



ST. JOSEPH'S
COLLEGE OF ENGINEERING
AND TECHNOLOGY,
- PALAI -
AUTONOMOUS

Choondacherry P.O., Pala, Kottayam - 686579
Kerala, India



CURRICULUM & SYLLABUS

B. Tech. (Honours) in
MECHANICAL ENGINEERING
Basket – Thermal Engineering

2024 SCHEME

www.sjcetpalai.ac.in



Signed By: DEVASSIA V P
Approved by Academic
Council dtd.19.06.2026

CURRICULUM

B.Tech (Honours) is an enhanced version of the Bachelor of Technology degree, offering the students the opportunity to undertake additional courses within their own discipline. This pathway allows students to deepen their knowledge in emerging or advanced areas of Engineering relevant to their field of study, providing a stronger foundation for specialized career paths or further academic pursuits.

For the award of B.Tech (Honours) in Mechanical Engineering, the student shall fulfill all the curricular requirements for B.Tech in Mechanical Engineering as per SJCT B.Tech Academic Regulations 2024 and shall earn 15 additional credits by undergoing the following courses, which shall be further governed by clause R16 of the Regulations.

Sl. No	Semester	Course Code	Course Name/Type	Weekly hours				Total Marks		Credits
				L	T	P	SS	CIE	ESE	
1	4	24SJHNMET410	Advanced Fluid Mechanics	3	1	0	5	40	60	4
2	5	24SJPMET510	Measurement Systems in Thermal Engineering	3	1	0	5	40	60	4
		24SJPMEM5XX	Approved MOOC*							
3	6	24SJHNMET610	Design and Optimization of Energy Systems	3	1	0	5	40	60	4
		24SJPMEM6XX	Approved MOOC*							
4	7	24SJHNMET710	Thermal Management of Electronic Systems	2	1	0	4	40	60	3
		24SJHNMEM7XX	Approved MOOC*							
Total Credits										15

* Students must register for theory courses in the 4th semester of the Honours curriculum

*MOOC to be approved by the Academic Council on recommendation of the Board of Studies.



ADVANCED FLUID MECHANICS

Course Code	24SJHNMET410	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Fluid Mechanics and Machinery	Course Type	PC

Course Objectives:

- To provide a strong foundation in fluid mechanics principles, including kinematics, governing equations, and analytical methods for fluid flow analysis.
- To develop the ability to analyse and model fluid flow behaviour using theoretical concepts such as potential flow and boundary layer theory.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain fluid motion using Lagrangian and Eulerian approaches, and describe flow behaviour using flow visualization techniques	K3
CO2	Apply conservation laws and Navier–Stokes equations to analyse fluid flow and obtain solutions for simple flow configurations.	K3
CO3	Analyse fluid flow using potential flow theory and apply concepts such as sources, sinks, and superposition to engineering problems.	K3
CO4	Apply boundary layer theory and turbulence concepts to analyse flow behaviour, including separation and turbulent flow characteristics.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

1- Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - No Correlation



SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction and Basic Concepts Definition of fluid and concept of continuum, Kinematics of fluid motion: Flow field, Eulerian and Lagrangian formulations, Flow visualization streamlines, path lines and streak lines; Local and individual time rates of change, acceleration	10	1
2	Governing Equations of Fluid Flow - Reynolds transport theorem; Mass and momentum conservation; Navier-Stokes equation; Special forms of Navier stokes equations, Some exact solutions of the Navier – Stoke’s equations – Couette flows – Plane Poiseuille flow Euler and Bernoulli equation, fully developed laminar flow through circular pipes- Hagen Poiseuille flow.	12	2
3	Potential Flow - Stream function and velocity potential function; Elementary plane flows; Irrotational motion in two dimensions-sources and sink Superposition of elementary plane flows, complex-variable formulation for plane potential flows Doublet, Concept of lift and drag	10	3
4	Boundary Layer Theory - Concept of boundary layer; Derivation of boundary layer equations; Boundary layer flow over a flat plate; Boundary layer flow with and without pressure gradient; Flow separation Turbulent flows: Characteristics of turbulent flows; Concept of averaging; Reynolds Averaged Navier Stokes (RANS) equations; Turbulent internal flows	12	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

