design of Heat Exchanger
2	Refrigeration	25MHP1205B	Industrial Refrigeration
3	Food Preservation	25MHP1205C	Food Preservation and Cold Chain Management
4	Automotive and Power Systems	25MHP1205D	Alternative fuels for I.C. Engines
PROFESSIONAL ELECTIVE COURSE - IV			
1	Refrigeration	25MHP1206A	Cryogenics
2	Heating Ventilation and Air Conditioning	25MHP1206B	Industrial Air Conditioning
3	Energy Engineering	25MHP1206C	Energy Conservation and Management
4	Automotive and Power Systems	25MHP1206D	Battery thermal management system

Title of the Course: Thermodynamics and combustion Course Code: 25MHP1101	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite:

To ensure that the students can fully benefit from this course, they should have basic knowledge of Basic Mathematics and Chemistry

Course Description:

This course provides an in-depth study of thermodynamics and combustion principles with a focus on energy conversion in multicomponent systems. Students will develop a strong foundation in the fundamental laws of thermodynamics, including zeroth, first, and second laws, and will explore advanced thermodynamic relations such as Maxwell's relations, Helmholtz and Gibbs free energies, and the Clapeyron equation. The course also emphasizes chemical thermodynamics and equilibrium, statistical interpretations of thermodynamic laws, and entropy concepts

Course Objectives:

By the end of this course, the students will be able to:

1. Students will get Knowledge of exergy, basic laws governing energy conversion in multicomponent systems and application of chemical thermodynamics.
2. Student will be aware about advanced concepts in thermodynamics with emphasis on the thermodynamic relations, equilibrium and stability of multiphase multi-component systems.
3. Student will be acquiring the confidence in analyze the motion of combusting and no combusting fluids whilst accounting for variable specific heats, non-ideal gas properties, chemical no equilibrium and compressibility

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	**Explain** the concepts of thermodynamics and kinetics of combustion
CO2	**Apply** the concepts of Thermodynamics and combustion phenomena in energy conversion devices.
CO3	**Analyze** the combustion mechanisms of various fuels.
CO4	**Evaluate** entropy change for flow and non-flow processes under steady and unsteady conditions
CO5	**Interpret** the thermodynamic behavior of reacting systems using concepts of chemical equilibrium and statistical thermodynamics.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011
CO1	2	2									
CO2	2		2		1						
CO3		3		2							2
CO4	2	3		2	2						
CO5	2	2									2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
MSE	30
CA2	10
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions/presentation, etc
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents:

Unit No.	Unit Title and Contents	Hours
1	**Laws of Thermodynamics** Zeroth and First Law of Thermodynamics applied to macroscopic systems. Second Law analysis applied to macroscopic systems. Concept & Evaluation of entropy, Clausius inequality, Principle of increase of entropy.	**08**
2	**Second Law Analysis of Thermodynamic Systems** Introduction, Thermodynamic availability, Second Law Analysis of Closed Systems and Open Systems.	**08**
3	**Generalized Thermodynamic Relationship** Thermodynamic Relations Mathematical theorems, Helmholtz and Gibb's function, T-ds equations, Maxwell's relations, energy equations, variation in heat capacities, Clapeyron relation	**08**
4	Combustion and Thermo-chemistry, Second law analysis of reacting mixture, Availability analysis of reacting mixture, Chemical equilibrium	**08**
5	Statistical thermodynamics, statistical interpretations of first and second law and Entropy.	**08**

Textbooks:			
Sr. No.	**Title**	**Author**	**Publisher**
1	An Introduction to Thermodynamics	Y.V.C. Rao	University Press (India) Private Limited (Revised Edition, 2004)
2	Thermodynamics: An Engineering Approach	Y.A. Cengal and M.A. Boles	McGraw Hill (Fifth edition)
3	Fundamentals of Classical Thermodynamics	G. Van Wylen, R. Sonntag and C. Borgnakke	John Willey & Sons (Fourth edition)

Reference Books:			
Sr. No.	**Title**	**Author**	**Publisher**
1	Thermodynamics	Cengel	Tata McGraw Hill Co., New Delhi, 1980
2	Fundamentals of Engineering Thermodynamics	Howell and Dedcius	McGraw Hill Inc., U.S. A
3	Engineering Thermodynamics	Jones and Hawkings	John Wiley and Sons Inc., U.S.A, 2004
4	Thermodynamics	Holman	McGraw Hill Inc., New York, 2002
5	Postulational and Statistical Thermodynamics	Rao Y.V.C	Allied Publishers Inc, 1994

Title of the Course: Advanced Fluid Dynamics Course Code: 25MHP1102	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite:

To ensure that the students can fully benefit from this course, they should have basic knowledge of Fluid Mechanics.

Course Description:

This course delves into advanced concepts of fluid dynamics, focusing on the mathematical modelling and analysis of fluid flow problems. Students will build on their foundational knowledge of fluid mechanics to study flow kinematics, potential flow theory, hydrodynamic stability, boundary layer phenomena, and turbulent flow characteristics. The course also covers the performance and operation of turbo machinery such as turbines, compressors, and pumps.

Course Objectives:

By the end of this course, the students will be able to:

1. To enable the students to analyse and solve fluid related problems by applying principles of mathematics, science and engineering.
2. To prepare students to use modern tools, techniques and skills to fulfil industrial needs related to fluid dynamics.
3. To train students with effective communication skill to demonstrate fluid dynamics theories.
4. To develop skills in the analysis of fluid systems with mathematical modeling for applications of fluid dynamics in research or design.
5. To develop a professional approach for lifelong learning in the fluid dynamics to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	**Describe** and **define** the fluid flow problems along with range of governing parameters
CO2	**Devise** the experiments in the field of fluid mechanics.
CO3	**Analyze** the flow patterns and differentiate between the flow regimes and its effects.
CO4	**Evaluate** the performance of turbomachinery.
CO5	**Interpret** the characteristics of compressible fluid flow and analyze the effects of shock waves and area variation in nozzles and diffusers.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011
CO1	3	2									
CO2	2	3	2	3	2						
CO3	3	3		3	2						2
CO4	2	3		2	2						
CO5	3	3		2	2						2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
MSE	30
CA2	10
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions/presentation, etc
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents:

Unit No.	Unit Title and Contents	Hours
1	**Basic equations of flow** Kinematics of flow, Control volume approach, Continuity equation, Momentum equation Linear momentum equation and angular momentum equation, Energy equation, Bernoulli equation	**08**
2	**Theory of Potential Flow and Hydrodynamic Stability** Kelvin's theorem, Stream function and Velocity potential, Irrational flow, Laplace equation and various flow fields, Combined flows and super positions, Examples of transition, Theoretical determination of Critical Reynolds Number,	**08**
3	**Flow over immersed bodies and boundary layer flow** Boundary layer equations, flow over flat plate, Boundary layers with non-zero pressure gradient, Approximate methods for boundary layer equations, separation and vortex shedding.	**08**
4	**Turbulent flow** Characteristics of Turbulent flow, Laminar turbulent transition, Governing equations for turbulent flow, turbulent boundary layer equations, measurement of turbulent quantities, shear stress models, universal velocity distribution and friction factor, fully developed turbulent flow, Dynamics of turbulence	**08**
5	**Turbo machinery** Equations of turbomachinery, Axial flow turbines, compressors, pumps and fans, Radial flow turbines, compressors, pumps and fans, Power absorbing vs. power producing devices, Performance characteristics of centrifugal pumps, Performance characteristics of hydraulic turbines	**08**

Textbooks:			
Sr. No.	**Title**	**Author**	**Publisher**
1	Advanced Engineering Fluid Mechanics	Muralidhar and Biswas	Alpha Science International, 2005
2	Mechanics of Fluids	Irwin Shames	McGraw Hill, 2003

Reference Books:			
Sr. No.	**Title**	**Author**	**Publisher**
1	Introduction to Fluid Mechanics	Fox R.W., McDonald A. T.	John Wiley and Sons Inc., 1985
2	Fluid Mechanics	Pijush K. Kundu, Ira M Kohen and David R. Dawaling	McGraw Hill Inc., U.S. A

Title of the Course: Advanced Heat Transfer Course Code: 25MHP1103	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite:

To ensure that the students can fully benefit from this course, they should have basic knowledge of heat transfer.

Course Description:

This course covers the fundamentals and advanced concepts of heat transfer through conduction (1D & 2D), convection (natural and forced), and radiation. It includes special topics such as fins, heat sources, unsteady conduction, boiling, condensation, and two-phase flow. Applications like heat pipes, transpiration cooling, ablation, and radiation network analysis are also addressed..

Course Objectives:

By the end of this course, the students will be able to:

1. To provide the student with general techniques to formulate, model and mathematically solve advanced heat transfer problems.
2. To provide the student with a detailed, but not exhaustive, presentation of selected advanced topics in convective heat transfer that are representative of "real world" engineering problems.
3. To introduce basic numerical methods and software tools for solving heat transfer problems.
4. To use appropriate analytical and computational tools to investigate heat and mass transport Phenomena.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	**Explain** the physical modelling aspects of heat transfer and an ability to make the appropriate choice between exact and approximate calculations in solving problems of heat transfer in complex systems.
CO2	**Identify** the analogy of flow and momentum diffusion to heat and mass transfer and identify the interdisciplinary character of real- life thermal engineering.
CO3	**Analyze** heat transfer in complex internal flow systems and in boundary layers and external flow configurations.
CO4	**Evaluate** radiation heat transfer between black body and gray body surfaces & Gas radiation.
CO5	**Assess** and **apply** advanced heat transfer techniques including phase change, transpiration cooling, and heat pipe technology in engineering systems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011
CO1	3	2			2						2
CO2	2	3	2	3	2						2
CO3	3	3		3	2						2
CO4	3	3		2							2
CO5	3	2		2	3						2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%, 30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
MSE	30
CA2	10
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions/presentation, etc
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents:

Unit No.	Unit Title and Contents	Hours
1	Conduction- One and Two Dimensions.	**08**
2	Fins, conduction with heat source, unsteady state heat transfer.	**08**
3	Natural and forced convection, integral equation, analysis and analogies.	**08**
4	Transpiration cooling, ablation heat transfer, boiling, condensation and two-phase flow mass transfer, cooling, fluidized bed combustion.	**08**
5	Heat pipes, Radiation, shape factor, analogy, shields. Radiation of gases, vapors and flames, Network method of analysis for Radiation Problem.	**08**

Textbooks:			
Sr. No.	**Title**	**Author**	**Publisher**
1	A Textbook on Heat Transfer	S. P. Sukhatme	Universities Press, 4th Edition,2006
2	Heat Transfer – A Practical Approach	Yunus. A. Cengel	Tata McGraw Hill, 3rd Edition, 2006
3	Fundamentals of Heat and Mass Transfer	Incropera and Dewitt	Wiley publications, 2nd Edition, 2007
4	Heat and Mass transfer	P. K Nag	Tata McGraw Hill, 2nd Edition

Reference Books:			
Sr. No.	**Title**	**Author**	**Publisher**
1	Analysis of Heat and Mass Transfer	Eckert and Drabe	McGraw Hill Higher Education, 2003
2	Boundary Layer Theory	H. Schlichting, K. Gersten	Springer, 8th edition, 2000
3	Heat Transfer	J. P. Holman	McGraw Hill Book Company, New York, 1990
4	Principles of Heat Transfer	Frank Kreith	Harper and Row Publishers, New York, 1973
5	Process Heat Transfer	Donald Q. Kern	Tata McGraw Hill Publishing Company Ltd., New Delhi, 1975
6	Fundamentals of Engineering Heat and Mass Transfer	R. C. Sachdeva	Wiley Eastern Ltd., India
7	Heat Conduction	Latif M. Jiji	Springer, 3rd edition, 2009

Title of the Course: Thermodynamics and combustion Laboratory Course Code: 25MHP1101L	L	T	P	Credit
	-	--	2	1

Course Pre-Requisite: Requisite Courses: Basic Mathematics, Chemistry

Course Description:

This laboratory course is designed to provide hands-on experience in the principles of **thermodynamics** and **combustion processes** through a series of practical experiments and data analysis. Students will conduct experiments related to energy conversion, heat engines, calorimetry, fuel properties, and combustion analysis. Emphasis is placed on experimental design, measurement techniques, error analysis, and interpretation of results in the context of real-world energy systems

Course Objectives:

1. To learn about work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about application of law to various energy conversion devices.
3. To evaluate the changes in properties of substances in various processes.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Describe the experimental procedure of experiments in thermodynamics lab
CO2	Solve field problems in Thermodynamics and Combustion by using different techniques.
CO3	Verify the concepts related to Thermodynamics and Combustion..
CO4	Prepare and present a detailed technical report based on experiment /mini project work.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1		1				2		3
CO2	2		2		2				2		3
CO3	3	3	3		2				2		3
CO4	2	2	1		2				1		3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), having 25% weightage for each component respectively and 50% weightage is for POE.

