

Course Title	Thermal management in electronic systems	Course No (to be assigned by Academic Cell)	MEXXXX			
Specialization	Mechanical Engineering	Structure (LTPC)	3	1	0	4
Faculty Proposing the course	Dr.B.Raja	Status	Core		Elective <input type="checkbox"/>	
To be offered for	UG / PG	Type	New		Modification <input type="checkbox"/>	
To take effect from	Dec 2021	Submitted for approval	46 th Senate			
Pre-requisite	Heat Transfer					
External Experts	Prof S. P Venkateshan (Retd) and Prof Shaligram Tiwari (IITM)					
Recommendation from the DAC : Recommended		Date of DAC	01-06-2021			
Learning Objectives	<ul style="list-style-type: none"> To introduce and emphasize the importance of thermal and fluid science aspects in electronic devices To introduce design aspects of active and passive thermal management devices. 					
Learning Outcomes	At the end of the course the students will be able to understand the importance of thermal management and application . The concepts will also help them to understand concepts of convective heat transfer. They can also estimate the performance of various turbo machineries.					
Contents of the course (With approximate break up of hours)	<p>Cooling Load of Electronic Equipment in a Thermal Environment - Thermal consideration in Chip Carrier, PCBs and Enclosure , Passive and active methods of cooling, Properties of materials used in electronics and equipment, manufacturing methods, fabrication techniques - Equipment level, cabinet level, board level and chip or component level. (L7 + T2)</p> <p>Conduction Cooling, thermal resistance and resistance networks , conduction in chip carriers, conduction in PCB, heat frames and thermal conduction modules , synthetic jets. (L5 + T3)</p> <p>Design application of natural and forced convection cooling in thermal management - Optimization of heat sinks and metal foams, fan selection ; Liquid Cooled heat sinks - mini and micro channel heat exchangers, fluid selection; Jet impingement technique, Synthetic jets (L10 + T3)</p> <p>Phase change methods - Heat pipes - principles, types, limits of heat pipe, thermal resistance, design procedure - application case studies and advancements; Loop heat pipes - Space applications - thermal management of satellites, Immersion cooling. (L10 + T3)</p> <p>Design procedure of Peltier and Seebeck elements for thermal management - figure of merits, Current, Voltage and Power matching of thermoelectric modules , Radiation cooling is space electronics, Emergency cooling modules- endothermic cooling and spot cooling techniques. (L10 + T3)</p>					
Text Books	<ol style="list-style-type: none"> Dave S. Steinberg, Cooling Techniques for Electronic Equipment, 1991, John Wiley & Sons, Inc HoSung Lee, Thermal Design: Heat Sinks, Thermoelectrics, Heat Pipes, Compact Heat Exchangers, and Solar Cells, 2011 John Wiley & Sons, Inc. 					

Reference Books	<ol style="list-style-type: none">1. W.M. Rohsenow, J.P Hartnett,C. Young, Heat Transfer Handbook, 1998, McGraw-Hill2. Kaveh Azar, Thermal Measurements in Electronics Cooling, 1997, CRC Press3. All Jamnia , Practical Guide to the Packaging of Electronics, 2002, CRC Press4. Yunus A. Cengel and Michael Boles Thermodynamics: An Engineering Approach, 6th Ed, 2001, McGraw-Hill
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