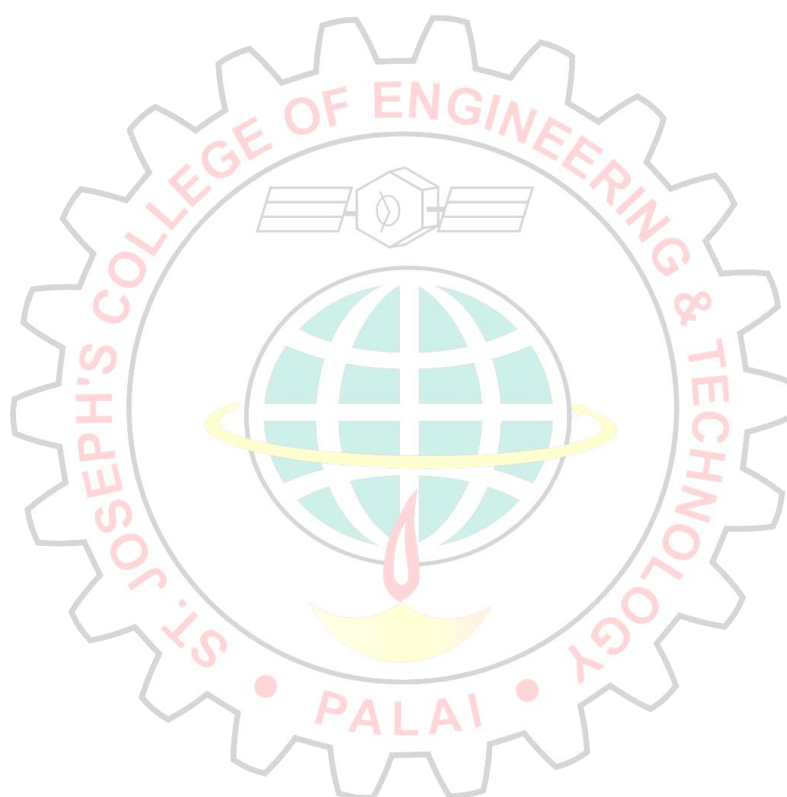
In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
➤ 2 Questions from each module. ➤ Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	➤ Each question carries 9 marks. ➤ Two questions will be given from each module, out of which one question should be answered. ➤ Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fluid Mechanics	Frank M. White	Mc Graw Hill	9 th , 2022
2	Fundamentals of Fluid Mechanics	Munson, Young, Okiishi	Wiley	9 th , 2020
3	Advanced Fluid Mechanics	W. P. Graebel	Academic Press	1 st , 2007

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Fluid Mechanics	Yunus A. Çengel	McGraw Hill	12 th , 2024
2	Introduction to Fluid Mechanics and Fluid Machines	S K Som	McGraw Hill	3 rd , 2017
3	Fluid Mechanics	Pijush K. Kundu, Ira M. Cohen, and David R. Dowling	Academic press	5 th , 2012
4	An Introduction to Fluid Dynamics	G. K. Batchelor	Cambridge University Press	5 th , 2000

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Lagrangian and Eulerian Approach, Types of fluid flow	https://youtu.be/H38vI93exns?list=PL3zvA_WajfGA0_Hx9TadcLtGHlRIn4WEM
1	Bernoulli's Equation	https://youtu.be/5IjpPhUNT14?list=PL3zvA_WajfGA0_Hx9TadcLtGHlRIn4WEM
2	Derivation of Navier Stokes Equation	https://youtu.be/d22CjwzLw5g?list=PL3zvA_WajfGA0_Hx9TadcLtGHlRIn4WEM
3	Fully Developed Flow	https://youtu.be/lneVkFukEKk?list=PL3zvA_WajfGA0_Hx9TadcLtGHlRIn4WEM
4	Introduction to Boundary Layer	https://youtu.be/1Vx4o29ZAWI?list=PL3zvA_WajfGA0_Hx9TadcLtGHlRIn4WEM



MEASUREMENT SYSTEMS IN THERMAL ENGINEERING

Course Code	24SJPMET510	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Engineering Thermodynamics	Course Type	PC

Course Objectives:

- To introduce the fundamental principles and characteristics of measurement systems and instruments.
- To develop understanding of error analysis, uncertainty, and reliability in engineering measurements.
- To provide practical knowledge of sensors, data acquisition, and instruments for measuring thermal and mechanical quantities.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply statistical methods and regression analysis to evaluate measurement data and error distributions.	K3
CO2	Enumerate uncertainty, perform calibration, and assess reliability in experimental measurements.	K3
CO3	Demonstrate the use of advanced sensors, microprocessor-based systems, and intelligent instrumentation.	K3
CO4	Employ instruments for measuring thermal quantities and explain selected advanced measurement techniques	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

1- Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - No Correlation



SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to Measurement systems: Measurement categories- primary and derived quantities, intrusive and non-intrusive methods; Statistical analysis of experimental data- normal error distributions (confidence interval and level of significance, Chauvenet's criterion), Chi-square test of goodness of fit, method of least squares (regression analysis, correlation coefficient), multivariable regression, Students' t-distribution, graphical analysis and curve fitting.	10	1
2	Error Analysis and Reliability: Statistical error analysis; uncertainty in measurement; uncertainty quantification, calibration methods; reliability of instruments, Design of experiments.	12	2
3	Advanced sensors (thermocouples, RTDs, strain gauges, piezoelectric sensors); microprocessor and computer-based measurement; analog-to-digital conversion; intelligent instruments; basics of telemetry.	10	3
4	Temperature measurement (contact and non-contact); pressure measurement (transducers, electronic gauges); flow measurement (rotameter, venturi, coriolis meters); introduction to advanced techniques (Schlieren, hot-wire anemometer, Orsat apparatus, gas analyzers).	12	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
2 Questions from each module. Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	Each question carries 9 marks. Two questions will be given from each module, out of which one question should be answered. Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Measurement Systems: Application and Design	Ernest O. Doebelin	McGraw-Hill	5 th , 2004
2	Experimental Methods for Engineers	J.P. Holman	McGraw-Hill	8 th , 2026

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Mechanical Measurements	R.S. Sirohi & H.C. Radha Krishna	New Age International	4 th , 2025
2	Measurement and Instrumentation Principles	Alan S. Morris	Butterworth-Heinemann	3 rd , 2001
3	Mechanical Measurements and Instrumentation	R.K. Rajput	S.K. Kataria & Sons	2 nd , 2023
4	Engineering Metrology and Measurements	N.V. Raghavendra & L. Krishnamurthy	Oxford University Press	1 st , 2013
5	The Art of Measuring in the Thermal Sciences	Josua Meyer & Michel De Paepe	CRC Press	1 st , 2024
6	Temperature Measurement and Control	J.R. Leigh	Institution of Engineering and Technology (IET)	1 st , 1988

Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Mechanical Measurements and Metrology <i>Lectures 1–6 (Basics of measurements, errors, classification of instruments)</i>	https://nptel.ac.in/courses/112106138
2	Mechanical Measurements and Metrology <i>Lectures 7–12 (Error analysis, calibration methods, reliability)</i>	https://nptel.ac.in/courses/112106138
3	Electrical Measurement and Electronic Instruments <i>Lectures 5–15 (Microprocessor-based measurement, data acquisition, intelligent instruments, telemetry basics)</i>	https://nptel.ac.in/courses/108105153
4	Mechanical Measurements and Metrology <i>Lectures 13–20 (Temperature, pressure, flow measurement)</i>	https://nptel.ac.in/courses/112106138

DESIGN AND OPTIMIZATION OF ENERGY SYSTEMS

Course Code	24SJHNMET610	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Mathematics for Physical Science - 4	Course Type	PC

Course Objectives:

- Introduce the fundamental principles of design and analysis of energy systems, including basic economic considerations and system modelling.
- To provide knowledge of optimization methods and enable students to formulate and solve engineering problems using mathematical and computational optimization techniques.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Apply basic principles of design and economic analysis to develop simple and workable energy system models.	K3
CO2	Apply numerical and data analysis techniques for solving and modelling engineering problems in energy systems.	K3
CO3	Formulate and solve optimization problems using calculus-based methods and one-dimensional search techniques. .	K3
CO4	Apply advanced optimization techniques to solve engineering problems.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

1- Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - No Correlation



SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Introduction to system design, Morphology of design (with flow chart), Concept of workable design, Basic practical examples of system design, Introduction to energy systems and design considerations, Basic economic analysis: cost, profit, and time value of money.	10	1
2	Introduction to system simulation and classification. Numerical solution of engineering equations using successive substitution method, Newton–Raphson method (single variable only), and Gauss–Seidel method (basic concepts and simple problems). Need for data analysis in energy systems; concept of best fit. Application of least squares regression (linear only) for modelling and analysis of energy system behavior.	10	2
3	Optimization: Introduction – formulation of optimization problems. Calculus techniques. Lagrange multiplier method. Search methods: concept of interval of uncertainty, reduction ratio, reduction ratios of exhaustive search, dichotomous search, Fibonacci search and Golden section search -numerical examples based on design and optimization of energy systems	12	3
4	Optimization: Method of steepest ascent / steepest descent, conjugate gradient method – examples. Geometric programming. Linear programming – two variable problem – graphical solution. Genetic algorithm. examples and exercises shall be based on design and optimization of energy systems	12	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

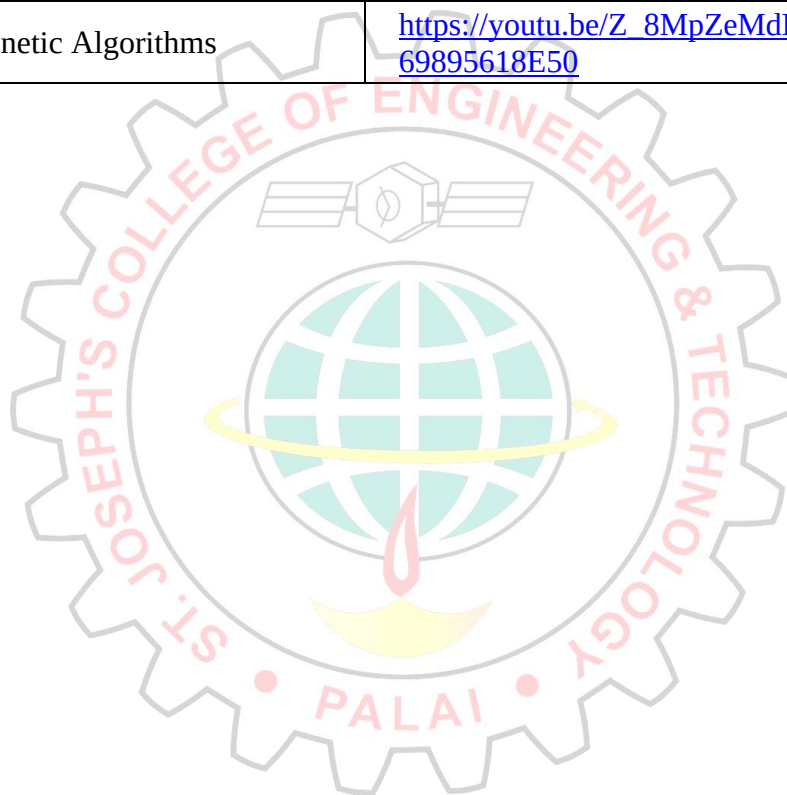
Part A	Part B	Total
➤ 2 Questions from each module. ➤ Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	➤ Each question carries 9 marks. ➤ Two questions will be given from each module, out of which one question should be answered. ➤ Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Thermal System Design and Optimization	C. Balaji	Springer	2 nd , 2021
2	Design and Optimization of Thermal Systems	Yogesh Jaluria	RS Press	3 rd , 2019
3	Optimization For Engineers	Kalyanmoy Deb	Prentice Hall India	2 nd , 2012

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Elements of thermal fluid system design	L.C. Burmeister	Prentice Hall	1 st , 1998
2	Design of thermal systems	W. F. Stoecker	McGraw Hill	3 rd , 1989
3	Engineering Optimization: Theory and Practice	Singiresu S Rao	New Age International Publishers	4 th , 2013



Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Introduction to Optimization	https://youtu.be/SHbb9dV-we8
	System Design and Analysis	https://youtu.be/xEF73wlmPn4
2	System Simulation	https://youtu.be/P_tbPDQ9RAM
	Introduction to Curve Fitting	https://youtu.be/i6ZmA9EEzrI?list=PLBE92469895618E50
3	Optimization- Basic ideas	https://youtu.be/0g8_u0RnwrQ?list=PLBE92469895618E50
4	Genetic Algorithms	https://youtu.be/Z_8MpZeMdD4?list=PLBE92469895618E50



THERMAL MANAGEMENT OF ELECTRONIC SYSTEMS

Course Code	24SJHNMET710	CIE Marks	40
Teaching Hours/Week (L:T:P:R)	2:1:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Pre-requisites (if any)	Heat and Mass Transfer	Course Type	PC

Course Objectives:

- To provide a strong foundation in heat transfer principles and their application in electronic cooling, and to develop the ability to analyze and design effective thermal management solutions for electronic systems.