Assessment Component	Marks
CA1	25
CA2	25
POE	50
--	-

CA1 POE based on 50% of course content, attendance, lab overall performance.
CA2 POE based on 100% of course content, attendance, lab overall performance.

Unit No.	Course Contents	Hours
1	Test on Grease dropping point apparatus.	**02**
2	Test on Redwood Viscometer .	**02**
3	Determination of flash and fire point of a lubricating oil	**02**
4	A test on Bomb calorimeter.	**02**
5	Mini steam power plant.	**02**
6	Cooling Tower	**04**
7	Reciprocating compressor unit	**04**

Text Book:

Sr.no	Title	Author	Publisher
1.	Thermodynamics	P. K. Nag	Tata McGraw Hill Publication
2.	Thermodynamics an engineering Approach	Cengel and Boles	Tata McGraw-Hill .

Reference Books:

Sr.no	Title	Author	Publisher
1.	Fundamentals of Thermodynamics	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J	John Wiley and Sons
2.	Engineering Thermodynamics	Jones, J. B. and uggan, R. E	Prentice-Hall of India
3.	Fundamentals of Engineering Thermodynamics	Moran, M. J. and Shapiro, H. N.,	John Wiley and Sons.

Useful Links:

https://archive.nptel.ac.in/courses/112/105/112105123/

Title of the Course: Advanced Fluid Dynamics Laboratory Course Code: 25MHP1102L	L	T	P	Credit
	-	--	2	1

Course Pre-Requisite: Requisite Courses: Basic Mathematics, Chemistry

Course Description:

This laboratory course offers an in-depth, hands-on exploration of advanced concepts in **fluid dynamics** through experimental investigation. Students will design, perform, and analyze experiments involving internal and external flows, turbulence, boundary layers, compressible flow, and flow visualization techniques. Emphasis is placed on modern instrumentation, data acquisition, uncertainty analysis, and comparing experimental results with theoretical and computational models.

Course Objectives:

1. To provide hands-on experience with advanced experimental techniques used in fluid dynamics research and applications.
2. To develop skills in various flow visualization techniques to study fluid flow patterns and behaviors.
3. To enhance students' ability to use statistical and computational tools for analyzing fluid flow data.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the working principles of various flow measurement instruments
CO2	Use flow visualization techniques to observe and analyze fluid flow patterns.
CO3	Compare experimental results with theoretical predictions to identify discrepancies and understand their causes.
CO4	Evaluate the accuracy and reliability of experimental data and measurement techniques.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1		1				2		2
CO2	2		1		2				1		1
CO3	2	2	2		2				2		3
CO4	2	2	1		2				1		3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), having 50% weightage for each component respectively.

Assessment Component	Marks
CA1	25
CA2	25
POE	-
ESE	-

CA1 POE based on 50% of course content, attendance, lab overall performance.
CA2 POE based on 100% of course content, attendance, lab overall performance.

Course Contents

Unit No.	Course Contents	Hours
1.	Laminar and Turbulent Flow in Pipes.	**02**
2.	Flow Visualization Using Dye Injection.	**02**
3.	Measurement of Flow Rate Using Orifice and Venturi Meters	**02**
4.	Jet Impact on Vanes.	**02**
5.	Cavitation in Fluid Flows.	**02**
6.	Flow Through Open Channels	**04**
7.	Trial on Pelton Wheels	**04**

Text Book:			
Sr.no	**Title**	**Author**	**Publisher**
1.	Advanced Engineering Fluid Mechanics	Muralidhar and Biswas	Alpha Science
2.	Mechanics of Fluids	Irwin Shames	Tata McGraw-Hill .

Reference Books:			
Sr.no	**Title**	**Author**	**Publisher**
1.	Introduction to Fluid Mechanics	Fox R.W., McDonald A.T	John Wiley and Sons
2.	Fluid Mechanics	Pijush K. Kundu, Ira M Kohen and David R	Prentice-Hall of India

Useful Links
https://youtu.be/H38vI93exns

Title of the Course: Advanced Heat Transfer Laboratory Course Code: 25MHP1103L	L	T	P	Credit
	-	-	2	1

Course Pre-Requisite: Requisite Courses: Basic heat transfer

Course Description:

Thermal conductivity of solids defines how well a material conducts heat, with metals being good conductors and insulators being poor. Natural convection relies on buoyancy-driven fluid movement due to temperature differences, while forced convection in a pipe uses external means like pumps to enhance heat transfer. Boiling heat transfer involves rapid heat exchange during liquid-to-vapor phase change. A double pipe heat exchanger uses concentric pipes for fluid-to-fluid heat transfer, while a shell and tube heat exchanger involves multiple tubes inside a shell for efficient large-scale heat exchange.

Course Objectives:

1. To provide hands-on experience with advanced experimental techniques used in heat transfer research and applications.
2. To investigate the fundamental mechanisms of heat transfer, including conduction, convection, and radiation.
3. To train students in the analysis and interpretation of experimental data in heat transfer.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the theoretical background behind heat transfer measurements and calculations
CO2	Conduct experiments to measure various heat transfer properties using appropriate instruments
CO3	Analyze experimental data to extract meaningful information about heat transfer characteristics
CO4	Evaluate the performance and accuracy of different heat transfer measurement instruments and techniques

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1		1				2		2
CO2	2		1		2				1		1
CO3	2	2	2		2				2		3
CO4	2	2	1		2				1		3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), having 25% weightage for each component respectively and 50% weightage is for POE.

Assessment Component	Marks
CA1	25
CA2	25
POE	50
ESE	-

CA1 POE based on 50% of course content, attendance, lab overall performance.
CA2 POE based on 100% of course content, attendance, lab overall performance.

Course Contents

Unit No.	Course Contents	Hours
1.	Thermal Conductivity of Solids	**02**
2.	Natural Convection	**02**
3.	Forced Convection in a Pipe	**02**
4.	Boiling Heat Transfer:	**02**
5.	Double pipe heat exchanger	**02**
6.	Shell and Tube Heat Exchanger	**04**

Text Book:

Sr.no	Title	Author	Publisher
1	A Textbook on Heat Transfer	S. P. Sukhatme	Universities Press
2	Heat Transfer – A Practical Approach	Yunus A. Cengel	Tata McGraw Hill

Reference Books

Sr.no	Title	Author	Publisher
1	A Textbook on Heat Transfer	S. P. Sukhatme	Universities Press
2	Heat Transfer – A Practical Approach	Yunus A. Cengel	Tata McGraw Hill
3	Analysis of Heat and Mass Transfer	Eckert and Drabe	McGraw Hill Higher Education
4	Boundary Layer Theory	H. Schlichting, K. Gersten	Springer

Useful Links

https://nptel.ac.in/courses/112/105/112105271/

Title of the Course: Nuclear Engineering **Course Code:** 25MHP1104A	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite: Heat and Mass Transfer

Course Description:

This course introduces the fundamental principles and applications of nuclear engineering. Topics include nuclear reactions, radioactivity, neutron interactions, nuclear fission and fusion, reactor physics, and the design and operation of nuclear reactors. The course also covers key aspects of nuclear fuel cycles, radiation shielding, safety analysis, and nuclear waste management.

Course Objectives:

1. Demonstrate the basic concepts and processes taking place inside a nuclear reactor, such as nuclear fission, neutron production, scattering, diffusion, slowing down and absorption.
2. The student will also be familiar with concepts of reactor criticality, the relationship.
3. The student will also be familiar with Time dependent (transient) behavior of power reactor in non-steady state operation and the means to control the reactor.
4. The student will also be familiar with concepts of heat removal from reactor core, reactor safety and radiation protection.

Course Outcomes:

CO	**After the completion of the course the student should be able to**
CO1	Understand the fundamentals of nuclear fission, radioactivity, nuclear reactions, and power generation in reactors.
CO2	Apply neutron transport and diffusion theories to evaluate neutron behavior in various reactor systems.
CO3	Analyze multi-group and multiregional diffusion equations and assess reactor criticality conditions.
CO4	Interpret reactor kinetics and control concepts to study time-dependent behavior of reactors under transient conditions.
CO5	Evaluate heat transfer from reactor core, critical heat flux, reactor safety, and radiation protection strategies.

CO-PO Mapping:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	-	-	-	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	2
CO3	3	3	2	2	3	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	2
CO5	3	3	2	2	3	2	3	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Basics of nuclear fission and power from fission** Radioactivity, nuclear reactions, cross sections, nuclear fission, power from fission, conversion and breeding	**08**
2.	**Neutron transport and diffusion** Neutron transport equation, diffusion theory approximation, Fick's law, solutions to diffusion equation for point source, planar source, etc., energy loss in elastic collisions, neutron slowing down	**08**
3.	**Reactor** Multigrain, multiregional diffusion equation, concept of criticality Solution of multigrain diffusion equations in one region and multiregional reactors, concept of criticality of thermal reactors	**08**
4.	**Reactor kinetics and control** Derivation of point kinetics equations, in hour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients	**08**
5.	**Reactor kinetics and control** Derivation of point kinetics equations, in hour equation, solutions for simple cases of reactivity additions, fission product poison, reactivity coefficients	**08**

Text Book:

Sr.no.	Title	Author	Publisher
1.	Introduction to Nuclear Engineering	John R. Lamarsh, Anthony J. Barrata	Prentice Hall

Reference Books :

Sr.no.	Title	Author	Publisher
1.	Introduction to Nuclear Reactor Theory	John R. Lamarsh	Addison-Wesley
2.	Nuclear Reactor Analysis	Dr. Meherwan P. Boyce, P.E	Wiley

Useful Links

https://nptel.ac.in/courses/112/103/112103243/
https://nptel.ac.in/courses/112/101/112101007/

Title of the Course: **Design of Thermal Turbo Systems**	L	T	P	Credit
Course Code: 25MHP1104B	**3**	**--**	**-**	**3**

Course Pre-Requisite: Thermodynamics, Fluid Mechanics, Heat Transfer, Mechanical Design

Course Description:

This course provides a comprehensive study of the design, analysis, and performance optimization of thermal turbo systems, including gas turbines, steam turbines, turbochargers, and jet engines. Emphasis is placed on thermodynamic cycle analysis, component-level performance (compressors, turbines, combustion chambers, and nozzles), and system integration for various applications such as aerospace, power generation, and automotive industries.

Course Objectives:

1. Recognize typical designs of turbo machines and Explain the working principles of turbomachines and apply it to various types of machines.
2. Determine the velocity triangles in turbomachinery stages operating at design and off-design conditions.
3. Perform the preliminary design of turbomachines (Fans compressors) on a 1-D basis.
4. Use design parameters for characterizing turbomachinery stages and determine the off-design behavior of turbines and compressors and relate it to changes in the velocity triangles • Explain and understand how the flow varies downstream of a turbomachinery blade row.
5. Recognize relations between choices made early in the turbomachinery design process and the final components and operability.
6. Explain the limits of safe operation of compressors.

