

**NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY**

**DEPARTMENT OF MECHANICAL ENGINEERING
(Open Elective)**

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Course Code	2MEOE01
Course Title	Thermal Management of Electronic Systems

Course Outcomes(CO):

At the end of the course, students will able to-

1. appraise the importance of thermal management of electronic systems,
2. distinguish the various heat transfer modes,
3. select various cooling methods for electronic systems,
4. solve thermal management related problems using simulation tools.

Syllabus

Teaching hours: 45

UNIT I Introduction

03 hours

Enclosures and thermal issues in ICs and electronic systems, PCB cooling and importance of thermal management of electronics, temperature effects on different failure modes.

UNIT II Heat transfer modes

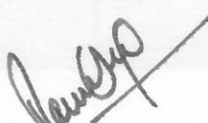
10 hours

Principles of conservation of energy, first law of thermodynamics, cooling load calculation of electronic devices, Heat transfer modes - basics of conductive heat transfer , convection basics; forced convection, radiation at normal ambient, combined modes, extended surfaces, contact resistance and thermal interface materials, thermal resistance networks, numerical methods

UNIT III Cooling methods and techniques

16 hours

Conduction cooling, cooling by heat sinks– design aspects of heat sinks, convection cooling, blowers, fans, ventilation of systems, selection of fan, liquid immersion cooling, flow-through cooling, cold wall cooling, cold plates, jet impingement cooling, synthetic jet cooling, thermoelectric/Peltier and solid state coolers, cooling using phase change, micro/mini channel cooling, cooling using heat pipes, liquid cooled high power modules, Vapour compression systems, Refrigerated cabinets, Conductive flexible links



UNIT IV Layout design and selection of cooling technique 06 hours

PCB layout design: Placement of various electronics components to evenly distribute the heat and minimum resistance from component to heat sink. Ranges of cooling rates of different cooling methods, selection criteria. Basics of design of heat exchanger. Experimental techniques used for thermal measurements, Reliability issues: importance, bathtub curve, Jedec standards

UNIT V Usage of software tools and applications 10 hours

Introduction to software tools for thermal management of electronic systems, applications and case studies related to effective thermal management of electronic systems (including cooling of ICs, microprocessors and power electronics, laptop thermal management, heat sink design, space applications)

Self - Study The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents

Suggested Readings:

1. Younes Shabany, Heat Transfer: Thermal Management of Electronics, CRC Press
2. Ravi Kandasamy and Arun S. Mujumdar, Thermal Management of Electronic Components, Lambert Academic Publishing
3. Dave S. Steinberg, Cooling Techniques for Electronic Equipment, Wiley
4. Incropera, P P and Dewitt, D P, Fundamentals of Heat and Mass Transfer, Wiley Eastern
5. Holman J P, Heat Transfer, McGraw Hill
6. Tong S C, Advanced Materials for Thermal Management of Electronic Packaging, Springer

L=Lecture T= Tutorial P=Practical, C=Credit

w.e.f. academic year 2020-21 and onwards