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Explain heat generation mechanisms in electronic components and apply fundamental heat transfer principles to analyse basic cooling methods and thermal resistance networks.	K2
CO2	Explain thermal management systems using air and liquid cooling techniques	K2
CO3	Explain the properties and behaviour of phase change materials during heating and cooling, and their application in electronic thermal management.	K2
CO4	Apply thermal analysis methods to design and evaluate electronic cooling systems.	K3

K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping:

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

1- Slight (Low), 2 - Moderate (Medium), 3 - Substantial (High), '-' - No Correlation



SYLLABUS

Module	Syllabus Description	Contact Hours	CO
1	Fundamentals of Electronic Cooling Introduction to electronic systems and the need for thermal management, Heat generation in electronic components (ICs, CPUs, and power electronics), Fundamentals of heat transfer: conduction, convection, and radiation. Thermal resistance networks and analogy with electrical circuits. Temperature limits, reliability, and failure mechanisms in electronic systems. Basic cooling techniques: natural and forced convection; active and passive cooling systems	8	1
2	Air and Liquid Cooling Techniques. Forced air cooling systems: fans and blowers, Heat sinks: types (plate fin, pin fin), materials, and basic design considerations, Thermal interface materials (TIMs) and contact resistance, Flow characteristics and pressure drop in electronic enclosures. Fundamentals of liquid cooling: single-phase systems, Cold plates and microchannel heat exchangers (basics), Immersion Cooling, Heat pipes: types working principles and applications	8	2
3	Phase Change Materials (PCM) for Thermal Management Introduction to phase change materials and their role in electronic cooling, Classification of PCMs: Thermophysical properties of PCMs Selection criteria of PCM for electronic applications, Depiction of phase change process, Heat transfer enhancement techniques: fins, nanoparticles, encapsulation methods, metal foams	8	3
4	Thermal Design, Analysis, and Applications Thermal management in high-performance systems (data centres, EV batteries, power electronics), Thermal modelling and simulation basics, Design optimization and thermal management strategies, Experimental techniques in thermal measurement, Reliability analysis and thermal stress, Case studies and industry applications	12	4

Course Assessment Method (CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE):

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
➤ 2 Questions from each module. ➤ Total of 8 Questions, each carrying 3 marks (8x3 = 24marks)	➤ Each question carries 9 marks. ➤ Two questions will be given from each module, out of which one question should be answered. ➤ Each question can have a maximum of 3 sub divisions. (4x9 = 36 marks)	60

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Heat Transfer: Thermal Management of Electronics	Younes Shabany	CRC Press	1 st , 2009
2	Thermal Computations for Electronics	Gordon N. Ellison	CRC Press	1 st , 2011
3	Electronics Cooling	S M Sohel	IntechOpen	1 st , 2016

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Thermal Management of Electronics, Volume 1	Rajesh Baby, C Balaji	Momentum Press Engineering New York	1 st , 2019
2	Thermal Management of Electronics, Volume II	Rajesh Baby, C Balaji	Momentum Press Engineering New York	1 st , 2019
3	Thermal Management of Electronic Systems	C.J.M. Lasance & R.A.W.M. Henkes (Eds.)	Kluwer Academic Publishers	1 st , 1994



Video Links (NPTEL, SWAYAM...)		
Module No.	Topic	Link ID
1	Electronics Enclosures Thermal issues	https://youtu.be/DXNX9kkMofE?list=PLAj7mW3Fc13hkG2gR4QbzVP4IlGd0xZIm
2	Fan cooling	https://youtu.be/oYIFWmxxfFs?list=PLAj7mW3Fc13hkG2gR4QbzVP4IlGd0xZIm
2	Heat pipes	https://youtu.be/bcosmdYm2d8?list=PLAj7mW3Fc13hkG2gR4QbzVP4IlGd0xZIm
2	Thermal Modeling and Heat Sinking	https://youtu.be/w6R6V1Mpz7s
3	Introduction to PCM	https://youtu.be/vdCgvJjxX0Q
4	Applications	https://youtu.be/WYsHDkyP9XM?list=PLbRMhDVUMngcwN9HHIOALFj1HYs9T64BF