CO	After the completion of the course the student should be able to
CO1	Describe types and working principles of turbomachines.
CO2	Explain fluid dynamic principles and flow through turbomachines.
CO3	Apply dimensional analysis and performance relations to turbomachines.
CO4	Analyze the design and performance of axial and centrifugal compressors.
CO5	Evaluate performance of axial fans and propellers for industrial applications

Course Outcomes:

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	-	-	2	-	-	-	-	-	1
CO3	3	3	2	2	3	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	2
CO5	3	2	3	2	3	2	-	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Introduction to Turbomachines:** Turbines Pumps and Compressors Fans and Blowers Compressible Flow Machines Incompressible Flow Machines Turbine, Compressor and Fan Stages Extended Turbomachines Axial Stages Radial Stages Mixed Flow Stages Impulse Stages Reaction Stages Variable Reaction Stages Multistage Machines Stage Velocity Triangles Design Conditions Off-design Conditions Applications	**08**
2.	**Fluid Dynamic Principles:** Equations of Motion (in Cartesian, Cylindrical and Natural Coordinate system) Further notes on Energy Equation, Isentropic Flow through Blade passages, High speed flows, Aero foil Blades.	**08**
3.	**Dimensional Analysis and Performance Parameters**: Units and Dimensions, Buckingham's Pi theorem, Principle of similarity, Incompressible flow machines, Compressible flow machines, Performance of Compressors, Fans and Blowers.	**08**
4.	**Compressor:** Axial and Centrifugal compressor, Elements of centrifugal compressor stage, stage velocity triangles, Enthalpy – Entropy diagram, Stage losses and Efficiency, Performance characteristics	**08**

5.	**Axial Fans and Propellers:** Fan Applications, Axial fans, Fan stage parameters, types of Axial fan stages, Propellers, Performance of Axial Fans.	**08**

Text Book			
Sr.no.	**Title**	**Author**	**Publisher**
1.	Turbines, Compressors and Fans	S M Yahya	McGraw Hill Publication
2.	Principles of Turbomachinery	Shepherd, D.G	Macmillan
Reference Books			
Sr.no.	**Title**	**Author**	**Publisher**
1.	Fans	J Bruneck	Pergamom Press
2.	Handbook of Turbomachinery	Earl Logan, Jr	Marcel Dekker Inc
3.	Fluid Mechanics and Thermodynamics of Turbomachinery	Dixon, S.I	Pergamon Press

Title of the Course: Gas Turbines Course Code: 25MHP1104C	L	T	P	Credit
	3	-	-	3

Course Pre-Requisite: Thermodynamics, Fluid Mechanics

Course Description:

This course offers an in-depth exploration of gas turbine engines, covering their thermodynamic principles, design considerations, and performance characteristics. It focuses on the application of gas turbines in aerospace propulsion, power generation, and industrial processes. Students will study the ideal and real thermodynamic cycles, component-level analysis (compressors, combustion chambers, turbines, and nozzles), and the integration of these components into efficient and high-performance systems.

Course Objectives:

1. To enable the students to analyze and solve gas turbine related problems by applying principles of mathematics, science and engineering.
2. To prepare students to use modern tools, techniques and skills to fulfill industrial needs related to gas turbine systems.
3. To train students with effective communication skills to demonstrate gas turbine theories.
4. To develop skills in the analysis of gas turbine systems in research or design.
5. Recognize relations between choices made early in the turbomachinery design process and the final components and operability.
6. To develop a professional approach to lifelong learning in the gas turbine to include the awareness of social and environment issues associated with engineering practices.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the role of key components such as the compressor, combustor, and turbine in a gas turbine engine.
CO2	Apply knowledge of mathematics, science, and engineering for designing gas turbine systems.
CO3	Analyze different gas turbine systems and their characteristics.
CO4	Evaluate the performance of gas turbine systems under various operating conditions.
CO5	Design the configuration and operation of axial and centrifugal compressors in turbomachinery applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	3	-	2	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	3	-	-	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Gas Turbine Plant:** Historical review. Thermodynamic analysis of practical gas turbine cycles. The turboprop engine. The compressor, combustor, turbine and exhaust nozzle characteristics. Performance characteristics of the stationary and turboprop and turbojet engine. The turbojet engine components. Specific thrust and overall efficiency. Static and flight performance at the design point. Fundamentals of rotating machines. Impulse and reaction machines. The centrifugal compressor: Works done and pressure rise. Design of centrifugal compressor, surge & stall.	**08**
2.	**Centrifugal Compressors:** Principal of operation, work done and pressure rise. Vane-less space, slip factor, power input factor and Mach number at intake to impeller	**08**
3.	**Axial Flow Compressor:** Principle of operation, velocity triangles. Design procedure for single and multistage compressors. Three dimensional effect compressor performance. Description and problems of transonic and supersonic compressors.	**08**
4.	**Combustion in Gas Turbine:** Problem to be faced in the design of gas turbine combustion systems. Fuel injection system. Combustion chamber designs. Pressure loss. Temperature distribution, Reaction time, Flame stabilization.	**08**

5.	**Turbine Characteristics:** Off design performance of gas turbine plant, matching of the engine components, equilibrium running diagram. Specific thrust and specific fuel consumption in such cases for stationary turbojet and turboprop units.	**08**

Text Book			
Sr.no.	Title	Author	Publisher
1.	Gas Turbine	V. Ganesan	Tata McGraw-Hill Education
Reference Books			
Sr.no.	Title	Author	Publisher
1.	Gas Turbine	Cohan, Rogers	Person
2.	Gas Turbine Engineering	Dr. Meherwan P. Boyce, P.E	CRC press
3.	Handbook of Turbomachinery	Earl Logan	CRC press
Useful Links			
https://nptel.ac.in/courses/112/103/112103262			

Title of the Course: **Design of Hydro Turbo machines** **Course Code: 25MHP1105A**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite:
Preliminary knowledge of **Fluid Mechanics**, **Engineering Thermodynamics**, and **Machine Design**

Course Description:
This course introduces the fundamental principles and advanced design concepts of **hydrodynamic machines**, including both **pumps and turbines**. It covers the classification, theory, and performance of impulse and reaction turbines, centrifugal and axial flow pumps, and cavitation phenomena. Detailed procedures for the **hydraulic and mechanical design** of pump impellers, volutes, diffusers, turbine runners, and guide vanes are presented. Emphasis is placed on velocity triangles, blade geometry on various flow surfaces, and practical design guidelines for **Francis** and **Kaplan turbines**, as well as mixed and axial flow pumps.

Course Objectives:
1. To enable the students to analyze and solve hydrodynamic machine related problems by applying principles of mathematics, science and engineering.
2. To prepare students to handle various strategic issues related to hydrodynamic machines such as turbines, pumps etc.
3. To train students with effective communication skills to demonstrate hydrodynamic theories.
4. To develop skills in designing the hydrodynamic machine component.
5. To develop a professional approach to lifelong learning in the hydrodynamic machine to include the awareness of social and environment issues associated with engineering practices..

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	**Describe** different types of hydrodynamic machines and their components.
CO2	**Apply** knowledge of mathematics, science, and engineering to design hydrodynamic machines.
CO3	**Carry** out analysis and interpret the performance of turbines and pumps using appropriate techniques.
CO4	**Evaluate** the performance of hydrodynamic machines and justify design choices.
CO5	**Design** blade geometries and flow surfaces for centrifugal and axial flow machines using appropriate velocity and flow analysis.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	3	-	2	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	3	-	-	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Introduction to Hydrodynamic Machines** Classification of turbines and various forms of turbine runners, Impulse turbines; general theory of impulse machines; performance characteristics, Reaction turbines; general theory of reaction machines; performance characteristics, types; Francis and Kaplan turbines; theory of cavitation flows in hydrodynamic runners. Hydrodynamic pumps; classification of pumps and various forms of pump impellers; general theory of centrifugal pumps; performance characteristics	**08**
2.	**Design of centrifugal pumps** selection of speed, determination of impeller inlet and outlet dimensions, meridional geometry inlet and exit blade angles, blade geometry, mixed flow pumps, elementary pump, design of twisted blade, design of volute, vane diffuser and return passage, suction spiral.	**08**
3.	**Axial Flow Pump Design and Analysis** Axial flow pumps, selection of speed, pump casing geometry hub diameter, number of blades and cascade solidity, selection of blade geometry on different flow surfaces, diffuser design.	**08**
4.	**Hydraulic Design of Reaction Turbines (Francis & Kaplan)** Introduction to hydraulic turbine design, Type series and diameter series, selection of type and diameter, Reaction turbine runner spaces, meridional velocity field, elementary turbines, Hydraulic design of Francis turbine, Choice of basic parameters, Inlet and Outlet edges of runner blade, blade profiles on flow surfaces, shape of blade duct-velocity diagrams on different flow surfaces, certain guide lines to finalize the runner design, Guide wheel, Vane geometry and torque on controlling mechanism, Discharge and circulation, spiral, speed ring, draft tube.	**08**

5.	**Hydraulic Design of Axial Flow Turbine Runners** Hydraulic design of axial turbine runners, characteristics of some aero foils, meridional flow field, blade geometry on each flow surface, procedure to finalize the runner design.	**08**

Text Book:			
Sr.no	**Title**	**Author**	**Publisher**
1	Hydraulic Turbine their Design and Equipment's	Nechleba M.	Constable & Co., 1957
2	Impeller Pumps	Lazarkieniz & Troskolanrkis	Pergamon Press, 1st edition, 1965
3	Hydraulic Engineering	Robinson J.A.	Jaico Publishing House, Bombay, 2nd Edition, 1998

Reference Books:			
Sr.no.	**Title**	**Author**	**Publisher**
1	Design and Performance of Centrifugal & Axial flow pumps & Compressors	Andre Kovats	Pergamon, 1st edition, 1964
2	Centrifugal & Axial Flow Pumps	Stapanoff, A.J.	John Wiley, Rev ed, 1993
3	Hydroelectric Engineering Practice, Vol-I & II	Editor Brown, J.G.	1st edition, 1958

Useful Links:	
1.	https://nptel.ac.in/courses/112/105/112105206/

Title of the Course: Air-Conditioning System Design Course Code: 25MHP1105B	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite: Preliminary knowledge of **Thermodynamics**, **Heat Transfer**, and **Fluid Mechanics**

Course Description:

This course focuses on the principles and applications of air conditioning systems with an emphasis on psychrometrics, load estimation, and air distribution. It covers moist air properties, psychrometric processes, use of charts and tables, SHF, RSHF, ERSHF, and system analysis for summer and winter air conditioning. Students will learn heating and cooling load calculations, including internal, solar, and infiltration loads.

Course Objectives:

1. To enable the students to analyze and solve air conditioning related problems by applying principles of mathematics, science and engineering.
2. To prepare students to use modern tools, techniques and skills to fulfil industrial needs related to low temperature systems.
3. To train students with effective communication skills to demonstrate air conditioning theories.
4. To develop skills in the analysis of air conditioning systems in research or design.
5. To develop a professional approach to lifelong learning in the air conditioning to include the awareness of social and environment issues associated with engineering practices

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	**Describe** the principles behind psychrometrics and how they influence air-conditioning system design.
CO2	**Apply** knowledge of mathematics, science, and engineering for solving air-conditioning system problems.
CO3	**Analyze** different air-conditioning systems and their performance characteristics.
CO4	**Evaluate** the performance of air-conditioning systems and interpret technical reports effectively.
CO5	**Design** air distribution and handling systems considering system balancing, thermal insulation, and equipment selection.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	3	-	2	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	3	-	-	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Psychometric.** Moist Air properties, use of Psychometric Chart, Various Psychometrics processes, Air Washer, Adiabatic Saturation. Fundamental properties of air and water vapor mixtures. - Definitions, equations and explanations, psychometric table and charts, Enthalpy deviation curve, psychometric processes and their analysis, SHF, effective surface temperature and bypass factor. Air quality required. Analysis of combination of processes psychometric system. Load Analysis: Inside design conditions, outside design conditions, sensible heat load and latent heat loads, heat gains from infiltration ventilation, solar radiation from walls, occupants and other sources. Heating load, Load estimation chart.	**08**
2.	**Summer and Winter Air Conditioning** Air conditioning processes-RSHF, summer Air conditioning, Winter Air conditioning, Applications with specified ventilation air quantity- Use of ERSHF, Application with low latent heat loads and high latent heat loads, performance and selection.	**08**
3.	**Heating & Cooling Load Calculations** Introduction, Health & comfort criteria, thermal comfort, air quality, estimating heat loss & heat gain, design conditions, thermal transmission, infiltration & ventilation loads, components of cooling load, internal loads, solar load through transparent surfaces, opaque surfaces, problems. Selection of components and system performance.	**08**
4.	**Air Distribution** Flow through Ducts, Static & Dynamic Losses, Air outlets, Duct Design–Equal Friction Method, Duct Balancing, Indoor Air Quality, Thermal Insulation, Fans & Duct System Characteristics, Fan Arrangement Variable Air Volume systems, Air Handling Units and Fan Coil units.Guide wheel, Vane geometry and torque on controlling mechanism, Discharge and circulation, spiral, speed ring, draft tube.	**08**

5.	**Air Handling Equipment's** Fans, air conditioning apparatus, unitary equipment, accessory equipment, Classification – all air- system, air water system, heat recovery system, radiation panel system, heat pump, air washers. noise control.	**08**

Text Book

Sr.no.	Title	Author	Publisher
1	Refrigeration & Air Conditioning	Manohar Prasad	New Age Publishers
2	Refrigeration & Air Conditioning	Stocker	McGraw Hill, 1992
3	Refrigeration & Air Conditioning	Arora C.P.	Tata McGraw Hill, 1985
4	Refrigeration and Air-conditioning	ARI	Prentice Hall, New Delhi, 1993
5	Design of Thermal Systems	Stocker	McGraw Hill, 1992

Reference Books

Sr.no.	Title	Author	Publisher
1	Handbook of Air-Conditioning System Design	Carrier Incorporation	McGraw Hill Book Co., U.S.A, 1965
2	ASHRAE Handbook: HVAC Systems and Equipment	—	ASHRAE, 1996
3	Control Systems for Heating, Ventilation and Air-Conditioning	Hainer R.W.	Van Nostrand
4	Modern Air Conditioning	Norman C. Harris	McGraw-Hill, New York, 1974
5	Air Conditioning Engineering	Jones W.P.	Edward Arnold Publishers Ltd., London, 1984

Useful Links:

1	https://youtu.be/e2IryaMQQ6A
2	https://youtu.be/YUgN5D-bmpg
3	https://youtu.be/Dj8ATzgrxyA
4	https://youtu.be/nvUhiXD63Eg

Title of the Course: Design of Solar and Wind System Course Code: 25MHP1105C	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite: Preliminary knowledge of **Thermodynamics**, **Fluid Mechanics**, and **Heat Transfer**

Course Description:

This course provides a comprehensive overview of renewable energy sources with a primary focus on solar thermal and wind energy systems. It explores the global and Indian energy scenario, various solar thermal applications, solar collectors, and performance analysis techniques. The course also delves into the fundamentals of wind energy, wind turbine theory, and the design and classification of wind machines. Emphasis is placed on practical applications, performance evaluation, and the potential of these technologies in the Indian context.

Course Objectives:

1. To develop a comprehensive technological understanding in solar PV system components
2. To provide in-depth understanding of design parameters to help design and simulate the performance of a solar PV power plant
3. Learn principles and operational features of wind machines, wind data performance

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	**Explain** the basics of solar energy conversion systems.
CO2	**Apply** knowledge of solar irradiance and site assessment techniques to determine the feasibility of solar PV installations.
CO3	**Analyze** a standalone photovoltaic (PV) system for performance and component selection.
CO4	**Evaluate** different wind energy conversion systems, their characteristics, and feasibility in Indian energy context.
CO5	**Design** and compare thermal and electrical solar collector systems for various energy applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	3	2	2	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	3	2	-	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Introduction to Global and Indian Energy Scenario** Energy scenario, Man and energy, World's production of commercial energy sources, India's production and reserves, Energy alternatives, The solar energy option	**08**
2.	**Solar Thermal Energy Applications** Thermal applications, Water heating, Space heating, Space cooling and refrigeration, Power generation, Distillation, Drying and Cooking, Concentrating collector, Central receiver system	**08**
3.	**Solar Collectors and Performance Analysis** Liquid flat plate collector, Performance analysis, Collection efficiency factor, Selective surfaces, Evacuated tube collector, BNL, Polymer and concrete collector, Solar air collector, types, performance analysis, Air heater with fins,	**08**
4.	**Wind Energy Fundamentals** Wind energy fundamentals and applications, Merits, Limitations, Nature and origin of wind, Wind turbine theory, Power of wind turbine for given incoming wind velocity Vi, Wind to electric energy conversion system	**08**
5.	**Wind Machines and Energy Utilization** Classification and development of wind machines, Multi bladed type, Propeller type, wind machines, Wind data performance calculation, Concluding remarks, prospects of wind energy for India	**08**

Text Book			
Sr.no.	**Title**	**Author**	**Publisher**
1	Energy Technology – Nonconventional, Renewable & Conventional	S. Rao, Dr. B. B. Parulekar	Khanna Publishers
2	Solar Energy	S. P. Sukhatme and J. K. Nayak	McGraw Hill Education
3	Solar Power Engineering	B. S. Mangal	Tata McGraw Hill, New Delhi, 1990
4	Wind Turbine Technology, Fundamentals of Concept in Wind Turbine Engg.	Spera D. A. (1994)	ASME eBook

Reference Books			
Sr.no.	**Title**	**Author**	**Publisher**
1	Principles of Energy Conversion	Culp, Archie W.	McGraw Hill Book Company
2	Active Solar Collectors and Their Applications	Rabl, A. (1985)	Oxford University Press
3	Solar Engineering of Thermal Processes	John A. Duffie, W. A. Beckman	John Wiley and Sons Inc
4	Wind Energy Systems	Gary L. Johnson	Prentice Hall, New Jersey
5	Wind Energy Fundamentals, Resource Analysis and Economics	Sathyajith Mathew	Springer Verlag, Berlin
6	Electric Energy from Winds	Kloeffler R.G., Sitz E.L. (1946)	Kansas State College of Engg., Manhattan, Kans

Useful Links:	
1	https://nptel.ac.in/courses/103/103/103103206/

SEMESTER – II SYLLABUS

Title of the Course: Steam Engineering Course Code: 25MHP1201	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite:

Basic knowledge of Thermodynamics, Fluid Mechanics, and Heat Transfer is required. Familiarity with engineering physics and mechanical systems is recommended for effective understanding.

Course Description:

This course introduces the fundamentals of steam generation, properties of steam, and its applications in power and process industries. Topics include boiler types and operations, steam turbines, heat transfer, condensate systems, and safety practices. Emphasis is placed on energy efficiency, maintenance, and system design. Suitable for mechanical and thermal engineering students.

Course Objectives:

1. To analyze different types of steam cycles and estimate efficiencies in a steam power plant.
2. To design pipe insulation through proper selection of materials with the help of basic heat transfer theory.
3. To access boiler performance for different loading conditions.
4. To develop a professional approach for lifelong learning in steam engineering to include the awareness of social and environmental issues associated with engineering practices

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain working of different boilers and significance of mountings and accessories, and use modern tools for boiler performance assessment.
CO2	Calculate the efficiency of steam cycles using thermodynamic equations.
CO3	Analyze a thermal system for different sources of waste heat.
CO4	Suggest suitable controls and instrumentation for effective process monitoring and energy efficiency improvement.
CO5	Design and assess insulation, refractory systems, and steam piping layout for energy savings and safety compliance.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011
CO1	3	2	-	2	3	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	2
CO3	3	3	2	3	2	2	-	-	-	-	2
CO4	3	3	3	2	3	2	2	-	-	-	2
CO5	3	3	3	2	3	2	2	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
MSE	30
CA2	10
ESE	50

CA1 and **CA2** are based on Assignment/ Declared test/ Quiz/Seminar/Group discussions presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Introduction** Fundamentals of steam generation, Quality of steam, Use of steam table, Mollier Chart Boilers, Types, Mountings and Accessories, Combustion in boilers, Determination of adiabatic flame temperature, quantity of flue gases, Feed Water and its quality, Blow down; IBR, Boiler standards.	**08**
2.	**Piping & Insulation** Water Line, Steam line design and insulation; Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria, Refractory-types, selection and application of refractory, Heat loss.	**08**
3.	**Steam Systems** Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system, Steam Engineering Practices; Steam Based Equipment's Systems.	**08**
4	**Boiler Performance Assessment** Performance Test codes and procedure, Boiler Efficiency, Analysis of losses; performance evaluation of accessories; factors affecting boiler performance	**08**
5	**Energy Conservation and Waste Minimization** Energy conservation options in Boiler; waste minimization, methodology; economic viability of waste minimization.	**08**

Text Books			
Sr.No	**Title**	**Author**	**Publisher**
1	Applied Thermodynamics	T. D. Estop, A. Mc Conkey	Parson Publication.
2	A Course in Power Plant Engineering	Domkundwar	Dhanapat Rai and Sons.
3	Engineering Thermodynamics	Yunus A. Cengel and Boles	Tata McGraw-Hill Publishing Co. Ltd.

Reference Books			
Sr.No	**Title**	**Author**	**Publisher**
1	Boiler Operation Engineering	P. Chattopadhyay	Tata McGraw Hill Education Pvt. Ltd, N Delhi
2	Steam: Its Generation and Use	Edited by J. B. Kitto & S C Stultz	The Babcock and Wilcox Company.

Title of the Course: Computational Techniques in Fluid Flow and Heat Transfer Course Code: 25MHP1202	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite:

Basic knowledge of fluid mechanics, heat transfer, and engineering mathematics (especially differential equations and linear algebra). Familiarity with numerical methods and basic programming skills is also recommended.

Course Description:

This course introduces numerical methods for solving fluid flow and heat transfer problems. It covers discretization techniques such as finite difference, finite volume, and finite element methods. Students learn to solve governing equations (Navier–Stokes, energy equation) using algorithms like SIMPLE and MAC. Emphasis is placed on stability, convergence, and implementation using computational tools to simulate real-world thermal-fluid systems.

Course Objectives:

1. Enable the students to analyse and solve fluid related problems by applying principles of mathematics, science and engineering.
2. Prepare students to use modern tools, techniques and skills to fulfill industrial needs related to computational techniques in fluid flow and heat transfer.
3. Train students with effective communication skill to demonstrate computational theories.
4. Develop skills in the analysis of fluid systems with mathematical modeling for applications of computers in research or design
5. Develop a professional approach to lifelong learning in the numerical analysis to include the awareness of social and environment issues associated with engineering practices

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain prediction methods, partial differential equations (PDEs), and numerical methods used in fluid and heat transfer simulations.
CO2	Apply Finite Difference Method (FDM) and Finite Volume Method (FVM) to solve fluid and thermal engineering problems.
CO3	Analyze boundary conditions, solution schemes, and numerical stability considerations for fluid flow and heat transfer simulations.
CO4	Compare FVM with alternative numerical methods (e.g., LBM) in terms of accuracy, stability, and computational cost.
CO5	Design a basic CFD simulation using SIMPLE, QUICK or ADI schemes and validate with grid refinement and stability analysis.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011
CO1	3	2	-	2	2	-	-	-	-	-	2
CO2	3	3	3	2	3	-	-	-	-	-	3
CO3	3	3	2	3	3	-	-	-	-	-	3
CO4	3	3	3	3	3	2	-	-	-	-	3
CO5	3	3	3	3	3	-	-	-	-	-	3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
MSE	30
CA2	10
ESE	50

CA1 and **CA2** are based on Assignment/ Declared test/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents

Unit No.	Unit Title and Contents	Hours
1	**Comparison of experimental, theoretical and numerical approaches:** Partial differential equations - Physical and mathematical classification - Parabolic, Elliptical and Hyperbolic equations. Computational economy, Numerical stability, Selection of numerical methods, validation of numerical results: Numerical error and accuracy – Round off error, accuracy of numerical results – Iterative convergence – Condition for convergence, Rate of convergence, under-relaxation and over relaxation, Termination of iteration: Tridiagonal Matrix algorithm	**08**
2.	**Finite Difference method:** Discretization – Converting Derivatives to discrete Algebraic Expressions, Taylor's series approach, polynomial fitting approach, Discretization error.	**08**

3.	**Heat conduction** Steady one-dimensional conduction in Cartesian and cylindrical co- ordinates, handling of boundary conditions: Two dimensional steady state conduction problems in Cartesian and cylindrical co-ordinates – point by point and line by line method of Solution: Dealing of Dirichlet, Neumann and Robbins type boundary conditions- Formation of discretized equations for regular boundaries, irregular boundaries and interfaces.	**08**
4	**One dimensional, two dimensional and three dimensional transient heat conduction problems in Cartesian and cylindrical co-ordinates:** Explicit, Implicit, Crank Nicholson and ADI methods- stability of each system Conservation form and conservative property of partial differential equations and finite difference equations- Consistency, stability and convergence for marching problems Discrete perturbation stability analysis - Fourier or Von Neumann stability analysis.	**08**
5	**Finite volume method 1:** Discretization of governing equations - Diffusion and convection-diffusion problems steady one-dimensional convection and diffusion, upwind, hybrid and power-law schemes: **Finite volume method 2:** Discretization equation for two-dimensions: False diffusion, calculation for the Flow Field- Stream function- vortices approach, SIMPLE, SIMPLER, SIMPLEC and QUICK Algorithms. Numerical Marching Techniques. Two dimensional parabolic flows with heat; Grid generation methods, Adaptive grids	**08**

Text Books:

Sr.No	Title	Author	Publisher
1	Numerical Fluid Flow & Heat transfer	S.V. Patankar	Hemisphere Publishing Corp., 1980.
2	Computational Fluid Flow and Heat Transfer	T. Sundernajan, K. Muralidhar	Narosa, 2nd edition, Reprint 2011.

Reference Books:

Sr.No	Title	Author	Publisher
1	An Introduction to Computational Fluid Dynamics	H. K. Versteeg and W. Malalasekera	Longman Scientific and Technical, 1st edition, 1995
2	Computational Fluid Dynamics	Hoffman Klaus	Vol-1 & 2, A Publication of Engineering Education System, Wichita Kansas, USA, 2000

Title of the Course: Internal Combustion Engine Design Course Code: 25MHP1203	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite: Thermodynamics, Heat Transfer

Course Description:

This course focuses on the design principles of internal combustion engines, covering thermodynamic cycles, performance parameters, combustion analysis, and mechanical design of key components such as the piston, crankshaft, and valve mechanism. Emphasis is placed on efficiency, emissions, and recent advancements in engine technology

Course Objectives:

1. To prepare students to use modern tools, techniques and skills to fulfill industrial needs related I.C. Engine systems.
2. To train students with effective communication skill to demonstrate I.C. Engine theories.
3. To develop skills in the analysis of I.C. Engine systems in research or design.
4. To develop a professional approach to lifelong learning in the I.C. Engine to include the awareness of social and environment issues associated with engineering practices

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the thermodynamic cycles used in internal combustion engines.
CO2	Apply the knowledge of mathematics, science, and engineering for solving internal combustion engine design problems.
CO3	Analyze the IC engine systems and interpret their design calculations and simulation results.
CO4	Evaluate the performance of I.C. engines under various operating conditions and interpret technical reports.
CO5	Design components of I.C. engines like piston, cylinder, crankshaft, injection and cooling systems considering mechanical and thermal loads.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	P011
CO1	3	2	-	-	1	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	-	2
CO3	3	3	2	3	3	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	3	2	-	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
MSE	30
CA2	10
ESE	50

CA1 and **CA2** are based on Assignment/ Declared test/ Quiz/Seminar/Group discussions presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Introduction to Engine Design** Engine selection, basic data for design like power torque, speed, mean effective pressure, air consumption, fuel consumption, stroke to bore ratio, heat distribution, exhaust temperature, power to weight ratio	**08**
2.	**Design Considerations** Combustion chamber design considerations for S.I. and C.I. engines. Thermal and Mechanical design of cylinder, piston, piston rings, cylinder head, valves, Mechanical design of connecting rod, crankshaft and crank case.	**08**
3.	**Simulation of I.C. Engine Processes** Simulation, S.I. Engine simulation with air as working medium, simulation with adiabatic combustion. Definitions of progressive combustion model, gas exchange process model and heat transfer process model	**08**
4	**Carburetion and Injection:** Carburetion Mixture characteristics, distribution, Carburetor systems, Carburetor and stratified charge engines, S.I. Engine fuel injection system and type, Modern Carburetor designs and air Pollution control, altitude compensation. **Injection Systems:** Design, Bosch distribution pump, Cummins- P-T injection system, Spray characteristics, quantity of fuel per cycle, types of nozzles, injection timing, fuel line hydraulics	**08**
5	**Cooling System:** Design, Heat transfer in I.C. engines, piston and cylinder temperatures, heat rejected to coolant, comparison of air and water cooling, temperature distribution for air- and water-cooled engine across the cylinder wall, **Ignition System:** Requirements, battery ignition, magneto ignition and electronic ignition systems, centrifugal and vacuum advance; spark plug types and selection, firing order and its importance.	**08**

Text Books:			
Sr. No.	**Title**	**Author**	**Publisher**
1	I. C Engine Fundamentals	J. B. Heywood	Tata McGraw Hill Pub.1st edition 1998..
2	Internal Combustion Engines	V. Ganesan	Tata McGraw Hill Book Co, Eighth Reprint, 2005.

Reference Books:			
Sr. No.	**Title**	**Author**	**Publisher**
1	Internal Combustion Engines and Air Pollution	F. Obert	In-text Educational Publishers, 1st edition 1973.
2	Internal Combustion Engines	Colin Fergusson, Allan Kirkpatrick	Wiley Publication.
3	High Speed Combustion Engines	P. M. Heldt	Chilton company 4th edition 1956.

Title of the Course: Steam Engineering and I.C. Engine Laboratory Course Code: 25MHP1201L	L	T	P	Credit
	-	--	2	1

Course Pre-Requisite:

Engineering Thermodynamics, Heat Transfer, Fluid Mechanics, Basic knowledge of Power Cycles

Course Description:

This lab offers hands-on experience in steam engineering and I.C. engine systems. Students perform experiments on steam generators, condensers, cooling towers, diesel engines, and variable compression engines to study energy conversion, performance, and efficiency.

Course Objectives:

1. To study the working and performance of steam generators and their mountings and accessories.
2. To evaluate the quality of steam and conduct energy analysis of steam power plants.
3. To understand condenser performance and cooling tower characteristics.
4. To perform performance tests on diesel engines and analyze their efficiency.
5. To gain practical exposure to computer-controlled and variable compression ratio I.C. engines.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Demonstrate working principles of steam generators, condensers, and cooling towers.
CO2	Analyze the quality of steam and evaluate energy performance of steam power plant components.
CO3	Conduct performance tests on diesel engines, computer-controlled I.C. engines, and VCR engines.
CO4	Interpret experimental data to assess efficiency and operational characteristics of steam and I.C. engine systems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2										1
CO2	3	3		2	2							2
CO3	2	3	3	2	2							2
CO4	2	3	2	3	2							3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), having 25% weightage for each component respectively and 50% weightage is for POE.

Assessment Component	Marks
CA1	25
CA2	25
POE	50
ESE	-

CA1 POE based on 50% of course content, attendance, lab overall performance.
CA2 POE based on 100% of course content, attendance, lab overall performance.

Course Contents

Unit No.	Course Contents	Hours
1.	Steam Generators	**02**
2.	Mounting and accessories	**02**
3.	Quality of Steam	**02**
4.	Energy Analysis of Steam Power Plant	**02**
5.	Condenser Analysis	**02**
6.	Cooling Tower	**02**
7.	Performance test on diesel engine	**02**
8.	Test on Computer controlled I.C. engine	**02**
9.	Test on variable compression ratio I.C. engine	**02**

Text Book:			
Sr.no	Title	Author	Publisher
1	Applied Thermodynamics	T. D. Eastop, A. McConkey	Parson Publication
2	A Course in Power Plant Engineering	Domkundwar	Dhanpat Rai and Sons

Reference Books:			
1	Applied Thermodynamics	T. D. Eastop, A. McConkey	Parson Publication
2	A Course in Power Plant Engineering	Domkundwar	Dhanpat Rai and Sons
3	Energy Performance Assessment for Equipment & Utility Systems	Bureau of Energy Efficiency	Bureau of Energy Efficiency
4	Boiler Operation Engineering: Questions and Answers	P. Chattopadhyay	Tata McGraw Hill Education Pvt. Ltd., N. Delhi

Useful Links:	
1.	https://nptel.ac.in/courses/112/107/112107216/

Title of the Course: CFD Laboratory Course Code: 25MHP1202L	L	T	P	Credit
	-	--	2	1

Course Pre-Requisite:

Knowledge of Engineering Thermodynamics, Heat and Mass Transfer, Fluid Mechanics, and Basic Numerical Methods.

Course Description:

This course offers a comprehensive understanding of steam power plant operations. It covers the design and functioning of steam generators, boiler mountings and accessories, and assessment of steam quality. It also includes energy analysis of steam power systems, condenser and cooling tower performance, and an introduction to numerical and computational methods for analyzing fluid flow and heat transfer in thermal systems. The course integrates both theoretical and applied perspectives essential for modern power engineering.

Course Objectives:

1. To Provide an overview of Computational Fluid Dynamics (CFD) principles, applications, and software.
2. To Learn to navigate user interfaces, set boundary conditions, and define simulation parameters.
3. To Understand the governing equations (Navier-Stokes, continuity, and energy equations) used in CFD simulations.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Describe the role and importance of turbulence modeling in simulating turbulent flows using various turbulence models.
CO2	Apply CFD software tools proficiently to set up and solve basic fluid flow problems
CO3	Analyze CFD simulation results to interpret flow characteristics, such as velocity profiles, pressure distribution, and turbulence intensity..
CO4	Assess the limitations and assumptions associated with CFD simulations in modeling complex flow phenomena.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1		1				2			3
CO2	2			2	2				2			3
CO3	3	2	3		2				2			3
CO4	3	2	1		2				1			3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), having 50% weightage for each component respectively.

Assessment Component	Marks
CA1	25
CA2	25
MSE	-
ESE	-

CA1 POE based on 50% of course content, attendance, lab overall performance.
CA2 POE based on 100% of course content, attendance, lab overall performance.

Course Contents

Unit No.	Course Contents	Hours
1.	Flow Through a Pipe	**02**
2.	Heat Transfer in a Heat Exchanger	**02**
3.	Flow Over an Airfoil	**02**
4.	Mixing and Stirring in a Stirred Tank Reactor	**02**

Text Book:

Sr.no	Title	Author	Publisher
1	Applied Thermodynamics	T. D. Eastop, A. McConkey	Parson Publication
2	A Course in Power Plant Engineering	Domkundwar	Dhanpat Rai and Sons
3	Energy Performance Assessment for Equipment & Utility Systems	Bureau of Energy Efficiency	Bureau of Energy Efficiency
4	Boiler Operation Engineering: Questions and Answers	P. Chattopadhyay	Tata McGraw Hill Education Pvt. Ltd., New Delhi
5	Numerical Fluid Flow & Heat Transfer	S. V. Patankar	Hemisphere Publishing Corp., 1980
6	Computational Fluid Flow and Heat Transfer	T. Sundararajan, K. Muralidhar	Narosa Publishing House, 2nd Ed., Reprint 2011

Reference Books :

Sr.no	Title	Author	Publisher
1	Applied Thermodynamics	T. D. Eastop, A. McConkey	Parson Publication
2	A Course in Power Plant Engineering	Domkundwar	Dhanpat Rai and Sons
3	Energy Performance Assessment for Equipment & Utility Systems	Bureau of Energy Efficiency	Bureau of Energy Efficiency
4	Boiler Operation Engineering: Questions and Answers	P. Chattopadhyay	Tata McGraw Hill Education Pvt. Ltd., New Delhi

Useful Links

1.	https://nptel.ac.in/courses/112/104/112104302/

Title of the Course: Seminar Course Code: 25MHP1204	L	T	P	Credit
	-	--	2	1

Course Pre-Requisite: Nil

Course Description:

This seminar explores advanced thermal systems with a focus on steam power plants, energy performance assessment, and computational techniques like CFD. It includes the study of key components, efficiency analysis, and application of numerical methods. Emphasis is placed on current research from reputed journals and conferences to support innovation and practical understanding.

Course Objectives:

1. To review and increase student's understanding of the specific topics.
2. To induce Learning management of values.
3. To teach how research papers are written and read such papers critically and efficiently and to summarize and review them to gain an understanding of a new field, in the absence of a textbook.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Identify and utilize credible sources of information, including academic journals, books, and databases..
CO2	Apply the existing knowledge on real life problems
CO3	Investigate the selected topic/ system
CO4	Verify the outcomes of the work have solved the specified problems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1		2				2			3
CO2	2		2		2				3			3
CO3	3	1	3		2				2			3
CO4	3	2	1		2				1			3

Assessment Scheme:

Two components of Continuous Assessment (CA1, CA2), having 25% weightage for each component respectively and 50% weightage is for POE.

Assessment Component	Marks
CA1	25
CA2	25
OE	50
ESE	-

CA1 POE based on 50% of course content, attendance, lab overall performance.
CA2 POE based on 100% of course content, attendance, lab overall performance.

Course Contents

Unit No.	Course Contents	Hours
1.	The seminar work should preferably be a problem with research potential, involve scientific research review, design, generation, collection, and analysis of data, determine a solution, and preferably bring out the individual contribution. The seminar should be based, preferably, on the area in which the candidate is interested to undertaking the dissertation work. The candidate has to be in regular contact with their guide, and the topic of the seminar must be mutually decided. The examination shall consist of the preparation of a report consisting of a literature review, a detailed problem statement, case studies, etc., according to the type of work carried out. The work has to be presented in front of the examiner panel formed by department for evaluation.	**20**

Text Book:

Suitable books based on the contents of the seminar topic selected.

Reference Books:

Suitable books based on the contents of the seminar topic selected and research papers from reputed national and international journals and conferences.

Useful Links	
1.	As per the need of the seminar topic.

Title of the Course: **Design of Heat Exchangers** **Course Code: 25MHP1205A**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite: Fundamentals of heat transfer and fluid mechanics

Course Description:

This course provides an in-depth study of the principles and methods used in the design, analysis, and optimization of heat exchangers. Emphasis is placed on thermal and hydraulic design, performance evaluation, and practical applications across various industries including power generation, HVAC, chemical processing, and automotive systems.

Course Objectives:

1. Enable the students to analyze and solve heat exchanger problems by applying principles of mathematics, science and engineering.
2. Prepare students to use modern tools, techniques and skills to fulfill industrial needs related to design of heat exchanger.
3. Develop skills in the analysis of heat exchanger with mathematical modeling for applications in research or design.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the fundamental principles and types of heat exchangers.
CO2	Apply fundamental knowledge of mathematics, science, and engineering for the needs in heat exchanger designing.
CO3	Analyze the thermal and hydraulic design of different types of heat exchangers.
CO4	Evaluate the design and performance of various types of heat exchangers, including cooling towers and compact exchangers.
CO5	Design a shell-and-tube or compact heat exchanger system considering pressure drop, fouling, and flow arrangement.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	-	2
CO3	3	3	2	3	3	-	-	-	-	-	2
CO4	3	3	2	2	3	2	-	-	-	-	2
CO5	3	3	3	2	3	2	-	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Types of heat exchanger** Heat Exchangers – Classification according to transfer process, number of fluids, surface compactness, and construction features. Tubular heat exchanger, plate type heat exchangers, extended surface heat exchangers, heat pipe, Regenerators. Classification according to flow arrangement: counter flow, parallel flow, cross flow exchanger.	**08**
2.	**Heat exchanger design methodology** Assumption for heat transfer analysis, problem formulation, e-NTU method, P-NTU method, Mean temperature difference method, fouling of heat exchanger, effects of fouling, categories of fouling, fundamental processes of fouling.	**08**
3.	**Compact and Double Pipe Heat Exchangers** Thermal and Hydraulic design of compact heat exchanger. Thermal and Hydraulic design of inner tube, Thermal and hydraulic analysis of Annulus, Total pressure drop.	**08**
4.	**Direct-contact heat exchanger, cooling towers** Relation between the wet-bulb and dew point temperatures. The Lewis number, Classification of cooling towers cooling, tower internals and the role of fill, Heat exchange heat transfer by simultaneous diffusion and convection. Analysis of cooling towers measurements. Design of cooling towers, determination of the number of diffusion units.	**08**
5.	**Shell and Tube heat exchangers** Tinker's, kern's, and Bell Delaware's methods, for thermal and hydraulic design of Shell and Tube heat exchangers	**08**

Text Book:			
Sr.no.	Title	Author	Publisher
1.	Fundamentals of Heat Exchanger Design	Ramesh K. Shah and Dusan P. Sekulic	John Wiley and sons Inc.,

Reference Books:			
Sr.no.	Title	Author	Publisher
1.	Heat Exchangers: Selection, Rating and ThermalDesign	D.C. Kern ,	McGraw Hill
2.	Heat Exchangers: Selection, Rating and ThermalDesign	SadikKakac and Hongton Liu	CRC Press
3.	Heat Exchanger Design	A .P. Frass and M.N. Ozisik	McGraw Hill
4.	Heat Exchanger Design and Theory Source Book	Afgan N. and Schlinder E.V	", McGraw Hill

Useful Links
https://nptel.ac.in/courses/112/105/112105248/

Title of the Course: **Industrial Refrigeration** **Course Code: 25MHP1205B**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite:

Preliminary knowledge of **Thermodynamics**, **Heat Transfer**, and **Basic Refrigeration & Air Conditioning Systems**.

Course Description:

This course introduces the concepts and applications **of** industrial refrigeration distinct from comfort air-conditioning. It covers cold storage techniques for frozen and unfrozen food, food processing refrigeration, and advanced topics such as freeze drying. The thermodynamic principles behind Carnot and vapor compression cycles are analyzed using refrigerant properties. The course explores compressor types used in industrial systems, design and operation of evaporators**,** condensers**,** and circulation systems. Additionally, it includes the study of various refrigeration vessels such as flash tanks, separators, and surge drums, emphasizing their role in system efficiency and safety.

Course Objectives:

1. To enable the students to analyze and solve refrigeration related problems by applying principles of mathematics, science and engineering.
2. To prepare students to use modern tools, techniques and skills to fulfill industrial needs related to refrigeration systems.
3. To train students with effective communication skill to demonstrate refrigeration/theories.
4. To develop skills in the analysis of refrigeration systems in research or design.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Describe the basic types and components of industrial refrigeration systems.
CO2	Apply knowledge of mathematics, science, and engineering for the needs in refrigeration.
CO3	Analyze different industrial refrigeration systems and their characteristics.
CO4	Evaluate the performance of various industrial refrigeration systems and their components.
CO5	Design suitable refrigeration system components such as evaporators, compressors, condensers, and piping arrangements for specific industrial applications.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	-	-	-	-	-	1
CO2	3	3	3	2	3	-	-	-	-	-	2
CO3	3	3	2	3	3	-	-	-	-	-	2
CO4	3	3	2	2	2	2	-	-	-	-	2
CO5	3	3	3	2	3	2	-	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	Industrial refrigeration as distinguished from comfort air-conditioning, what is industrial refrigeration, Refrigerated storage of unfrozen food, Frozen food, Refrigeration in food processing, freeze drying	**08**
2.	Carnot cycle , conditions for high cop of Carnot cycle ,Steady flow energy equation, Analysis of Carnot cycle using refrigerant enthalpies, Dry vs wet compression, The standard vapor compression cycle	**08**
3.	Reciprocating, scroll and screw compressor: Multistage industrial applications, cylinder arrangement, cooling methods - oil injection	**08**
4.	Types of Evaporators, Liquid circulation: Mechanical pumping and gas pumping - advantage and disadvantage of liquid re-circulation - circulation ratio - top feed and bottom feed refrigerant - Net Positive Suction Head (NPSH) - two pumping vessel system – suction risers, design, piping loses. Different Industrial Condensers arrangement	**08**
5.	Vessels in industrial refrigeration: High pressure receiver - flash tank -liquid and vapor separator, separation enhancers, low pressure receivers, surge drum	**08**

Text Book:			
Sr.no.	Title	Author	Publisher
1	C. P. Arora	Refrigeration and Air Conditioning	Tata McGraw Hill Education Pvt. Ltd.
2	Wilbert F. Stocker	Industrial Refrigeration Handbook	McGraw-Hill Professional Publishing

Reference Books:			
Sr.no.	Title	Author	Publisher
1	Roy J. Dossat	Principles of Refrigeration	Pearson
2	ASHRAE	Handbook: Refrigeration	ASHRAE
3	ASHRAE	Handbook: HVAC Systems and Equipment	ASHRAE
4	ISHRAE, ASHRAE	Journal of Air Conditioning and Refrigeration	ISHRAE / ASHRAE

Useful Links:	
1	https://nptel.ac.in/courses/112/105/112105129/

Title of the Course: **Food Preservation and Cold Chain Management** **Course Code: 25MHP1205C**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite: Preliminary knowledge of Biology **(**especially Microbiology), Chemistry, and Food Science

Course Description:

This course provides a comprehensive overview of traditional and modern methods of food preservation aimed at extending shelf life and ensuring food safety. It covers the role of microorganisms in food spoilage and preservation, and introduces low-temperature techniques such as refrigeration and freezing, as well as high-temperature methods like pasteurization and sterilization. Students will learn about moisture control techniques including drying, dehydration, and evaporation, along with modern technologies such as irradiation, pulsed electric fields, high-pressure processing, and microwave heating**.** The course emphasizes scientific principles behind each method, equipment used, and their applications in the food industry.

Course Objectives:

1. To understand the importance microorganisms in food preservation
2. To introduce the basics of various food processing and preservation technologies
3. To know the need and importance of preservation in dairy and fishery industry.
4. To analyze the compositional and technological aspects of milk and fish and other food products
5. To apply study of food preservation for preservation of various food products.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Describe the importance of microorganisms in food preservation and introduce the basics of various food processing and preservation technologies.
CO2	Identify suitable food preservation techniques for various food products and apply cold chain management practices.
CO3	Analyze the compositional and technological aspects of milk, fish, and other food products during preservation.
CO4	Evaluate the effectiveness and efficiency of food preservation and cold chain management strategies.
CO5	Design a basic food preservation system using a combination of traditional and emerging preservation techniques.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	1	-	-	-	-	1
CO2	3	3	3	2	3	2	2	-	-	-	2
CO3	3	3	2	3	3	2	-	-	-	-	2
CO4	3	3	2	2	2	3	2	-	-	-	2
CO5	3	3	3	2	3	2	2	-	-	-	2

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.

MSE is based on 50% of course content.

ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Food Microbiology:** Principles of Food Preservation, microorganisms associated with foods bacteria, yeast and mold, Importance of bacteria, yeast and molds in foods. Classification of microorganisms based on temperature, pH, water activity, nutrient and oxygen requirements, typical growth curve of microorganisms. Classification of food based on pH, Food infection, food intoxication, definition of shelf life, perishable foods, semi perishable foods, shelve stable foods.	**08**
2.	**Food Preservation by Low Temperature Freezing and Refrigeration:** Introduction to refrigeration, cool storage and freezing, definition, principle of freezing, freezing curve, changes occurring during freezing, types of freezing i.e. slow freezing, quick freezing, introduction to thawing, changes during thawing and its effect on food. Freezing methods -direct and indirect, still air sharp freezer, blast freezer, fluidized freezer, plate freezer, spiral freezer and cryogenic freezing.	**08**
3.	**Food Preservation by high temperature**: Commercial heat preservation methods: Sterilization, commercial sterilization, Pasteurization, and blanching.	**08**
4.	**Food Preservation by Moisture control:** Drying and Dehydration - Definition, drying as a means of preservation, differences between sun drying and dehydration (i.e. mechanical drying), heat and mass transfer, factors affecting rate of drying, normal drying curve, names of types of driers used in the food industry. Drying methods and equipment, air convection dryer, tray dryer, tunnel dryer, continuous belt dryer, fluidized bed dryer, spray dryer, drum dryer, vacuum dryer, freeze drying foam mat drying. Evaporation - Definition, factors affecting evaporation, names of evaporators used in food industry.	**08**

5.	**Food Preservation by Irradiation and chemicals** Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. Recent Trends Pulsed electric fields, High pressure technology, Ohmic heating, Microwave heating, Hurdle technology.	**08**

Text Book			
Sr.no.	**Title**	**Author**	**Publisher**
1	Potter N. H.	Food Science	CBS Publication, New Delhi
2	Ramaswamy H., Marcott M.	Food Processing Principles and Applications	CRC Press

Reference Books			
Sr.no.	**Title**	**Author**	**Publisher**
1	B. Srilakshmi	Food Science	New Age Publishers
2	Meyer	Food Chemistry	New Age
3	Bawa A. S., O. P. Chauhan et al.	Food Science	New India Publishing Agency
4	Frazier W. C., Westhoff D. C.	Food Microbiology	TMH Publication, New Delhi
5	Desrosier N. W., Desrosier J. N.	The Technology of Food Preservation	CBS Publication, New Delhi
6	Paine F. A., Paine H. Y.	Handbook of Food Packaging	Thomson Press India Pvt. Ltd., New Delhi
7	Toledo Romeo T.	Fundamentals of Food Process Engineering	Aspen Publishers

Useful Links:	
1	https://nptel.ac.in/courses/126/105/126105011/
2	https://nptel.ac.in/courses/126/103/126103017/

Title of the Course: **Alternative Fuels for I.C. Engine** **Course Code: 25MHP1205D**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite: Basic knowledge of Thermodynamics and Combustion. Fundamentals of Internal Combustion Engines

Course Description:

This course introduces conventional petroleum fuels, their refining processes, and properties relevant to I.C. engines. It emphasizes the need for alternative fuels such as alcohols, LPG, CNG, hydrogen, biogas, and producer gas, along with their production methods, properties, and application in engines. The course covers single-fuel and dual-fuel engine operation, required engine modifications, and the performance and emission characteristics of alternative fuels in comparison with conventional gasoline and diesel engines.

Course Objectives:

1. To provide knowledge of petroleum-based fuels, their refining process, and properties relevant to IC engines.
2. To introduce the need, availability, and methods of production of alternative fuels.
3. To study the performance and emission characteristics of SI and CI engines using alternative fuels.
4. To understand required modifications in engines for single-fuel and dual-fuel operations.
5. To evaluate the potential of alternative fuels in reducing dependency on fossil fuels and minimizing environmental impact.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the structure, refining process, and properties of petroleum fuels used in IC engines.
CO2	Identify the need for alternative fuels and describe their methods of production.
CO3	Analyze the combustion, performance, and emission characteristics of SI engines operating on alternative fuels.
CO4	Evaluate the use of alternative fuels in CI engines under dual-fuel operation and required modifications.
CO5	Assess the techno-economic and environmental benefits of alternative fuels compared to conventional fuels.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	3	2	-	2	-	-	-	-	-	2
CO3	3	3	-	2	2	-	-	-	-	-	2
CO4	3	2	3	2	3	-	-	-	-	-	2
CO5	2	2	-	2	2	2	3	-	-	-	3

Assessment Scheme:

Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Fuels:** Introduction, Structure of petroleum, Refining process, Products of refining process, Fuels for spark ignition, Knock rating of SI engine fuels, Octane number requirement, Diesel fuels and Numericals.	**08**
2.	**Properties of petroleum products:** Specific gravity, Density, Mokecular weight, Vapour pressure,Viscosity, Flash point, Fire point, Cloud point, Pour point, Freezing point, Smoke point & Char value, Aniline point, Octane Number, Performance Number, Cetane Number, Emulcification, Oxidation Stability, Acid Value/Number, Distillation Range, and Sulphur content.	**08**
3.	**Alternative fuels for I.C. engines** : Need for alternative fuels such as Ethanol, Methanol, LPG, CNG,Hydrogen, Biogas and Producer gas and their methods of manufacturing. Single Fuel Engines: Properties of alternative fuels, use of alternative fuels in SI engines, Engine modifications required, Performance and emission characteristics of alternative fuels in SI mode of operation v/s gasoline operation.	**08**
4.	**Dual fuel Engine: :** Dual fuel Engine: Need and advantages, the working principle, Combustion in dual fuel engines, Factors affecting combustion in dual fuel engine, Use of alcohols, LPG, CNG, Hydrogen, Biogas and Producer gas in CI engines in dual fuel mode. Engine modifications required. Performance and emission characteristics of alternative fuels (mentioned above) in Dual Fuel mode of operation v/s Diesel operation. Biodiesels: What are biodiesels, Need of biodiesels, Properties of biodiesels V/s petro diesel, Performance and emission characteristics of biodiesels v/s Petro diesel operation.	**08**

5.	**Availability:** Suitability & Future prospects of these gaseous fuels in Indian context. Environmental pollution with conventional and alternate fuels, Pollution control methods and packages.	**08**

Text Book:			
Sr.no.	**Title**	**Author**	**Publisher**
1	A Course in Internal Combustion Engines	R.P Sharma & M.L.Mathur	D.Rai& Sons
2	Elements of Fuels, Furnaces & Refractories	O.P. Gupta	Khanna Publishers, 2000
3	Internal Combustion Engines	Domkundwar V.M.	Dhanpat Rai & Co., 1999

Reference Books:			
Sr.no.	**Title**	**Author**	**Publisher**
1	Internal Combustion Engines Fundamentals	John B. Heywood	McGraw Hill
2	Present and Future Automotive Fuels	Osamu Hirao & Richard Pefley	Wiley Interscience Publication. NY. 1988

Title of the Course: Cryogenics Course Code: 25MHP1206A	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite: Refrigeration and air conditioning

Course Description:

This course provides a comprehensive introduction to cryogenics, the study of the production and effects of very low temperatures (typically below –150°C or 123 K). Students will explore the fundamental principles of thermodynamics, heat transfer, and fluid mechanics as they relate to cryogenic systems. The course covers cryogenic materials, liquefaction of gases (e.g., helium, nitrogen, hydrogen), insulation techniques, storage and transportation of cryogens, and applications in science, medicine, aerospace, and industry.

Course Objectives:

1. To Understand the basic principles of cryogenics and low-temperature physics.
2. To Analyze the properties and behaviors of materials at cryogenic temperatures.
3. To Design and evaluate cryogenic systems and equipment.
4. To Apply cryogenic techniques in practical scenarios across different industries

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the basic principles of low-temperature physics and their significance.
CO2	Apply knowledge of cryogenic materials to select appropriate materials for specific applications.
CO3	Examine the safety protocols and risk assessments necessary for handling cryogenic systems.
CO4	Assess the design and functionality of cryogenic storage and transfer systems.
CO5	Design a cryogenic liquefaction or refrigeration system with suitable thermodynamic and material considerations.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	-	-	-	-	-	1
CO2	3	3	3	2	3	2	-	-	-	-	2
CO3	3	3	2	3	3	3	3	-	-	-	2
CO4	3	3	2	3	3	3	-	-	-	-	2
CO5	3	3	3	3	3	2	-	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Introduction to Cryogenics** VCRS Cycle, Limitation of VCRS System, Cascade system, History and development of cryogenics. Basic principles of thermodynamics relevant to cryogenics.	**08**
2.	**Gas Liquefaction, Separation and Purification System** Thermodynamically ideal system, Joule-Thomson effect, Adiabatic expansion, Actual liquefaction systems, Performance parameters, Critical components of liquefaction systems. Ideal gas separation system, separation of binary mixtures at cryogenic temperatures, Requirement of Purification, Purification systems at low temperatures.	**08**
3.	**Cryogenic Refrigeration Systems** Joule-Thompson Refrigeration systems, Expansion engine refrigeration systems, Philips refrigerators, G-M Refrigerators, Stirling Refrigerator, Solvay Refrigerator, Magnetic Refrigeration.	**08**
4.	**Properties of Engineering Materials** Material properties at low temperatures, Thermal, Mechanical and Magnetic properties of cryogens..	**08**
5.	**Cryogenic Fluid Storage, Handling and Transfer** Handling, Insulation, Instrumentation & Vacuum Technology Temperature, Pressure, Flow rate and Liquid level measurement. Cryogenic storage vessels, Dewar and large tanks, Storage and transport of LNG and other liquefied industrial gases. Liquid hydrogen storage and transport for hydrogen-fueled vehicle. Special insulation requirements at low temperatures, insulating materials. Need of vacuum, various vacuum pumps.	**08**

Text Book:			
Sr.no.	Title	Author	Publisher
1.	Cryogenics	Dr. B. S. Gawali	Mahalaxmi Publication
2.	Cryogenic Engineering	R. B. Scott	CRC Press

Reference Books:			
Sr.no.	Title	Author	Publisher
1.	Helium Cryogenics	Steven W. Van Sciver ,	McGraw Hill
2.	Handbook of Cryogenic Engineering	J.G. Weisend II	CRC Press
3.	Fundamentals of Cryogenic Engineering	Mamoru Ishigaki and Nobuyuki Yoshida	McGraw Hill

Useful Links
https://archive.nptel.ac.in/courses/112/101/112101004/

Title of the Course: Industrial Air-Conditioning Course Code: 25MHP1206B	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite:

Basic Thermodynamics, Fundamentals of Heat and Mass Transfer, Fluid Mechanics, Engineering Mathematics

Course Description:

This course covers the principles and applications of psychrometrics, heat and mass transfer in HVAC systems, air cleaning methods, ventilation strategies, and air handling equipment. Topics include moist air properties, psychrometric charts, air washers, ventilation standards, air filtration systems, noise control, fan and duct design, and the complete design of a year-round air conditioning system. Analytical and graphical approaches are used for system performance analysis.

Course Objectives:

1. To enable the students to analyze and solve air conditioning related problems by applying principles of mathematics, science and engineering.
2. To prepare students to use modern tools, techniques and skills to fulfil industrial needs related to air conditioning.
3. To train students with effective communication skills to demonstrate air conditioning theories.
4. To develop skills in the analysis of air conditioning systems in research or design.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the principles, processes, and equipment of psychrometry and air conditioning.
CO2	Apply knowledge of mathematics, science, and engineering for the needs in air-conditioning system design.
CO3	Analyze different air-conditioning systems and their characteristics.
CO4	Evaluate the performance and interpret the reports in the field of air-conditioning.
CO5	Design an effective air-handling system using psychrometric principles and air-conditioning components.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	1	-	-	-	-	1
CO2	3	3	3	2	3	2	-	-	-	-	2
CO3	3	3	2	3	3	2	-	-	-	-	2
CO4	3	3	2	2	3	2	-	-	-	-	2
CO5	3	3	3	2	3	2	-	-	-	-	2

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Psychometric:** moist air properties; mass transfer and evaporation of water into moist air; theory of psychrometer; correlation of w.b.t. with temperature of adiabatic saturation; Lewis number; construction of psychometric chart.	**08**
2.	**Heat and Mass Transfer**: Direct contact transfer equipment; simple air washer and indirect evaporative cooling contact mixture principle; enthalpy potential; basic equation for direct contact transfer equipment; graphical and analytical methods for heat and mass transfer analysis of air washers with heated and chilled water sprays	**08**
3.	**Ventilation:** Necessity; ventilation standards; natural and mechanical ventilation; forces for natural ventilation; general ventilation rules; determining ventilation requirement; use of decay equation.	**08**
4.	**Air Cleaning:** Physical and chemical vitiation of air; permissible concentration of air contaminants; mechanical and electronic air cleaners; dry and wet filters; radiators and convectors. Design of a year-round air conditioning system.	**08**
5.	**Air handling Equipment:** Fans & Duct System Characteristics, Fan Arrangement Variable Air Volume systems, Air Handling Units and Fan Coil units. air conditioning apparatus, unitary equipment, accessory equipment, Noise control. Piping and Ducts: Pressure drops in piping and fittings; design of water and refrigerant piping; Air conditioning duct design methods.	**08**

Text Book:			
Sr.no.	Title	Author	Publisher
1	Refrigeration & Air Conditioning	Manohar Prasad	New Age Publishers
2	Refrigeration & Air Conditioning	Stoecker	McGraw Hill, 1992

Reference Books:			
Sr.no.	Title	Author	Publisher
1	Refrigeration & Air Conditioning	Manohar Prasad	New Age Publishers
2	Refrigeration & Air Conditioning	Stoecker	McGraw Hill, 1992
3	ASHRAE Handbook: HVAC Systems and Equipment	ASHRAE	ASHRAE, 1996
4	Control Systems for Heating, Ventilation and Air-Conditioning	Hainer R.W.	Van Nostrand
5	Modern Air Conditioning	Norman C. Harris	McGraw-Hill, New York, 1974

Useful Links:	
1	https://www.youtube.com/watch?v=3oupVAmC5mE

Title of the Course: **Energy Conservation and Management** **Course Code: 25MHP1206C**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite: Environment Studies, Elements of Mechanical Engineering, Thermodynamics

Course Description:

Covers energy resources, auditing, management, and conservation techniques, with focus on industrial efficiency, financial analysis, environmental impact, and sustainable development.

Course Objectives:

1. To emphasis the student to study and understand the energy data of industries.
2. To explain the problems energy accounting and balancing
3. To workout energy audit and motivate the students to suggest methodologies for energy savings.
4. To prepare the students utilize the available resources in optimal ways
5. To emphasis the student to study and understand the energy data of industries.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Describe various energy conservation techniques and their applications in different sectors.
CO2	Use energy audit tools and techniques to assess the energy performance of buildings and industrial processes.
CO3	Exercise energy audit and suggest methodologies for energy savings.
CO4	Review and interpret energy policies and their implications for energy management practices.
CO5	Design a basic energy audit and conservation plan considering financial, technical and environmental aspects.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	3	2	-	-	-	1
CO2	3	3	2	3	3	3	2	-	-	2	2
CO3	3	3	3	3	3	3	3	1	1	2	3
CO4	2	2	1	2	2	3	3	2	1	2	2
CO5	3	3	3	3	3	3	3	2	1	2	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Unit 1 Introduction of Commercial and non-commercial energy** Commercial and non-commercial energy, Primary energy resources, Commercial energy production, Final energy consumption, Indian energy scenario, Sectorial energy consumption, Energy needs of growing economy, Energy intensity on purchasing power parity (PPP) basis, Long term energy scenario, Energy pricing,Energy security, Energy strategy for the future, Energy conservation and its importance	**08**
2.	**Unit 2 Energy auditing** methodology & analysis, Definition of energy management & its objectives, energy audit, need, types of energy audit, energy performance, matching energy use to requirements, maximizing systems efficiencies, energy audit instruments and metering.	**08**
3.	**Unit 3 Financial Management** Investment need, Appraisal and criteria Financial Analysis techniques, Simple Payback Period, Return On Investment, Net Present Value, Interest rate of return, Risk and sensitivity analysis, Financing Options, ESCOS.	**08**
4.	**Unit 4 Energy Conservation in energy Intensive Industries**. Cogeneration – Need, Principle, Technical Options for Cogeneration. Classification, Factors Influencing choice, Heat to Power ratios, Load Patterns, Prime movers used in Conservation. Advantages and Disadvantages of various systems. Case Studies	**08**
5.	**Unit 5 Energy and environment** Air pollution, Climate change, United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM methodology and procedure, Sustainable Development.	**08**

Text Book:			
Sr.no.	**Title**	**Author**	**Publisher**
1	Energy Manager Training Manual (4 Volumes)	Bureau of Energy Efficiency (BEE)	www.energymanagertraining.com, Bureau of Energy Efficiency, Govt. of India, 2004

Reference Books:			
Sr.no.	**Title**	**Author**	**Publisher**
1	Energy Manager Training Manual (4 Volumes)	Bureau of Energy Efficiency (BEE)	www.energymanagertraining.com, BEE, Govt. of India, 2004
2	Energy Management	W.R. Murphy, G. McKay	Butterworth's
3	Industrial Energy Management and Utilization	L.C. Witte, P.S. Schmidt, D.R. Brown	Hemisphere Publishing, Washington, 1988
4	Design and Management for Energy Conservation	P.W. Callaghan	Pergamon Press, Oxford
5	Energy Manager Training Manual (4 Volumes)	Bureau of Energy Efficiency (BEE)	www.energymanagertraining.com, BEE, Govt. of India, 2004

Useful Links:	
1	https://archive.nptel.ac.in/courses/112/105/112105221/

Title of the Course: **Battery Thermal Management System** **Course Code: 25MHP1206D**	**L**	**T**	**P**	**Credit**
	3	**--**	**-**	**3**

Course Pre-Requisite: Basic knowledge of Thermodynamics and Heat Transfer

Course Description:

This course covers fundamentals of electrochemistry, lithium-ion battery technologies, and battery pack construction. It introduces Battery Management Systems (BMS), their design, protection, and control, along with recent trends in energy storage, renewable integration, recycling, and economic aspects.

Course Objectives:

1. To understand the fundamentals of electrochemistry and lithium-ion battery technologies.
2. To study battery pack construction, protection, and safety mechanisms.
3. To explain the functions, topology, and requirements of Battery Management Systems (BMS).
4. To develop knowledge of BMS design, installation, testing, and troubleshooting.
5. To explore recent trends, renewable integration, recycling, and economic aspects of battery systems.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the fundamentals of electrochemistry, lithium-ion chemistries, and performance characteristics of EV batteries.
CO2	Identify and describe battery pack construction, safety, and protection features.
CO3	Analyze the functionality, topology, and requirements of Battery Management Systems (BMS).
CO4	Design and evaluate BMS circuits, including installation, testing, and troubleshooting.
CO5	Interpret recent trends in energy storage, renewable integration, recycling, and economic aspects of battery systems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	2	-	-	-	2
CO2	2	3	2	-	2	-	2	-	-	-	2
CO3	3	3	-	2	2	-	3	-	-	-	2
CO4	3	2	3	3	3	-	3	-	-	-	2
CO5	2	2	-	2	2	2	3	-	-	-	3

Assessment Scheme:
Two components of Continuous Assessment (CA-1, CA-2), Mid Semester Examination (MSE) and End Semester Examination (ESE) having 20%,30% and 50% weightage respectively.

Assessment Component	Marks
CA1	10
CA2	10
MSE	30
ESE	50

CA1 and **CA2** are based on Assignment/ Surprise test/ Quiz/Seminar/Group discussions /presentation, etc.
MSE is based on 50% of course content.
ESE is based on 100% course content with 60-70% weightage for course content covered after MSE.

Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Unit 1 Energy and Electrochemistry:** Sources of energy for propulsion & their comparison: Net Calo1ific Value, Conversion efficiency, History and background of battery technology, Electrochemistry fundamentals & te1minologies, Lithium ion battery and different chemistries, Portable power applications and electrical load requirements, Factors affecting the choice of EV battery systems, Commercially available lithium ion cells, Electrical characteristics of battery: Capacity, C-rate, impedance, DOD, SOC, SOH, Life cycles, Mechanical characteristics, Fonn factor, Safety.	**08**
2.	**Unit 2 Battery Pack Construction:** Battery modules and complete battery pack system, Assembly methods, Electrical connections, Cell level protection system, batte1y pack level protection system, Understanding laptop battery pack system.	**08**
3.	**Unit 3 Battery Management System:** Introduction, Battery pack requirements: Measurement, Protection and management, Cell balancing, Battery pack electronics, Battery Management System (BMS): Functionality, technology and topology (centralized) modular, master-slave, distributed).	**08**
4.	**Unit 4 Design of Battery Management System:** BMS Application Specific Integrated Circuit (ASIC) selection, Analog BMS design, Digital BMS design, BMS deploying: Installing, testing and Troubleshooting	**08**
5.	**Unit 5 Recent Trends and Economy:** Communication systems for battery pack, Review of electric car battery pack, Important considerations, Recent trends: Grid level energy storage, Solar & wind integration, Recycling and pricing.	**08**

Text Book:			
Sr.no.	**Title**	**Author**	**Publisher**
1	Electric Vehicle Technology Explained	James Larrninie	John Wiley & Sons
2.	Themal Management of Electric VehicleBattery Systems	Ibrahim Dincer, Halil S. Hamut, Nader Javani,	ISBN: 978-1-118-90024-6

Reference Books:			
Sr.no.	**Title**	**Author**	**Publisher**
1	Modem Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals	Mehrdad Ehsani, Yimin Gao, Ali Emadi	CRC Press

Useful Links:	
1	http://nptel.ac.in/courses/l 08103009/

Title of the Course: Research Methodology Course Code: 25MHP1207	L	T	P	Credit
	3	--	-	3

Course Pre-Requisite: Nil

Course Description:

This course provides students with a systematic understanding of research processes, methodologies, and techniques used across academic and professional disciplines. It covers the formulation of research problems, development of research objectives and hypotheses, selection of appropriate research designs, data collection methods, statistical analysis, interpretation of results, and academic writing.

Course Objectives:

1. To prepare students for undergoing research, identify and formulate the research problems, state the hypothesis, design a research layout, set a research process and methodology.
2. To enable students to interpret the results, propose theories, suggest possible/alternative solutions, solve, and prove the solution adapted–logically and analytically, conclude the research findings.
3. To impart knowledge to analyze critically the literature and publish research in reputed conferences/ journals.
4. To expose students to research ethics, IPR and Patents.

Course Outcomes:

CO	After the completion of the course the student should be able to
CO1	Explain the fundamental research process, including identification of research problems, formulation of objectives, and approaches to data collection and analysis.
CO2	Apply statistical and experimental methods such as T-test, ANOVA, and regression analysis in research methodology.
CO3	Analyze research problems using hypothesis testing and validate findings with appropriate tools and techniques.
CO4	Compose research articles, project reports, and dissertations using effective technical writing and reference management tools.
CO5	Draft patent and IPR documentation including filing procedures, and explain national/international frameworks for protection of intellectual property.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	2
CO2	3	3	2	2	2	-	-	-	-	-	2
CO3	3	3	2	2	3	-	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	-	2
CO5	3	3	2	2	3	2	3	-	-	-	2

Assessment Scheme:

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Course Contents

Unit No.	Unit Title and Contents	Hours
1.	**Engineering Research Process:** Meaning of research problem, Sources of research problem, Criteria and Characteristics of a good research problem, Errors in selecting a research problem, Definition, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation.	**08**
2.	**Research Methodology:** Problem statement formulation, resources identification for solution, Experimental and Analytical modeling, Simulations, Numerical and Statistical methods in engineering research. Hypothesis and its testing by different techniques: T-Test, Z-test etc.	**08**
3.	**Research Methods:** Uni and Multivariate Analysis: ANOVA, Design of Experiments/Taguchi Method, Regression Analysis. Software tools like spreadsheets. Processing and Analysis of Data: Processing Operations, Types of Analysis-Presentation and Interpretation of Data Editing, Classification and Tabulation-Interpretation. Analyze your results and draw conclusions.	**08**
4.	**Research Practices:** Effective literature studies approaches, critical analysis, Plagiarism, Research ethics, Mendeley - Reference Management Software. Research communication- Effective Technical Writing, Writing a research article for Journal/conference paper, Technical report, Dissertation/ Thesis report writing, Software used for report writing such as word, Latex etc. Presentation techniques for paper/report/seminar. Publishing article in Scopus/SCI/Web of science indexed journal or conference.	**08**
5.	**Patents** Patent Rights: Scope of Patent Rights, Various Patent databases, Geographical Indications. Procedure for grants of patents, Patenting under Patent Cooperation Treaty (PCT). Licensing and transfer of technology. Administration of Patent System. Introduction to International Scenario: World Intellectual Property Organization (WIPO), Trade-Related Aspects of Intellectual Property Rights (TRIPs), Patenting under PCT	**08**

Text Book:			
Sr.no.	**Title**	**Author**	**Publisher**
1.	Research Methodology	Kothari C. R	New Age International
2.	Research Methodology: An Introduction for Science & Engineering Students	Melville Stuart and Goddard Wayne,	Juta and Company

Reference Books:			
Sr.no.	**Title**	**Author**	**Publisher**
1.	Intellectual Property in New Technological Age	Merges Robert, Menell Peter, Lemley Mark,	ASPEN Publishers
2.	Intellectual Property Rights Under WTO	Ramappa T	S. Chand

Useful Links
https://onlinecourses.nptel.ac.in/noc21_ge03/preview- Introduction to research
https://onlinecourses.swayam2.ac.in/ntr21_ed23/preview - Academic Research & Report Writing
https://onlinecourses.nptel.ac.in/noc21_ge12/preview - Qualitative Research Methods and Research Writing
https://onlinecourses.nptel.ac.in/noc21_hs44/preview - Effective Writing
https://www.scopus.com/search/form.uri?display=basic#basic